

**Navajo Nation
Lower Greasewood Water System Improvements**

PROJECT MANUAL

**CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND
WELL HOUSES**

VOLUME 1 OF 2

DIVISION 0 - BIDDING AND CONTRACTING REQUIREMENTS

Bid Issue

**Navajo Tribal
Utility Authority
USDA-RD AZ**

February 2019

Brown and Caldwell
6975 Union Park Center, Suite 490
Midvale, UT 84047



THIS PAGE LEFT INTENTIONALLY BLANK

PROJECT MANUAL
FOR CONSTRUCTION OF
Navajo Nation
LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS
CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND WELL HOUSES
Volume 1 of 2
Division 0 – Bidding and Contracting Requirements
Navajo Tribal Utility Authority
USDA-RD AZ

Prepared by:

Brown and Caldwell
6975 Union Park Center, Suite 490
Midvale, UT 84047

Project No. 143956



Title Sheet
00015-1

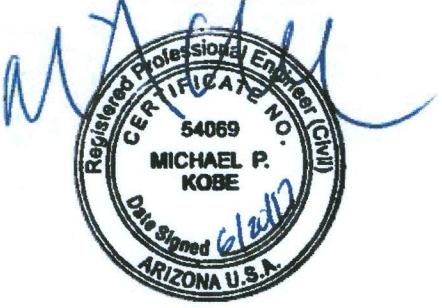

Contract 2
Bid Issue



THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 00016

SEALS PAGE

LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS
CONTRACT NO. 2 WATER TREATMENT PLANT, PIPELINES, AND WELL HOUSES

ITEMS IN THIS PROJECT MANUAL	PREPARED BY
Contract, Bidding and General Requirements Divisions 0 - 2, 7 (07905), 9, 10 (10441), 11, 13-15	
	<p>Mike Kobe, P.E. Brown and Caldwell 6975 Union Park Center, Suite 490 Midvale, UT 84047</p>
Divisions 3 - 5	
	<p>Scott Harper Brown and Caldwell 1697 Cole Blvd, Suite 200 Golden, CO 80401</p>

Divisions 6 – 8, 10 (Excluding Sections 07905 & 10441)	
 <p>EXP. 3/31/18</p>	<p>Greg Short, AIA Short And Brennan Architects 2200 W 29th Ave, Suite 102 Denver, CO 80211</p>
Division 16 -17	
 <p>EXP. 9/30/19</p>	<p>Ken Chandler, P.E. Brown and Caldwell 201 East Washington St, Suite 500 Phoenix, AZ 85004</p>

****END OF SECTION****

SECTION 00017

TABLE OF CONTENTS

Navajo Nation

LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS

CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND WELL HOUSES

**Reference
Number**

Title

VOLUME 1

DIVISION 0 – BIDDING AND CONTRACTING REQUIREMENTS

00010	Cover
00015	Title Sheet
00016	Seals Page
00017	Table of Contents

Bidding

00111	Advertisement for Bids
00200	Instructions to Bidders
00410	Bid Form
00430	Bid Bond
00440	List of Proposed Subcontractors
00451	Qualifications Statement
00461	Compliance Statement
00462	Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
00463	Certification for Contract, Grants and Loans
XP-315	Davis Bacon Certification 4
Wage Rates	Federal Wage Rates

Contract

00510	Notice of Award
00520	Agreement between Owner and Contractor for Construction Contract
00550	Notice to Proceed
00610	Performance Bond
00615	Payment Bond
00620	Application for Payment
00625	Certificate of Substantial Completion
00700	Standard General Conditions of the Construction Contract
00800	Supplementary Conditions
00941	Change Order
00942	Field Order

Table Of Contents
00017-1

Contract 2
Bid Issue

Appendix A	Rights-of-way and Easements Obtained by Owner
Appendix B	Permits Obtained by Owner

VOLUME 2 – TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

01010	Summary of Work
01014	Work Sequence
01071	Standard References
01200	Project Meetings
01300	Submittals
01310	Construction Schedule
01400	Quality Assurance, Inspection, and Testing
01410	Testing Laboratory and Special Inspection Services
01500	Contractor's Utilities
01560	Environmental Controls
01561	Storm water Pollution Prevention Plan (SWPPP)
01580	Project Identification Signs
01605	Shipment, Protection and Storage
01660	Equipment and System Performance and Operational Testing
01662	Commissioning
01664	Training
01710	Final Cleanup
01720	Record Drawings
01730	Operating and Maintenance Information
01800	Environmental Conditions
01900	Structural Design and Anchorage Requirements for Nonstructural Components and Nonbuilding Structures
01999	Reference Forms

DIVISION 2- SITE CONSTRUCTION

02100	Site Preparation
02160	Horizontal Directional Drilling
02200	Earthwork
02270	Erosion Control (Vegetative)
02743	Asphalt Concrete Pavement

DIVISION 3- CONCRETE

03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-In-Place Concrete
03600	Grout

DIVISION 4- MASONRY

04200 Unit Masonry

DIVISION 5- METALS

05100 Structural Metals
05210 Steel Joist Framing
05311 Steel Roof Deck
05501 Anchors to Concrete and Masonry
05505 Miscellaneous Metalwork
05530 Grating, Floor Plates, Stair Treads, and Safety Stair Nosing's
05910 Zinc Coating

DIVISION 6- WOOD AND PLASTICS

06100 Rough Carpentry
06160 Sheathing

DIVISION 7- THERMAL AND MOISTURE PRETECTION

07190 Water Repellants
07410 Standing-Seam Metal Roof Panels
07620 Sheet Metal Flashing and Trim
07905 Preformed Joint Fillers
07920 Joint Sealants

DIVISION 8- DOORS AND WINDOWS

08110 Hollow Metal Doors and Frames
08330 Overhead Coiling Doors
08710 Door Hardware
08800 Glazing

DIVISION 9- FINISHES

09900 Coating Systems
09901 Coating for Steel Water Storage Reservoir

DIVISION 10- SPECIALTIES

10441 Warning Signs
10520 Fire Protection Specialties

DIVISION 11- EQUIPMENT

11000	General Requirements for Equipment
11002	Rigid Equipment Mounts
11100	Sluice Gates
11324	Submersible Turbine Pumps for Water Well Service
11700	Chlorine Containment System and Accessories
11727	Chlorine Gas Feed System
11825	Package Granular Activated Carbon Adsorption System for Drinking Water Treatment
11830	Pressure Filters – Iron and Manganese Removal

DIVISION 12- FURNISHINGS

NOT USED

DIVISION 13- SPECIAL CONSTRUCTION

13201	Welded Steel Backwash Water Storage Tank
13540	Granular Activated Carbon

DIVISION 14- CONVEYING SYSTEMS

14611	Monorail and Hoist
-------	--------------------

DIVISION 15- MECHANICAL

15050	Piping Systems
15061	Steel Pipe
15062	Ductile Iron Pipe
15064	Plastic Pipe
15065	HDPE Pipe
15066	Copper Piping
15075	Joint Gaskets
15085	Piping Connections
15096	Pipe Hangers and Supports
15097	Seismic Restraints for Piping
15102	Resilient-Seated Gate Valves
15103	Butterfly Valves
15110	Eccentric Plug Valves
15118	Spring Loaded Swing Check Valves
15125	Steel Pipe Casing

15150	Air Release and Vacuum Valves for Clean Water Service
15154	Pressure Relief Valves
15184	Manual Valve and Gate Operators and Operator Appurtenances
15632	Electric Unit Heaters
15863	Propeller Wall Fans
15944	Louvers

DIVISION 16- ELECTRICAL

16000	General Requirements for Electrical Work
16030	Electrical Acceptance Testing
16124	Single Mode Fiber Optic Data Communication System
16155	Individual Motor Starters
16431	Arc Flash Analysis, Short Circuit Study, and Protective Device Coordination Report

DIVISION 17- INSTRUMENTATION

17000	General Requirements for Instrumentation and Control
17030	Process Instrumentation and Control System Testing
17110	Instrument and Control Panels
17900	Control Specifications

END OF TABLE OF CONTENTS

DRAWINGS SETS (BOUND SEPARATELY)

DRAWINGS FOR CORNFIELDS PARALLEL AND LOWER GREASEWOOD
INTERCONNECTION PIPELINES

DRAWINGS FOR LOWER GREASEWOOD TREATMENT PLANT, LOWER
GREASEWOOD WELL 1 PUMP HOUSE, AND GANADO N0 WELL PUMP
HOUSE

END OF SECTION

THIS PAGE LEFT INTENTIONALLY BLANK

Advertisement for Bids¹

Project Name: **Navajo Nation Lower Greasewood Water System Improvements**

Owner: **Navajo Tribal Utility Authority (NTUA), North Navajo Route 12, Fort Defiance, AZ 86504**

Funded by: **USDA-RD AZ, US EPA, and NTUA**

Sealed Bids for the construction of the **Contract No. 2: Water Treatment Plant, Pipelines and Well Houses**, which includes:

- **Lower Greasewood Treatment Plant, Well 1 Pump House, and Ganado N0 Well Pump House: Construction of a new 700 gpm groundwater treatment plant with pressure filter treatment equipment for removal of iron and manganese, as well as granular activated carbon treatment equipment for removal of organics, new pump houses and well site improvements at Lower Greasewood Well 1 and Ganado N0 Well, and miscellaneous telemetry system improvements in Lower Greasewood System,**
- **Cornfields Parallel and Lower Greasewood Interconnection Pipelines: Construction of approximately 21,869 LF of 6-inch and 2,174 LF of 4-inch potable water line, altitude valve station and pressure reducing valve station.**

Each bid response shall be submitted in accordance to Section 00200 Instructions to Bidders of the Bid Documents and received by NTUA Purchasing Department (Avis Jimm, Purchasing Agent, (928) 729-6243, avisj@ntua.com), North Navajo Route 12, Fort Defiance, Arizona 86504 until **3:00 p.m. local time on April 11, 2019**, and then at said office publicly opened and read aloud. No late, facsimiled, or electronic mailed bids will be accepted.

Bids will be received for a single prime Contract. Bids shall be on a unit price basis as indicated in the Bid Form.

To ensure delivery by the due date and time, all bids should be addressed to:

PHYSICAL ADDRESS: Navajo Tribal Utility Authority
ATTN: Avis Jimm, Purchasing Department
North Navajo Route 12 (Fed Ex/UPS/Hand-Deliver)
Fort Defiance, Arizona 86504

A Pre-Bid Conference followed by a site visit will be held on **March 13, 2019 at 9:00 a.m.** local time at the New NTUA Corporate Building, Dibé Nitsaa Conference Room 2111, located on BIA Route N12, in Fort Defiance, Arizona, near intersection of BIA Route N12 and Indian Health Service Route 7 (map can be provided upon request). Attendance at the Pre-Bid Conference is not mandatory to qualify to submit a Bid Proposal. Questions regarding bid documents are due to NTUA **March 28, 2019**. Answers to Questions will be provided by **April 4, 2019**.

Preference will be applied to qualified Indian-owned businesses in accordance with the Federal Indian preference laws as specified in the Navajo Business and Procurement Act (12 N.N.C. § 1501 et seq.); the

¹This document is a MODIFIED version of EJCDC® C-111 Suggested Advertisement for Bids for Construction Contracts, Copyright © 2013 by the National Society of Professional Engineers, American Society of Civil Engineers, and American Council of Engineering Companies, or is based in part on excerpts from EJCDC documents. Those portions of the text that originated in the published EJCDC documents remain subject to the copyright.

Navajo Nation Procurement Act (12 N.N.C. § 301 et seq.); Navajo Business Opportunity Act (5 N.N.C. § 201 et seq.) and other applicable statutory and regulatory requirements.

Suppliers, brokers, agents, subsidiaries, successors, and assigns shall be fully subject to the requirements and provisions of the Navajo Nation Business Opportunity Act.

Electronic Copies of the Contract Documents may be obtained from the NTUA Purchasing Department (Avis Jimm, Purchasing Agent, (928) 729-6243, avisj@ntua.com), North Navajo Route 12, Fort Defiance, Arizona. Contract Documents may also be purchased on CD at a cost of \$5.00 (no deposit). Prospective Bidders are advised that the cost of the CD of the Contract Documents or portions thereof are non-refundable.

The Contract Documents may be examined at the following locations:

- Engineer of Record
- NTUA Purchasing Department, North Navajo Route 12, Fort Defiance, Arizona 86504, (928) 729-6243
- Construction Reporter, 1609 Second St. NW, Albuquerque, NM 87102, (505) 243-9793
- Dodge Reports, 1615 University Boulevard NE, Albuquerque, NM 87102, (877) 989-5753

Engineer: Brown and Caldwell, 6975 Union Park Center, Suite 490, Midvale, UT 84047
(801) 316-9813, sbranchley@brwncald.com

This project is partially funded with United States Environmental Protection Agency funds, and therefore procurement will be subject to Davis Bacon Act Requirements.

Advertised: **March 7, 2019**

****END OF SECTION****

Instructions to Bidders¹

TABLE OF CONTENTS

	Page
ARTICLE 1 – Defined Terms	2
ARTICLE 2 – Copies of Bidding Documents	2
ARTICLE 3 – Qualifications of Bidders	2
ARTICLE 4 – Site and Other Areas; Existing Site Conditions; Examination of Site; Owner’s Safety Program; Other Work at the Site	3
ARTICLE 5 – Bidder’s Representations	5
ARTICLE 6 – Pre-Bid Conference	6
ARTICLE 7 – Interpretations and Addenda.....	6
ARTICLE 8 – Bid Security	6
ARTICLE 9 – Contract Times	6
ARTICLE 10 – Liquidated Damages.....	7
ARTICLE 11 – Substitute and “Or-Equal” Items.....	7
ARTICLE 12 – Subcontractors, Suppliers, and Others	7
ARTICLE 13 – Preparation of Bid	8
ARTICLE 14 – Basis of Bid	9
ARTICLE 15 – Submittal of Bid.....	10
ARTICLE 16 – Modification and Withdrawal of Bid.....	10
ARTICLE 17 – Opening of Bids	11
ARTICLE 18 – Bids to Remain Subject to Acceptance	11
ARTICLE 19 – Evaluation of Bids and Award of Contract	11
ARTICLE 20 – Bonds and Insurance.....	13
ARTICLE 21 – Signing of Agreement.....	13
ARTICLE 22 – Sales and Use Taxes	13
ARTICLE 23 – Contracts to be Assigned	13
ARTICLE 24 – WAGE RATE REQUIREMENTS.....	13
ARTICLE 25 – Navajo Nation Business Activity Tax	14

¹This document is a MODIFIED version of EJCDC® C-200 Suggested Instructions to Bidders for Construction Contracts. Copyright © 2013 by the National Society of Professional Engineers, American Society of Civil Engineers, and American Council of Engineering Companies, or is based in part on excerpts from EJCDC documents. Those portions of the text that originated in published EJCDC documents remain subject to the copyright.

ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office* – The office from which the Bidding Documents are to be issued and where bidding procedures are to be administered.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the advertisement or invitation to bid may be obtained from the Issuing Office. The deposit will be refunded to each document holder of record who returns a complete set of Bidding Documents in good condition within 10 days after opening of Bids.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:
- A. Evidence of Bidder's [authority or ability to obtain required](#) authority to do business in the state where the Project is located.
 - B. Bidder's state or other contractor license number, [or evidence of Bidder's ability to obtain state contractor license](#), if applicable.
 - C. Subcontractor and Supplier qualification information; coordinate with provisions of Article 12 of these Instructions, "Subcontractors, Suppliers, and Others."
 - D. [Bidder's Qualification Statement – Section 00451](#)
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER’S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 *Existing Site Conditions*

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:

- a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
- b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
- d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

- ~~4. Geotechnical Baseline Report: The Bidding Documents contain a Geotechnical Baseline Report (GBR). The GBR describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations (“Baseline Conditions”). The GBR is a Contract Document.~~

~~The Baseline Conditions in the GBR are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the GBR, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.~~

~~Nothing in the GBR is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods,~~

~~techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.~~

- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.
- D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written

Instructions to Bidders

00200-4

143956 Lower Greasewood Water System Improvements

Bid Issue

contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER’S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder’s safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without

exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of **five (5)** percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.
- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

Instructions to Bidders

00200-6

143956 Lower Greasewood Water System Improvements

Bid Issue

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, as **if** awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those “or-equal” or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an “or-equal” or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids **in the case of a proposed substitute and 5 days prior in the case of a proposed “or-equal.”** Each such request shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer’s decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. **Substitutes and “or-equal” materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.04 and 7.05 of the General Conditions after the Effective Date of the Contract.**
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.
- 11.03 **If an award is made, Contractor shall be allowed to submit proposed substitutes and “or-equals” in accordance with the General Conditions.**

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- ~~12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.~~
- ~~12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.~~
- 12.03 **As required by the bid documents**, the apparent Successful Bidder, and any other Bidder so requested, **all Bidders shall** within five days after Bid opening, submit **with its bid** to Owner a list of the Subcontractors proposed for the following portions of the Work:
- A. Pipeline Installation**
 - B. Treatment Equipment**
 - C. Electrical**
 - D. Mechanical**

Instructions to Bidders

00200-7

143956 Lower Greasewood Water System Improvements

Bid Issue

E. Masonry

If requested by Owner, such **Such** list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, or other individual or entity. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

The Owner/Engineer will request a list of Suppliers within 5 days of bid opening from the apparent Successful Bidder.

- 12.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.
- 12.05 **Contractor shall not be required to employ and Subcontractor, Supplier, individual or entity against whom Contractor has reasonable objection.**
- 12.06 **The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.06.**

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.
 - A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
 - B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."
- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.
- 13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.04 A Bid by an individual shall show the Bidder's name and official address.
- 13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

- 13.06 All names shall be printed in ink below the signatures.
- 13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.09 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

~~14.01 Lump Sum~~

- ~~A. Bidders shall submit a as set forth in the Bid Form.~~

14.02 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.03 Allowances

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

~~14.04 Price Plus Time Bids~~

- ~~A. The Owner will consider the time of Substantial Completion commitment made by the Bidder in the comparison of Bids.~~
- ~~B. Bidder shall designate the number of days required to achieve Substantial Completion of the Work and enter that number in the Bid Form as the total number of calendar days to substantially complete the Work.~~
- ~~C. The total number of calendar days for Substantial Completion designated by Bidder shall be less than or equal to a maximum of [____], but not less than the minimum of [____]. If Bidder purports to designate a time for Substantial Completion that is less than the allowed minimum, or greater than the allowed maximum, Owner will reject the Bid as nonresponsive.~~

- ~~D. The Agreement as executed will contain the Substantial Completion time designated in Successful Bidder's Bid, and the Contractor will be assessed liquidated damages at the rate stated in the Agreement for failure to attain Substantial Completion within that time.~~
- ~~E. [Bidder shall also designate the time in which it will achieve Milestones, and achieve readiness for final payment. Such time commitments shall be consistent with the "Time of Substantial Completion" to which Bidder commits. The Agreement as executed will contain, as binding Contract Times, Successful Bidder's time commitments regarding Milestones, as applicable, and readiness for final payment.]~~

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a sealed package marked **"DO NOT OPEN LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS WATER SYSTEM IMPROVEMENTS – CONTRACT NO. 2 RE-SOLICITATION"**. The package shall include the name and address of Bidder, **a statement that the Bidder is an Indian Owned Business if applicable**, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to Owner at address in Article 1.01 of Bid Form.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- A. Preference will be applied to qualified Indian-owned businesses in accordance with the Federal Indian preference laws as specified in the Navajo Business and Procurement Act (12 N.N.C. § 1501 et seq.); the Navajo Nation Procurement Act (12 N.N.C. § 301 et seq.); Navajo Business Opportunity Act (5 N.N.C. § 201 et seq.) and other applicable statutory and regulatory requirements.
 - B. Indian-owned business means any Indian owned (as defined by the United States Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit: Provided, that such Indian ownership shall constitute not less than 51 per centum of the enterprise. Proposers must submit evidence of Indian ownership with their bid submittal.
 - C. Suppliers, brokers, agents, subsidiaries, successors, and assigns shall be fully subject to the requirements and provisions of the Navajo Nation Business Opportunity Act.
- 19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.03 Evaluation of Bids
- A. All bids submitted by qualified Indian-owned businesses shall be opened first. Award shall be made to the qualified Indian-owned business with the lowest responsive bid among qualified Indian-owned business provided the bid does not exceed the maximum feasible price.
 - B. If no qualified Indian-owned businesses is entitled to award, bids shall then be opened and award shall be given to qualified bidders with the lowest responsive bid provided the bid is less than or equal to the maximum feasible price.
 - C. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

Instructions to Bidders

00200-11

143956 Lower Greasewood Water System Improvements
Bid Issue

- D. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- E. **After determination of the Successful Bidder based on the Base Bid and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its Base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.**
1. **The Base Bid (Schedules A, B, C, D, E, F, and G)**
 - a. **Schedule A – Mobilization for Water Treatment Plant, NO Well House, and Well 1 Well House**
 - b. **Schedule B – Lower Greasewood Water Treatment Plant**
 - c. **Schedule C – Well 1 Site and Well House**
 - d. **Schedule D – Well 2 Electrical and Controls**
 - e. **Schedule E – NO Well Site and Well House for 14-inch well**
 - f. **Schedule F - NO Well Site and Well House for 8-inch well**
 - g. **Schedule G – Inspection Services**
 - h. **Schedule H – Lower Greasewood Tank Rehab**
 2. **Bid ADD Alternatives:**
 - a. **ALTERNATIVE No. 1 – Greasewood South Pipeline (2,183 feet of 4-inch PVC Pipeline)**
 - b. **ALTERNATIVE No. 2 – Cornfields East Altitude Valve Station and Pipeline (Altitude Valve Station and 4-inch pipeline)**
 - c. **ALTERNATIVE No. 3 – Cornfields West Pipeline (7,879 feet of 6-inch PVC Pipeline and PRV Station)**
 - d. **ALTERNATIVE No. 4 – Greasewood North Pipeline (13,938 feet of 6-inch PVC Pipeline)**
 - e. **ALTERNATIVE No. 5 – Fiber Optic System for Water Treatment Plant and NO Well House**
- ~~F. Bid prices will be compared after adjusting for differences in time of Substantial Completion (total number of calendar days to substantially complete the Work) designated by Bidders. The adjusting amount will be determined at the rate set forth in the Agreement for liquidated damages for failing to achieve Substantial Completion, or such other amount that Owner has designated in the Bid Form.~~
- ~~1. The method for calculating the lowest bid for comparison will be the summation of the Bid price shown in the Bid Form plus the product of the Bidder specified time of Substantial Completion (in calendar days) times the rate for liquidated damages [or other Owner designated daily rate] (in dollars per day).~~
 - ~~2. This procedure is only used to determine the lowest bid for comparison and contractor selection purposes. The Contract Price for compensation and payment purposes remains the Bid price shown in the Bid Form.~~

Instructions to Bidders

00200-12

143956 Lower Greasewood Water System Improvements

Bid Issue

- 19.04 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

- 20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Within ten days thereafter, Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.
- 21.02 **This Contract is funded in part with funds provided by the United States Department of Agriculture, Rural Utilities Service (RUS) and the United States Environmental Protection Agency. Refer to Supplementary General Conditions for Federal requirements.**
- 21.03 **Concurrence by RUS in the award of the Contract is required before Contract is effective.**

ARTICLE 22 – SALES AND USE TAXES

- 22.01 Owner is exempt from **Arizona** state sales and use taxes on materials and equipment to be incorporated in the Work. (Exemption No. 86-0204662). Said taxes shall not be included in the Bid. Refer to Paragraph SC-7.09 of the Supplementary Conditions for additional information.

~~**ARTICLE 23 – CONTRACTS TO BE ASSIGNED**~~

ARTICLE 24 – WAGE RATE REQUIREMENTS

- 24.01 **If the contract price is in excess of \$100,000, provisions of the Contract Work Hours and Safety Standards Act at 29 CFR 5.5(b) apply.**
- 24.02 **This project is partially funded by monies made available by the U.S. EPA State Tribal Assistance Grant Fund, therefore Davis Bacon Act wage requirements apply.**

ARTICLE 25 – NAVAJO NATION BUSINESS ACTIVITY TAX

- 25.01 Bidder shall include the cost of the Navajo Nation Business Activity Tax (BAT) in the submitted bid. This is a tax on the net source gains (gross receipts less deductions) from the sale of Navajo goods or services, with the legal incidence of the tax on the party receiving the gross receipts. Navajo goods are all goods produced, processed, or extracted within the Navajo Nation, and Navajo services are all services performed within the Navajo Nation. Bidder is advised to investigate and understand the applications of this tax prior to submitting a bid.

****END OF SECTION****

Section 00410

Bid Form¹

Navajo Nation Lower Greasewood Water System Improvements

Contract No. 2: Water Treatment Plant, Pipelines, and Well Houses

¹ EJCDC® C-410 Bid Form for Construction Contracts. Copyright © 2013 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

TABLE OF CONTENTS

	Page
Article 1 – Bid Recipient	3
Article 2 – Bidder’s Acknowledgements	3
Article 3 – Bidder’s Representations.....	3
Article 4 – Bidder’s Certification	4
Article 5 – Basis of Bid.....	5
Article 6 – Time of Completion	11
Article 7 – Attachments to this Bid	11
Article 8 – Defined Terms.....	12
Article 9 – Bid Submittal.....	12

ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid is submitted to: **Navajo Nation Tribal Utility Authority (NTUA)**
Avis Jimm, Purchasing Agent, NTUA Purchasing Department North Navajo Route 12, Fort Defiance, Arizona 86504
- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:
- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related

reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.

- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

- 5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Unit Price Bid Items for **Lower Greasewood Water Improvement Project Base Bid - Water Treatment Plant, Well 1 Well House, N0 Well Equipping and Well House. Navajo Nation BAT shall be included in all pricing as required.**

Schedule/ ItemNo.	Items Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
Mobilization					
Schedule A	Mobilization Water Treatment Plant, N0 Well House, and Well 1 Well House				
1	Mobilization/Demobilization	LS	1		
	Schedule A Total				
Schedule B	Lower Greasewood Water Treatment Plant				
1	Division 1 Requirements	LS	1		
2	Site/Civil	LS	1		
3	Structural	LS	1		
4	Mechanical	LS	1		
5	Granular Activated Carbon Removal System	LS	1		
6	Iron and Manganese Removal System	LS	1		
7	Chlortainer with Scale System	LS	1		
8	HVAC	LS	1		
9	Electrical	LS	1		
10	Instrumentation, Controls, and SCADA Integration	LS	1		
11	Fiber, Conduit, Pull Boxes, Etc.	LS	1		
12	All Other Items pertaining to Water Treatment Plant not listed above	LS	1		
	Schedule B Total				

Schedule C	Well 1 Well House				
1	Site/Civil	LS	1		
2	Well House (includes all structural, piping, appurtenances, mechanical, HVAC, and electrical to construct well house)	LS	1		
3	Instrumentation, Controls, and SCADA Integration	LS	1		
4	All Other Items pertaining to Well House 1 not listed above	LS	1		
	Schedule C Total				
Schedule D	Well 2 Electrical				
1	Electrical, Instrumentation, Controls and SCADA Integration	LS	1		
	Schedule D Total				
Schedule E	NO Well House for 14-inch well				
1	Pitless unit, submersible pump and motor, appurtenances, chlorination and clean-up after pump install	LS	1		
2	Site/Civil	LS	1		
3	Well House and chlorination system (includes all structural, piping, appurtenances, mechanical, HVAC, and electrical to construct well house)	LS	1		
4	Instrumentation, Controls, Fiber Optic Cable, and SCADA Integration	LS	1		
5	All Other Items pertaining to NO Well House not listed above	LS	1		
	Schedule E Option 1 Total				

Schedule F	NO Well House for 8-inch well				
1	Pitless unit, submersible pump and motor, appurtenances, chlorination and clean up after pump install	LS	1		
2	Site/Civil	LS	1		
3	Well House and chlorination system (includes all structural, piping, appurtenances, mechanical, HVAC, and electrical to construct well house)	LS	1		
4	Instrumentation, Controls, Fiber Optic Cable, and SCADA Integration	LS	1		
5	All Other Items pertaining to NO Well House not listed above	LS	1		
	Schedule F Total				
Schedule G	Inspection Services				
1	Allowance for Inspection Services	LS	1		\$35,000
	Schedule G Total				
Schedule H	Lower Greasewood Tank				
1	Refurbish and Return Lower Greasewood Tank to Service	LS	1		
	Schedule H Total				
Total of All Unit Price Base Bid Items (Sum of Schedules A – H)					\$

5.02 Add Alternate Bid items that includes **Cornfields Parallel and Lower Greasewood Interconnect Pipelines. Navajo Nation BAT shall be included in all pricing as required.**

ALTERNATIVE No. 1	Greasewood South Pipeline				
1-1	Additional Mobilization, bonds, insurance, etc.	LS	1		
1-2	4-inch PVC Pipeline (includes all valves, appurtenances, trenching, backfill, compaction, etc.)	LF	2,183		
1-3	Gas Line Crossing	LS	1		
1-4	BIA Route 15 Road Crossing	LS	1		
1-5	Road Crossing (STA 3006+40)	LS	1		
1-6	BIA Route 9001 Road Crossing	LS	1		
1-7	All Other Items pertaining to the Greasewood South Pipelines not listed above	LS	1		
1-8	Allowance for Inspection Services	LS	1		\$6,000
	ALTERNATIVE No. 1 Total				
ALTERNATIVE No. 2	Cornfields East Altitude Valve Station and Pipeline				
2-1	Additional Mobilization, bonds, insurance, etc.	LS	1		
2-2	Cornfields East Tank Altitude Valve & Vault (includes vault, valve, appurtenances, etc.)	LS	1		
2-3	4-inch PVC Pipeline (includes all valves, appurtenances, trenching, backfill, compaction, etc.)	LF	220		
2-4	All Other Items pertaining to Cornfields Altitude Valve Station and Pipeline not listed above	LS	1		
2-5	Allowance for Inspection Services	LS	1		\$2,000
	ALTERNATIVE No. 2 Total				
ALTERNATIVE No. 3	Cornfields West Pipeline & PRV Station				

3-1	Additional Mobilization, bonds, insurance, etc.	LS	1		
3-2	6-inch PVC Pipeline (includes all valves, appurtenances, trenching, backfill, compaction, etc.)	LF	7,879		
3-3	Pressure Reducing Valve & Vault (includes vault, valve, appurtenances, etc.)	LS	1		
3-4	Pueblo Colorado Wash Crossing	LS	1		
3-5	All Other Items pertaining to Cornfields West Pipeline and PRV Station not listed above	LS	1		
3-6	Allowance for Inspection Services	LS	1		\$14,000
	ALTERNATIVE No. 3 Total				
ALTERNATIVE No. 4	Greasewood North Pipeline				
4-1	Additional Mobilization, bonds, insurance, etc.	LS	1		
4-2	6-inch PVC Pipeline (includes all valves, appurtenances, trenching, backfill, compaction, etc.)	LF	13,938		
4-3	BIA Route 28 Road Crossing	LS	1		
4-5	6-inch HDPE pipe - Horizontal Directional Drilling	LF	530		
4-6	Wash Crossing STA 2088+60 to STA 2091+80	LS	1		
4-7	All Other Items pertaining to Greasewood North Pipelines not listed above	LS	1		
4-8	Allowance for Inspection Services	LS	1		\$24,000
	ALTERNATIVE No. 4 Total				
ALTERNATIVE No. 5	Fiber Optic System for Water Treatment Plant & NO Well House				
5-1	Additional Mobilization, bonds, insurance, etc.	LS	1		

5-2	Fiber Optic System: tie in to NTUA fiber optic junction and extension to Water Treatment Plant.	LS	1		
5-3	Fiber Optic System: tie into NTUA fiber optic junction and extension to NO Well House.	LS	1		
	ALTERNATIVE No. 5 Total				
Total of All Unit Price Base Bid Items (Alternatives 1 through 5)					\$

All Unit Price Bid Items are to be completed by bidder and shall be included in the Total Bid Price.

Total Base Bid (Schedule A – H) \$ _____

Total Base Bid and Alternatives 1, 2, 3, 4, and 5 \$ _____

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are submitted with and made a condition of this Bid:

- A. Required Bid security in the form of a Bid Bond (Section 00430) or Certified Check (circle type of security provided);
- B. List of Proposed Subcontractors (Section 00440);
- C. List of Proposed Suppliers;
- D. List of Project References;
- E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
- F. Contractor's License No.: _____;

- G. Required Bidder Qualification Statement with supporting data; and
- H. Signed Compliance Statement (RD 400-6). Refer to specific equal opportunity requirements set forth in the Supplemental General Conditions;
- I. Signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions (AD-1048);
- J. Signed RD Instruction 1940-Q, Exhibit A-1, Certification for Contracts, Grants, and Loans.
- K. XP-315 Davis Bacon Certification 4

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:

[Signature] _____

[Printed name] _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.:

(where applicable)

****END OF SECTION**

Bid Bond¹

BIDDER (Name and Address):

OWNER (Name and Address):

Description (*Project Name— Include Location*):

Penal sum		\$
	(Words)	(Figures)

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Bid Bond
00430-2

Contract 2
Bid Issue

****END OF SECTION****

Bid Bond
00430-3

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 00440

List of Proposed Subcontractors

All Bidders shall complete this form for all proposed subcontracts. If the contractor fails to receive a bid for a category of work, the contractor shall designate on the listing form that no bid was received. If the contractor fails to receive more than one bid for a category of work, the contractor shall state on the listing form that only one bid was received, together with the name of the subcontractor.

Contractor:	
--------------------	--

Subcontractor	Business Address	Phone/Fax Number	Arizona License#	Work Description

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

QUALIFICATIONS STATEMENT¹

**THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT
PERMITTED BY LAWS AND REGULATIONS**

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

Project Name:

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person:

Title:

Phone:

Email:

¹ EJCDC® C-451 Qualifications Statement. Copyright © 2013 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

6. TYPE OF ORGANIZATION:

☐ SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

☐ PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

☐ CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

- Treasurer: _____

- Secretary: _____

☐ LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

☐ JOINT VENTURE

Sate of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction: _____

Type of License: _____

License Number: _____

Jurisdiction: _____

Type of License: _____

License Number: _____

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise: _____

Minority Business Enterprise: _____

Woman Owned Enterprise: _____

Small Business Enterprise: _____

Other (_____): _____

9. BONDING INFORMATION

Bonding Company: _____

Address: _____

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

☐ YES ☐ NO

If YES, attach as an Attachment details including Project Owner's contact information.

Qualifications Statement
00451-5

Contract 2
Bid Issue

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 500- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____
YEAR	_____	TRFR	_____

Total number of man-hours worked for the last 5 Years:

YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____
YEAR	_____	TOTAL NUMBER OF MAN-HOURS	_____

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____
YEAR	_____	DART	_____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HERewith, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20__

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

1. Schedule A (Current Experience).
2. Schedule B (Previous Experience).
3. Schedule C (Major Equipment).
4. Audited balance sheet for each of the last 3 years for firm named in Section 1.
5. Evidence of authority for individuals listed in Section 7 to bind organization to an agreement.
6. Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
7. Required safety program submittals listed in Section 13.
8. Additional items as pertinent.

SCHEDULE A

CURRENT EXPERIENCE

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B

PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

[illegible]

****END OF SECTION****

Qualifications Statement
00451-12

Contract 2
Bid Issue

Section 00461

USDA
Form RD 400-6
(Rev. 4-00)

Form Approved
OMB No. 0575-0018

COMPLIANCE STATEMENT

This statement relates to a proposed contract with _____

(Name of borrower or grantee)

who expects to finance the contract with assistance from either the Rural Housing Service (RHS), Rural Business-Cooperative Service (RBS), or the Rural Utilities Service (RUS) or their successor agencies, United States Department of Agriculture (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance). I am the undersigned bidder or prospective contractor, I represent that:

1. ☐ I have, ☐ have not, participated in a previous contract or subcontract subject to Executive Order 11246 (regarding equal employment opportunity) or a preceding similar Executive Order.
2. If I have participated in such a contract or subcontract, ☐ I have, ☐ have not, filed all compliance reports that have been required to file in connection with the contract or subcontract.

If the proposed contract is for \$50,000 or more and I have 50 or more employees, I also represent that:

3. ☐ I have, ☐ have not previously had contracts subject to the written affirmative action programs requirements of the Secretary of Labor.
4. If I have participated in such a contract or subcontract, ☐ I have, ☐ have not developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required of me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the RHS, RBS or RUS, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications for proposed subcontractors for specific time periods) I will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods): (See Reverse).

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays the valid OMB control number. The valid OMB control number for this information collection is 0575-0018. The time required to complete this information collection is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Position 6

RD 400-6 (Rev. 4-00)

Compliance Statement
00461-1

Contract 2
Bid Issue

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR
CERTIFICATIONS OF NON-SEGREGATED FACILITIES**

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding \$ 10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Date _____


(Signature of Bidder or Prospective Contractor)

Address (including Zip Code)

END OF SECTION

Compliance Statement
00461-2

Contract 2
Bid Issue

	United States Department of Agriculture	AD-1048
Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion Lower Tier Covered Transactions		
<p><i>The following statement is made in accordance with the Privacy Act of 1974 (5 U.S.C. § 552(a), as amended). This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, and 2 C.F.R. §§ 180.300, 180.355, Participants' responsibilities. The regulations were amended and published on August 31, 2005, in 70 Fed. Reg. 51865-51880. Copies of the regulations may be obtained by contacting the Department of Agriculture agency offering the proposed covered transaction.</i></p> <p><i>According to the Paperwork Reduction Act of 1995 an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0505-0027. The time required to complete this information collection is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The provisions of appropriate criminal and civil fraud privacy, and other statutes may be applicable to the information provided.</i></p>		
<i>(Read Instructions On Page Two Before Completing Certification)</i>		
<p>A. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency;</p> <p>B. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.</p>		
ORGANIZATION NAME		PR/AWARD NUMBER OR PROJECT NAME
NAME(S) AND TITLE(S) OF AUTHORIZED REPRESENTATIVE(S)		
SIGNATURE(S)	DATE	

The U.S. Department of Agriculture (USDA) prohibits discrimination in all of its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs). Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Assistant Secretary for Civil Rights, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, S.W., Stop 9410, Washington, DC 20250-9410, or call toll-free at (866) 632-9992 (English) or (800) 877-8339 (TDD) or (866) 377-8642 (English Federal-relay) or (800) 845-6136 (Spanish Federal-relay). USDA is an equal opportunity provider, employer and lender.

Instructions for Certification

- (1) By signing and submitting this form, the prospective lower tier participant is providing the certification set out on page 1 in accordance with these instructions.
- (2) The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension or debarment.
- (3) The prospective lower tier participant shall provide immediate written notice to the person(s) to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
- (4) The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549, at 2 C.F.R. Parts 180 and 417. You may contact the department or agency to which this proposal is being submitted for assistance in obtaining a copy of those regulations.
- (5) The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
- (6) The prospective lower tier participant further agrees by submitting this form that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
- (7) A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the System for Award Management (SAM) database.
- (8) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
- (9) Except for transactions authorized under paragraph (5) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

END OF SECTION

Section 00463

RD Instruction 1940-Q
Exhibit A-1

CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant or Federal loan, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant or loan.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant or loan, the undersigned shall complete and submit Standard Form - LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including contracts, subcontracts, and subgrants under grants and loans) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

(name)

(date)

(title)

oOo

(08-21-91) PN 171

****END OF SECTION****

Certification for Contracts, Grants and Loans
00463-1

Contract 2
Bid Issue

Davis-Bacon Act Certification

The Contractor acknowledges to and for the benefit of the Owner _____ ("Purchaser") and the State of Arizona (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the U.S. EPA State Tribal Assistance Grant Fund and such law contains provisions commonly known as the Davis-Bacon Act that requires all contractors and subcontractors performing work on federal construction contracts or federally assisted contracts in excess of \$2,000 to pay their laborers and mechanics not less than the federal prevailing wage rates and fringe benefits for corresponding classes of laborers and mechanics employed on similar projects in the area as determined by the Secretary of Labor.

The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the Davis-Bacon Act, (b) as such has compensated all contractors and sub-contractors performing work on this project not less than the prevailing wage rate and fringe benefits for corresponding classes as determined by the Secretary of Labor, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

(Contractor Signature & Date)

(Owner Signature & Date)

General Decision Number: AZ190015 01/04/2019 AZ15

Superseded General Decision Number: AZ20180015

State: Arizona

Construction Type: Heavy

County: Navajo County in Arizona.

HEAVY CONSTRUCTION PROJECTS (DOES NOT INCLUDE DAM CONSTRUCTION)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019

BOIL0627-004 10/01/2017

	Rates	Fringes
BOILERMAKER.....	\$ 35.30	28.41

* ELEC0518-007 08/01/2018		

(South and East of boundary beginning at a point where Clear Creek crosses the Coconino-Navajo County Line, extending North-easterly along Clear Creek and North-easterly to Cottonwood Wash, along Cottonwood Wash North-easterly to intersection with Navajo Reservation, East along Navajo Reservation Boundary line to intersection with Navajo/Apache County lines)

	Rates	Fringes
ELECTRICIAN.....	\$ 28.60	11.36

 ELEC0640-008 07/01/2018

(Remaining Part)

	Rates	Fringes
ELECTRICIAN.....	\$ 28.30	10.30

 IRON0433-001 01/01/2014

	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 33.50	26.80

 LABO0383-006 06/01/2017

	Rates	Fringes
LABORER		
GROUP 4		
Jackhammer.....	\$ 20.47	5.01

 SUAZ2012-003 05/17/2012

	Rates	Fringes
LABORER: Common or General.....	\$ 14.59	0.00
LABORER: Pipelayer.....	\$ 20.00	0.00
OPERATOR: Loader (Front End)....	\$ 20.23	6.31
OPERATOR:		
Backhoe/Excavator/Trackhoe.....	\$ 22.70	0.00
TRUCKDRIVER.....	\$ 21.00	0.00

 WELDERS - Receive rate prescribed for craft performing
 operation to which welding is incidental.

=====

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons

resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====
END OF GENERAL DECISION

THIS PAGE LEFT INTENTIONALLY BLANK

Section 00510
Notice of Award

Date of Issuance:

Owner: **Navajo Tribal Utility Authority
(NTUA)**

Owner's Contract No.:

Engineer: **Brown and Caldwell**

Engineer's Project No.: **143956**

Project: **Navajo Nation
Lower Greasewood Water
System Improvements**

Contract Name: **Contract No. 2: Water Treatment
Plant, Pipelines, and Well Houses**

Bidder:

Bidder's Address:

TO BIDDER:

You are notified that Owner has accepted your Bid dated [] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

[describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is: \$ [] *[note if subject to unit prices, or cost-plus]*

[] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically. *[revise if multiple copies accompany the Notice of Award]*

☐ a set of the Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [] counterparts of the Agreement, fully executed by Bidder.
2. Deliver with the executed Agreement(s) the Contract security *[e.g., performance and payment bonds]* and insurance documentation as specified in the Instructions to Bidders and General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **Navajo Tribal Utility Authority (NTUA)**

Authorized Signature

By:

Title:

Copy: Engineer

****END OF SECTION****

Notice of Award
00510-1

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)¹**

THIS AGREEMENT is by and between Navajo Tribal Utility Authority (NTUA) (“Owner”) and
____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

- **Lower Greasewood Treatment Plant, Lower Greasewood Well 1 Pump House, and Ganado N0 Well Pump House:** Construction of a new 700 gpm groundwater treatment plant with pressure filter treatment equipment for removal of iron and manganese, as well as granular activated carbon treatment equipment for removal of organics, new pump houses and well site improvements at Lower Greasewood Well 1 and Ganado N0 Well, and miscellaneous telemetry system improvements in Lower Greasewood System.
- **Cornfields Parallel and Lower Greasewood Interconnection Pipelines:** Construction of approximately 21,869 LF of 6-inch and 2,174 LF of 4-inch potable water line, altitude valve station and pressure reducing valve station.

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **The overall project will provide additional water supply to the Dilkon Water System by adding a new supply well near Ganado (Contract No. 1) and Contract No. 2 the interconnecting pipelines from the Ganado Water System to the Lower Greasewood Water System, as well as and a new groundwater treatment plant and well improvements in the Lower Greasewood Water System to address water quality issues in order to comply with an TTHM based Administrative Compliance Order.**

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by **Brown and Caldwell**.

3.02 The Owner has retained **Brown and Caldwell** (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

¹ EJCDC® C-520 Agreement between Owner and Contractor for Construction Contract (Stipulated Price). Copyright © 2013 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Contract Times: Days*

- A. The Work will be substantially completed within 365 calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 456 calendar days after the date when the Contract Times commence to run.

~~B. Parts of the Work shall be substantially completed on or before the following Milestone(s):~~

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion: Contractor shall pay Owner \$1500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.
4. ~~Milestones: Contractor shall pay Owner \$500 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for achievement of Milestone 1, until Milestone 1 is achieved.~~

~~B. Bonus: Contractor and Owner further recognize the Owner will realize financial and other benefits if the Work is completed prior to the time specified for Substantial Completion. Accordingly, Owner and Contractor agree that as a bonus for early completion, Owner shall pay Contractor \$_____ for each day prior to the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract) that the Work is substantially complete. The maximum value of the bonus shall be limited to \$_____.~~

4.04 *Special Damages*

[Deleted]

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:

- A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the **25th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

- 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract

- a. **95** percent of Work completed (with the balance being retainage); ~~if the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and~~
 - b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

- B. Upon Substantial Completion **of the entire construction to be provided under the Contract Documents**, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **100** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

7.01 All amounts not paid when due shall bear interest at the rate of 1 percent per annum.

ARTICLE 8 – CONTRACTOR’S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:

- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
- B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
- E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor’s safety precautions and programs.
- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor’s entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
1. This Agreement (pages 1 to , inclusive).
 2. Performance bond (pages to , inclusive).
 3. Payment bond (pages to , inclusive).
 4. ~~Other bonds.~~
 - a. ~~(pages to , inclusive).~~
 5. General Conditions (pages to , inclusive).
 6. Supplementary Conditions (pages to , inclusive).
 7. Specifications as listed in the tables of contents of the Project Manual Volumes 1 and 2.
 8. Drawings (not attached but incorporated by reference) consisting of **two (2) drawing sets**:
 - a. DRAWINGS FOR CORNFIELDS PARALLEL AND LOWER GREASEWOOD INTERCONNECTION PIPELINES,
 - b. DRAWINGS FOR LOWER GREASEWOOD WATER TREATMENT PLANT, LOWER GREASEWOOD WELL 1 PUMP HOUSE, AND GANADO NO WELL PUMP HOUSE,
 sheets with each sheet bearing the following general title: **Lower Greasewood Water System Improvements** ~~the Drawings listed on the attached sheet index.~~
 9. Addenda (numbers to , inclusive).
 10. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages to , inclusive).
 - b. **All Rights-of-way and Easements (as found in Appendix A)**
 - c. **All Permits (as found in Appendix B)**
 - d. **Owner's Certificate of Tax Exemption (as found in Appendix C)**
 - e. **Documentation submitted by Contractor prior to Notice of Award (pages to , inclusive)**
 11. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Change Orders.
 - c. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.

- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 Assignment of Contract

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 Successors and Assigns

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 Severability

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Other Provisions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

NOTE(S) TO USER:

1. See Article 21 of the Instructions to Bidders and correlate procedures for format and signing of the documents.
2. The Effective Date of the Contract stated above and the dates of any construction performance bond (EJCDC® C-610 or other) and construction payment bond (EJCDC® C-615 or other) should be the same, if possible. In no case should the date of any bonds be earlier than the Effective Date of the Contract.

OWNER:

CONTRACTOR:

Navajo Tribal Utility Authority (NTUA)

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____
(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

****END OF SECTION****

NOTICE TO PROCEED

Owner:	Navajo Tribal Utility Authority (NTUA)	Owner's Contract No.:	
Contractor:		Contractor's Project No.:	
Engineer:	Brown and Caldwell	Engineer's Project No.:	143956
Project:	Navajo Nation Lower Greasewood Water System Improvements	Contract Name:	Contract No. 2: Water Treatment Plant, Pipelines, and Well Houses
		Effective Date of Contract:	

TO CONTRACTOR:

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [_____, 20__].

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work shall be done at the Site prior to such date. In accordance with the Agreement, the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner: **Navajo Tribal Utility Authority (NTUA)**

Authorized Signature

By:

Title:

Date Issued:

Copy: Engineer

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

PERFORMANCE BOND¹

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

Navajo Tribal Utility Authority (NTUA)
North Navajo Route 12, Fort Defiance, Arizona 86504

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location)*:

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract,

arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced

PAYMENT BOND¹

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

Navajo Tribal Utility Authority (NTUA)

North Navajo Route 12, Fort Defiance, Arizona 86504

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

(seal)

Contractor's Name and Corporate Seal

By: _____
Signature

Print Name

Title

Attest: _____
Signature

Title

SURETY

(seal)

Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

Print Name

Title

Attest: _____
Signature

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
 - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
 1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
 - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:

****END OF SECTION****

Payment Bond
00615-3

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction

Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

~~Progress Estimate - Unit Price Work~~

Contractor's Application

[illegible]

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Navajo Tribal Utility Authority (NTUA)	Owner's Contract No.:	
Contractor:		Contractor's Project No.:	
Engineer:	Brown and Caldwell	Engineer's Project No.:	143956
Project:	Navajo Nation Lower Greasewood Water System Improvements	Contract Name:	Contract No. 2: Water Treatment Plant, Pipelines, and Well Houses

This [preliminary] [final] Certificate of Substantial Completion applies to:

☐

All Work

☐

The following specified portions of the Work:

Date of Substantial Completion

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work shall be as provided in the Contract, except as amended as follows: *[Note: Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.]*

Amendments to Owner's
responsibilities:

☐

None

☐

As follows

Amendments to
Contractor's responsibilities:

☐

None

☐

As follows:

The following documents are attached to and made a part of this Certificate: *[punch list; others]*

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract.

EXECUTED BY ENGINEER:		RECEIVED:	RECEIVED:
By: _____	By: _____	By: _____	
(Authorized signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)	
Title: _____	Title: _____	Title: _____	
Date: _____	Date: _____	Date: _____	

****END OF SECTION****

Certificate of Substantial Completion
00625-1

THIS PAGE LEFT INTENTIONALLY BLANK

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT¹

TABLE OF CONTENTS

	Page
Article 1 – Definitions and Terminology	6
1.01 Defined Terms	6
1.02 Terminology	10
Article 2 – Preliminary Matters	11
2.01 Delivery of Bonds and Evidence of Insurance	11
2.02 Copies of Documents	11
2.03 Before Starting Construction	11
2.04 Preconstruction Conference; Designation of Authorized Representatives	12
2.05 Initial Acceptance of Schedules	12
2.06 Electronic Transmittals	12
Article 3 – Documents: Intent, Requirements, Reuse	13
3.01 Intent	13
3.02 Reference Standards	13
3.03 Reporting and Resolving Discrepancies	14
3.04 Requirements of the Contract Documents	14
3.05 Reuse of Documents	15
Article 4 – Commencement and Progress of the Work	15
4.01 Commencement of Contract Times; Notice to Proceed	15
4.02 Starting the Work	15
4.03 Reference Points	15
4.04 Progress Schedule	16
4.05 Delays in Contractor’s Progress	16
Article 5 – Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions	17
5.01 Availability of Lands	17
5.02 Use of Site and Other Areas	17

¹EJCDC® C-700 Standard General Conditions of the Construction Contract. Copyright © 2013 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.03	Subsurface and Physical Conditions.....	18
5.04	Differing Subsurface or Physical Conditions	19
5.05	Underground Facilities	20
5.06	Hazardous Environmental Conditions at Site	22
Article 6 – Bonds and Insurance		24
6.01	Performance, Payment, and Other Bonds	24
6.02	Insurance—General Provisions	25
6.03	Contractor’s Insurance	26
6.04	Owner’s Liability Insurance	28
6.05	Property Insurance.....	28
6.06	Waiver of Rights	30
6.07	Receipt and Application of Property Insurance Proceeds	31
Article 7 – Contractor’s Responsibilities		31
7.01	Supervision and Superintendence	31
7.02	Labor; Working Hours	32
7.03	Services, Materials, and Equipment.....	32
7.04	“Or Equals”	32
7.05	Substitutes	33
7.06	Concerning Subcontractors, Suppliers, and Others	35
7.07	Patent Fees and Royalties	36
7.08	Permits	37
7.09	Taxes	37
7.10	Laws and Regulations.....	37
7.11	Record Documents.....	38
7.12	Safety and Protection.....	38
7.13	Safety Representative	39
7.14	Hazard Communication Programs	39
7.15	Emergencies	39
7.16	Shop Drawings, Samples, and Other Submittals.....	39
7.17	Contractor’s General Warranty and Guarantee.....	42
7.18	Indemnification	42
7.19	Delegation of Professional Design Services	43
Article 8 – Other Work at the Site		44
8.01	Other Work	44

8.02	Coordination	44
8.03	Legal Relationships.....	45
Article 9 – Owner’s Responsibilities.....		46
9.01	Communications to Contractor.....	46
9.02	Replacement of Engineer	46
9.03	Furnish Data	46
9.04	Pay When Due.....	46
9.05	Lands and Easements; Reports, Tests, and Drawings	46
9.06	Insurance.....	46
9.07	Change Orders.....	46
9.08	Inspections, Tests, and Approvals.....	46
9.09	Limitations on Owner’s Responsibilities	46
9.10	Undisclosed Hazardous Environmental Condition.....	47
9.11	Evidence of Financial Arrangements.....	47
9.12	Safety Programs	47
Article 10 – Engineer’s Status During Construction.....		47
10.01	Owner’s Representative.....	47
10.02	Visits to Site.....	47
10.03	Project Representative.....	47
10.04	Rejecting Defective Work.....	48
10.05	Shop Drawings, Change Orders and Payments.....	48
10.06	Determinations for Unit Price Work	48
10.07	Decisions on Requirements of Contract Documents and Acceptability of Work	48
10.08	Limitations on Engineer’s Authority and Responsibilities.....	48
10.09	Compliance with Safety Program.....	49
Article 11 – Amending the Contract Documents; Changes in the Work		49
11.01	Amending and Supplementing Contract Documents	49
11.02	Owner-Authorized Changes in the Work	50
11.03	Unauthorized Changes in the Work.....	50
11.04	Change of Contract Price	50
11.05	Change of Contract Times	51
11.06	Change Proposals	51
11.07	Execution of Change Orders.....	52
11.08	Notification to Surety.....	53

Article 12 – Claims.....	53
12.01 Claims	53
Article 13 – Cost of the Work; Allowances; Unit Price Work.....	54
13.01 Cost of the Work	54
13.02 Allowances	57
13.03 Unit Price Work	57
Article 14 – Tests and Inspections; Correction, Removal or Acceptance of Defective Work.....	58
14.01 Access to Work.....	58
14.02 Tests, Inspections, and Approvals.....	58
14.03 Defective Work.....	59
14.04 Acceptance of Defective Work.....	59
14.05 Uncovering Work	60
14.06 Owner May Stop the Work	60
14.07 Owner May Correct Defective Work.....	60
Article 15 – Payments to Contractor; Set-Offs; Completion; Correction Period	61
15.01 Progress Payments	61
15.02 Contractor’s Warranty of Title	64
15.03 Substantial Completion	64
15.04 Partial Use or Occupancy	65
15.05 Final Inspection	66
15.06 Final Payment.....	66
15.07 Waiver of Claims	67
15.08 Correction Period	67
Article 16 – Suspension of Work and Termination	68
16.01 Owner May Suspend Work	68
16.02 Owner May Terminate for Cause.....	68
16.03 Owner May Terminate For Convenience	69
16.04 Contractor May Stop Work or Terminate	70
Article 17 – Final Resolution of Disputes	70
17.01 Methods and Procedures.....	70
Article 18 – Miscellaneous	71
18.01 Giving Notice	71
18.02 Computation of Times.....	71

18.03	Cumulative Remedies	71
18.04	Limitation of Damages	71
18.05	No Waiver	71
18.06	Survival of Obligations	71
18.07	Controlling Law	71
18.08	Headings.....	71

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance

with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and

submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the

Standard General Conditions of the Construction Contract

00700-9

result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
2. a preliminary Schedule of Submittals; and
3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other

submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract

Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or

requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. abnormal weather conditions;
 - 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 - 4. acts of war or terrorism.

- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

- A. *Limitation on Use of Site and Other Areas:*
 - 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
 - D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or

make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
2. is of such a nature as to require a change in the Drawings or Specifications; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments:*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

- b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
- 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 - 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the

costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
 - 4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
 - 1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 - 2. claims for damages insured by reasonably available personal injury liability coverage.
 - 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
 - 1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 - 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 - 3. Broad form property damage coverage.
 - 4. Severability of interest.
 - 5. Underground, explosion, and collapse coverage.
 - 6. Personal injury coverage.

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
 - E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
 - F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.
 - G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
 - H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
 - I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 1. include at least the specific coverages provided in this Article.
 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal;

demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
 5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

- C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property

insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

- a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests

for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
- O. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that

the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
- G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

Standard General Conditions of the Construction Contract

00700-39

Contract 2
Bid Issue

- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
 2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.
 1. *Shop Drawings:*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.
 2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.
- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other

than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.

- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.
- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and

other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER’S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer’s status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner’s duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner’s duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner’s identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner’s responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner’s responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner’s responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner’s Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor’s failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such

Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 Compliance with Safety Program

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 Amending and Supplementing Contract Documents

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or

Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and

retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection

with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a

decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and

employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 - 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
 - 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. Payment Becomes Due:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. Reductions in Payment by Owner:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

- j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the

certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is

satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

- C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.
- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 4. Contractor's repeated disregard of the authority of Owner or Engineer.

- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

Standard General Conditions of the Construction Contract

00700-69

Contract 2
Bid Issue

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 Contractor May Stop Work or Terminate

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 Methods and Procedures

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

****END OF SECTION****

Supplementary Conditions¹

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

TABLE OF CONTENTS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY	2
ARTICLE 2 – PRELIMINARY MATTERS	3
ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK	4
ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS	4
ARTICLE 6 – BONDS AND INSURANCE	6
ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES	9
ARTICLE 8 – OTHER WORK AT THE SITE	11
ARTICLE 9 – OWNER’S RESPONSIBILITIES	11
ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION	11
ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK	14
ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK	14
ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD	16
ARTICLE 17 – FINAL RESOLUTION OF DISPUTES	17
ARTICLE 18 – MISCELLANEOUS	18
ARTICLE 19 – FEDERAL REQUIREMENTS	19
ARTICLE 20 – NAVAJO PREFERENCE	23

¹This document is a MODIFIED version of EJCDC® C-800 Guide to the Preparation of Supplementary Conditions, Copyright © 2013 by the National Society of Professional Engineers, American Society of Civil Engineers, and American Council of Engineering Companies, or is based in part on excerpts from EJCDC documents. Those portions of the text that originated in the published EJCDC documents remain subject to the copyright.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01. ~~Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:~~

~~**Geotechnical Baseline Report (GBR)** — The interpretive report prepared by or for Owner regarding subsurface conditions at the Site, and containing specific baseline geotechnical conditions that may be anticipated or relied upon for bidding and contract administration purposes, subject to the controlling provisions of the Contract, including the GBR's own terms. The GBR is a Contract Document.~~

~~**Geotechnical Data Report (GDR)** — The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner in support of the Geotechnical Baseline Report. The GDR's content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions, comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.~~

SC-1.01.A.3 Add the following language at the end of last sentence of Paragraph 1.01.A.3:

The Application for Payment form to be used on this Project is EJCDC C-620 (see Section 00620). The Agency must approve all Applications for Payment before payment is made.

SC-1.01.A.8 Add the following language at the end of last sentence of Paragraph 1.01.A.8:

The Change Order form to be used on this Project is EJCDC C-941 (see Section 00941). Agency approval is required before Change Orders are effective.

SC-1.01.A.20 Add the following language at the end of last sentence of Paragraph 1.01.A.20:

The Engineer's Consultants on this project are: AeroGraphics, AMEC Environmental and Infrastructure, Depauli Engineering and Surveying, ETD, Inc., Eurofins Eaton Analytical, Goldtooth Precision Solutions, Liquid Engineering, Maryboy Management Group, Pureflow Filtration Div., and Short and Brennan Architects.

SC-1.01.A.32 Add the following language at the end of last sentence of Paragraph 1.01.A.32:

The term "Construction Manager," as used in the technical specifications, refers to the Resident Project Representative.

SC-1.01.A.48 Add the following language at the end of the last sentence of Paragraph 1.01.A.48:

A Work Change Directive cannot change Contract Price or Contract Times without a subsequent Change Order.

SC-1.01.A.49 Add the following new Paragraph after Paragraph 1.01.A.48:

Abnormal Weather Conditions – Conditions of extreme or unusual weather for a given region, elevation, or season as determined by Engineer. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered Abnormal Weather Conditions.

SC-1.01.A.50 Add the following new Paragraph after Paragraph 1.01.A.49:

Agency - The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 USC Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.01 ~~Delete Paragraphs 2.01 B. and C. in their entirety and insert the following in their place:~~

~~B. Evidence of Contractor's Insurance: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies of insurance (including all endorsements, and identification of applicable self insured retentions and deductibles) required to be provided by Contractor in Article 6. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.~~

~~C. Evidence of Owner's Insurance: After receipt from Contractor of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner under Article 6 (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.~~

SC-2.02.A Amend the first sentence of Paragraph 2.02.A. to read as follows:

Owner shall furnish to Contractor five copies of the Contract Documents (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

SC-2.02 ~~Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:~~

~~A. Owner shall furnish to Contractor [] copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.~~

SC-2.03.A Add the following after the last sentence of Paragraph 2.03.A.3:

Pursuit to the EPA funding requirements, the Contractor shall subdivide the Schedule of Values into two sections:

A. Water Treatment Plant

B. Pipelines, Well Houses, and Other

SC-2.06.B Add the following language to the end of 2.06.B:

Special requirements for electronic data apply to this Project. See http://www.consensusdocs.org/Resource_/FileManager/200.2_Guidebook_08_12_13.pdf entitled "Electronic Communications Protocol Addendum," Consensus DOCS form # 200.2.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01.A Amend the last sentence of Paragraph 4.01.A by striking out the following words:

In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

SC-4.05.C.2 Amend Paragraph 4.05.C.2 by striking out the following text: "abnormal weather conditions;" and inserting the following text:

Abnormal Weather Conditions;

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.01.A Amend the second sentence of Paragraph 5.01.A by adding the following text to the end of the Paragraph: Rights-of-way and easements obtained by the Owner specifically for this project are included in Appendix A of the Contract Documents.

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.B:

- C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to Owner:**
- 1. Report dated October 11, 2013, prepared by AMEC Earth & Infrastructure, Socorro, NM, entitled: "Geotechnical Report for the Lower Greasewood Water Supply Improvements Project, Arizona", consisting of 69 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are those indicated in the definition of Technical Data in the General Conditions.**
 - 2. Report prepared by Brown and Caldwell, Midvale, UT and Pureflow Filtration Div., Whittier, CA, entitled: "Pilot Study Report for Navajo Tribal Utility Authority at Lower Greasewood Water Source Improvement Project, Greasewood, Arizona, Proposed Iron, Manganese and TOC Removal Using Pureflow PM-200M Catalytic Adsorptive Media and Granular Activated Carbon", consisting of 178 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are as indicated in the definition of Technical Data in the General Conditions.**
 - 3. Water Quality Summary Report dated April 15, 2013, prepared by NNEPA, Window Rock, AZ, for PWSID# 0400342 Dilkon/Indian Wells/Lower Greasewood/White Cone that summarizes: "Results for Total Trihalomethanes (TTHMs) Stage 1" The Technical Data contained in such report upon whose accuracy Contractor may rely are as indicated in the definition of Technical Data in the General Conditions.**
- D. The following drawings of physical conditions relating to existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities) are known to Owner:**
- 1. ~~Drawings dated~~**
 - a. ~~None of the contents of such drawings is Technical Data on whose accuracy Contractor may rely.~~**
 - 1. Environmental Assessment has been completed and any issues pertinent to the project have been incorporated.**
 - 2. Portions of the project may lie within the 100 year floodplain for the Pueblo Colorado Wash.**
- E. Contractor may examine copies of reports and drawings identified in SC-5.03.C and SC-5.03.D that were not included with the Bidding Documents at NTUA Office, North Navajo Route 12, Fort Defiance, Arizona during regular business hours, or may request copies from Engineer.**

SC-5.06 Add the following subparagraphs 5.06.A.1 and 5.06.A.2:

- 1. ~~The following reports regarding Hazardous Environmental Conditions at the Site are known to Owner:~~**
 - a. ~~Report dated December 10, 2012, prepared by Eph Environmental Consultants, Princeton, N.J., entitled: "Results of Investigation of Conditions at Iron Foundry at South and Front Streets, Pembrig, NJ",~~**

Supplementary Conditions

00800-5

Contract 2
Bid Issue

~~consisting of 27 pages. The Technical Data contained in such report upon whose accuracy Contractor may rely are [here indicate any such Technical Data or state "none."]~~

2. ~~The following drawings regarding Hazardous Environmental Conditions at the Site are known to Owner:~~

~~a. Drawings dated November 27, 2002, prepared by Eph Environmental Consultants, Princeton, N.J., entitled: "Iron Foundry Site Conditions", consisting of 5 sheets numbered ___ to ___, inclusive.~~

~~1) None of the contents of such drawings is Technical Data on whose accuracy Contractor may rely.~~

SC-5.06 ~~Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:~~

~~A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.~~

~~B. Not Used.~~

ARTICLE 6 – BONDS AND INSURANCE

SC-6.02 Add the following paragraph immediately after Paragraph 6.02.B:

1. Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

SC-6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. **Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:**

State:	<u>Statutory</u>
--------	------------------

Federal, if applicable (e.g., Longshoreman's):	<u>Statutory</u>
--	------------------

Jones Act coverage, if applicable:

Bodily injury by accident, each accident	\$ <u>N.A.</u>
--	----------------

Bodily injury by disease, aggregate	\$ <u>N.A.</u>
-------------------------------------	----------------

Employer's Liability:

Bodily injury, each accident	\$ <u>500,000</u>
------------------------------	-------------------

Bodily injury by disease, each employee	\$ <u>500,000</u>
---	-------------------

Supplementary Conditions

00800-6

Contract 2
Bid Issue

Bodily injury/disease aggregate	\$ <u>500,000</u>
For work performed in monopolistic states, stop-gap liability coverage shall be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	\$ <u>N.A.</u>
Foreign voluntary worker compensation	<u>Statutory</u>
2. Contractor's Commercial General Liability under Paragraphs 6.03.B and 6.03.C of the General Conditions:	
General Aggregate	\$ <u>2,000,000</u>
Products - Completed Operations Aggregate	\$ <u>1,000,000</u>
Personal and Advertising Injury	\$ <u>1,000,000</u>
Each Occurrence (Bodily Injury and Property Damage)	\$ <u>2,000,000</u>
3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:	
Bodily Injury:	
Each person	\$ <u>1,000,000</u>
Each accident	\$ <u>1,000,000</u>
Property Damage:	
Each accident	\$ <u>1,000,000</u>
Combined Single Limit of	\$ <u>1,000,000</u>
4. Excess or Umbrella Liability:	
Per Occurrence	\$ <u>5,000,000</u>
General Aggregate	\$ <u>5,000,000</u>
5. Contractor's Pollution Liability:	
Each Occurrence	\$ <u>N.A.</u>
General Aggregate	\$ <u>N.A.</u>



If box is checked, Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract

6. ~~Additional Insureds: In addition to Owner and Engineer, include as additional insureds the following:~~

7. Contractor's Professional Liability:

Each Claim	\$ <u>N.A.</u>
Annual Aggregate	\$ <u>N.A.</u>

8. ~~{Here list additional types and amounts of insurance that may be required by Owner.}~~

~~SC 6.05. Add the following to the list of requirements in Paragraph 6.05.A, as a numbered item:~~

- ~~13. be subject to a deductible amount of no more than [\$] for direct physical loss in any one occurrence.~~

~~SC 6.05.A.1 Add the following new subparagraph after subparagraph 6.05.A.1:~~

- ~~a. In addition to Owner, Contractor, and all Subcontractors, include as insureds the following:~~

~~{Here list by name (not category, role, or classification) other persons or entities to be included on the builder's risk policy as insureds.}~~

~~SC 6.05.A. Add the following to the list of items in Paragraph 6.05.A, as numbered items:~~

- ~~14. include for the benefit of Owner loss of profits and soft cost coverage including, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, plus attorneys fees and engineering or other consultants' fees, if not otherwise covered;~~

- ~~16. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:~~

~~a. {here list specific items of equipment and purchase value}~~

~~b. {here list items of material and purchase value}~~

- ~~17. include by express endorsement coverage of damage to Contractor's equipment.~~

~~SC 6.05.A. Delete Paragraph 6.05.A of the General Conditions and substitute the following in its place:~~

~~Contractor shall provide and maintain installation floater insurance for property under the care, custody, or control of Contractor. The installation floater insurance shall be a broad form or "all risk" policy providing coverage for all materials, supplies,~~

~~machinery, fixtures, and equipment that will be incorporated into the Work. Coverage under the Contractor's installation floater will include:~~

- ~~1. any loss to property while in transit,~~
- ~~2. any loss at the Site, and~~
- ~~3. any loss while in storage, both on-site and off-site.~~

~~Coverage cannot be contingent on an external cause or risk, or limited to property for which the Contractor is legally liable. The Contractor will be solely responsible for any deductible carried under this coverage and claims on materials, supplies, machinery, fixture, and equipment that will be incorporated into the Work while in transit or in storage. This policy will include a waiver of subrogation applicable to Owner, Contractor, Engineer, all Subcontractors, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them.~~

SC-6.05.A. Delete the first sentence of Paragraph 6.05.A and insert the following sentence in its place:

Owner shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations).

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

~~SC-7.02.B. Add the following new subparagraphs immediately after Paragraph 7.02.B:~~

- ~~1. Regular working hours will be~~
- ~~2. Owner's legal holidays are~~

~~SC 7.02.B. Amend the first and second sentences of Paragraph 7.02.B to state "...all Work at the Site shall be performed during regular working hours, [] through []. Contractor will not perform Work on a [], [], or any legal holiday."~~

~~SC 7.02.B. Delete Paragraph 7.02 B. in its entirety, and insert the following:~~

~~B. In the absence of any Laws or Regulations to the contrary, Contractor may perform the Work on holidays, during any or all hours of the day, and on any or all days of the week, at Contractor's sole discretion.~~

SC-7.02.C. Add the following new paragraph immediately after Paragraph 7.02.B:

Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

~~SC 7.02.C. Add the following new subparagraph immediately after Paragraph 7.02.C:~~

- ~~1. For purposes of administering the foregoing requirement, additional overtime costs are defined as [here insert parameters for compensated overtime hours]~~

SC-7.04.A Amend the third sentence of Paragraph 7.04.A by striking out the following words:

Unless the specification or description contains or is followed by words reading that no like, equivalent, or 'or-equal' item is permitted.

SC-7.04.A.1 Amend the last sentence of Paragraph a.3 by striking out "and;" and adding a period at the end of Paragraph a.3.

SC-7.04.A.1 Delete paragraph 7.04.A.1.a.4 in its entirety and insert the following in its place:

4. [Deleted]

SC-7.06.A Amend Paragraph 7.06.A by adding the following text to the end of the Paragraph: The Contractor shall not award work valued at more than fifty (50%) percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC-7.06.B Delete paragraph 7.06.B in its entirety and insert the following in its place:

B. [Deleted]

SC-7.06.E Amend the second sentence of Paragraph 7.06.E by striking out "Owner may also require Contractor to retain specific replacements; provided, however, that".

SC-7.08.A Amend the second sentence of Paragraph 7.08.A by adding the following text to the end of the Paragraph: Permits obtained by the Owner specifically for this project are included in Appendix B of the Contract Documents.

SC-7.09 Add a new paragraph immediately after Paragraph 7.09.A:

B. Owner is exempt from payment of sales and compensating use taxes of the State of Arizona and of cities and counties thereof on all materials to be incorporated into the Work.

1. Owner will furnish the required certificate of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.

2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

3. Owner's exemption does not exempt Contractor from payment of Navajo Nation tax.

SC-7.12 Insert the following after the second sentence of Paragraph 7.12.C:

The following Owner safety programs are applicable to the Work: *NTUA Safety Manual, Latest Edition*

ARTICLE 8 – OTHER WORK AT THE SITE

SC-8.02 Delete Paragraph 8.02.A in its entirety and replace with the following:

- A. Owner intends to contract with others for the performance of other work at or adjacent to the Site.
1. The Owner's Resident Project Representative shall have authority and responsibility for coordination of the various contractors and work forces at the Site;
 2. The following specific matters are to be covered by such authority and responsibility: When Contractor is allowed to clear, grub, and grade NO Well site, equip the well, and start construction of the well house. *Note – this work will not begin until the Owner's well drilling contractor is complete with drilling and testing the well.*
 3. The extent of such authority and responsibilities is: *[here provide the extent]*

ARTICLE 9 – OWNER'S RESPONSIBILITIES

~~SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:~~

~~SC-9.13 Owner will furnish an "Owner's Site Representative" to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's consultant, agent, or employee. Owner's Site Representative will be *[Here identify individual or entirety]*. The authority and responsibilities of Owner's Site Representative follow: *[Here describe the duties and activities of the Owner's Site Representative]*~~

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.
1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
 3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.

4. **Liaison:**
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
5. **Interpretation of Contract Documents:** Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
6. **Shop Drawings and Samples:**
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
7. **Modifications:** Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
8. **Review of Work and Rejection of Defective Work:**
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
9. **Inspections, Tests, and System Start-ups:**
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate

Owner's personnel, and that Contractor maintains adequate records thereof.

- b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

- a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
- b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
- c. Maintain records for use in preparing Project documentation.

11. Reports:

- a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

- 12. Payment Requests:** Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

- 13. Certificates, Operation and Maintenance Manuals:** During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

- a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
- b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
- c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

SC-11.07.C Add the following new Paragraph after Paragraph 11.07.B:

All Contract Change Orders must be concurred in by Agency before they are effective.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

~~SC 13.01.B.5.c Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:~~

~~c. Construction Equipment and Machinery:~~

- ~~1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner with the advice~~

~~of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.~~

- ~~2) Costs for equipment and machinery owned by Contractor will be paid at a rate shown for such equipment in the [cite the rate book appropriate for the Project]. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs. Costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than \$1,000 will be considered small tools.~~

SC-13.02.C Delete Paragraph 13.02.C in its entirety and insert the following in its place:

C. [Deleted]

SC-13.03.E Delete Paragraph 13.03.E in its entirety and insert the following in its place:

- E. The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment under the following conditions:
1. if the extended price of a particular item of Unit Price Work amounts to five (5) percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than twenty-five (25) percent from the estimated quantity of such item indicated in the Agreement; and
 2. if there is no corresponding adjustment with respect to any other item of Work; and
 3. if Contractor believes that Contractor has incurred additional expense as a result thereof, Contractor may submit a Change Proposal, or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, Owner may make a Claim, seeking an adjustment in the Contract Price.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.02.B Delete Paragraph 14.02.B in its entirety and insert the following in its place: B. Contractor shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by the Contractor. Costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01.B Amend the second sentence of Paragraph 15.01.B.1 by striking out the following text: “a bill of sale, invoice, or other.”

SC-15.01.B.3 Add the following language at the end of paragraph 15.01.B.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-15.01.B.4 Add the following new Paragraph after Paragraph 15.01.B.3:

The Application for Payment form to be used on this Project is EJCDC C-620 (see Section 00620). The Agency must approve all Applications for Payment before payment is made.

SC-15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

1. The Application for Payment with Engineer’s recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due twenty (20) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-15.02.A Amend Paragraph 15.02.A by striking out the following text: “no later than seven days after the time of payment by Owner” and insert “no later than the time of payment by Owner.”

SC-15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17 Delete ARTICLE 17 in its entirety and insert the following:

ARTICLE 17 - SOVEREIGN IMMUNITY; DISPUTE RESOLUTION

SC-17.01 Add the following language as Paragraph 17.01 with the title “Sovereign Immunity”:

- A. Nothing herein shall be considered a waiver, express or implied, of the sovereign immunity of the Navajo Nation, except to the limited extent provided for in the Navajo Sovereign Immunity Act, as amended, at 1 N.N.C. §§551 et seq.

SC-17.02 Add the following language after Article 17.01 with the title “Arbitration”:

- A. Any dispute arising out of or relating to this Contract shall be resolved by arbitration procedures referenced in the Navajo Sovereign Immunity Act, as amended, at 1 N.N.C. §554 J and §544 K, and as set forth in the Navajo Nation Arbitration Act, as amended, at 7 N.N.C. §§1101 et seq.

SC-17.03 Add the following after Article 17.02 with the title “Arbitration Rules”:

- A. Such arbitration shall be conducted in accordance with the International Institute for Conflict Prevention and Resolution Rules for Non-Administered Arbitration, except to the extent such rules are modified by the following:
 - 1. unless otherwise agreed to in writing by the Parties, all arbitration procedures shall be held in Window Rock, Arizona; and,
 - 2. the arbitration panel shall consist of a single arbitrator, unless one of the Parties’ claims exceeds \$1,000,000.00, exclusive of interests, costs, and fees; in such case the arbitration panel shall consist of three (3) arbitrators with at least one arbitrator possessing at least ten (10) years of experience in Indian Law.

~~SC 17.02 Add the following new paragraph immediately after Paragraph 17.01.~~

~~SC 17.02 Arbitration~~

- ~~A. All matters subject to final resolution under this Article will be decided by arbitration in accordance with the rules of [insert name of selected arbitration agency], subject to the conditions and limitations of this paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.~~
- ~~B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in this Article, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations. The demand for arbitration should include specific reference to Paragraph SC 17.02.D below.~~

~~C. No arbitration arising out of or relating to the Contract shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:~~

~~1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and~~

~~2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.~~

~~D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include a concise breakdown of the award, and a written explanation of the award specifically citing the Contract provisions deemed applicable and relied on in making the award.~~

~~E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.~~

~~F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by Owner and Contractor.~~

~~SC 17.03 Add the following new paragraph immediately after Paragraph 17.02.~~

~~SC 17.03 Attorneys' Fees: For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.~~

ARTICLE 18 – MISCELLANEOUS

SC-18.07 Delete paragraph 18.07 in its entirety and insert the following:

18.07 Controlling Law

A. This agreement shall be construed and the legal relations between the parties determined in accordance with the laws of the Navajo Nation, without giving effect to any choice of law rules which may direct the application of the laws of any other jurisdiction. Any dispute hereunder requiring judicial resolution shall only be made the subject of an action brought in a court of competent jurisdiction located within the Navajo Nation and the parties each accept the exclusive jurisdiction of such courts to the extent authorized by the Navajo sovereign immunity act, 1 N.N.C. §§551, et seq.

SC-18.09 Add the following new paragraph after Paragraph 18.08:

SC-18.09 Tribal Sovereignty.

- A. No provision of this Agreement will be construed by any of the signatories as abridging or debilitating any sovereign powers of the Navajo Tribe; affecting the trust-beneficiary relationship between the Secretary of the Interior, Tribe, and Indian landowner(s); or interfering with the government-to-government relationship between the United States and the Tribe.

ARTICLE 19 – FEDERAL REQUIREMENTS

SC-19 Add Article 19 titled “FEDERAL REQUIREMENTS”

SC-19.01 Add the following language as Paragraph 19.01 with the title “Agency Not a Party”:

- A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees is a party to this Contract.

SC-19.02 Add the following sections after Article 19.01 with the title “Contract Approval”:

- A. Owner and Contractor will furnish Owner’s attorney such evidence as required so that Owner’s attorney can complete and execute the following “Certificate of Owner’s Attorney” (Exhibit I of RUS Bulletin 1780-26) before Owner submits the executed Contract Documents to Agency for approval.
- B. Concurrence by Agency in the award of the Contract is required before the Contract is effective.

SC-19.03 Add the following language after Article 19.02.B with the title “Conflict of Interest & Gratuities”:

- A. Contractor may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. Owner’s officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in Contractor. Owner’s officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

SC-19.04 Add the following language after Article 19.03.A with the title “Gratuities”:

- A. If Owner finds after a notice and hearing that Contractor, or any of Contractor’s agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this

Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

- B. In the event this Contract is terminated as provided in paragraph 19.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

SC-19.05 Add the following language after Article 19.04.B with the title “Small, Minority and Women’s Businesses”:

- A. Contracting with small and minority businesses, women’s business enterprises, and labor surplus area firms. If Contractor intends to let any subcontracts for a portion of the work, Contractor must take all necessary affirmative steps to assure that minority businesses, women’s business enterprises, and labor surplus area firms are used when possible. Affirmative steps must include:
- (1) Placing qualified small and minority businesses and women’s business enterprises on solicitation lists;
 - (2) Assuring that small and minority businesses, and women’s business enterprises are solicited whenever they are potential sources;
 - (3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women’s business enterprises;
 - (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses and women’s business enterprises; and
 - (5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and Minority Business Developments Agency of the Department of Commerce.

SC-19.06 Add the following after Article 19.05.A with the title “Anti-Kickback”:

- A. Contractor shall comply with the Copeland Anti-Kickback Act (40 U.S.C 3145)) as supplemented by Department of Labor regulations (29 CFR Part 3, “Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States”). The Act provides that Contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up

any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

SC-19.07 Add the following after Article 19.06.A with the title “Clean Air and Pollution Control Acts (42 U.S.C 7401-7671q.) and the Federal Pollution Control Act (33 U.S.C. 1251-1387), as amended”:

- A. Contractor to agree to comply with all applicable standards, orders or regulations issues pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

SC-19.08 Add the following after Article 19.07.A with the title “Equal Employment Opportunity”:

- A. The Contract is considered a federally assisted construction contract. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of “federally assisted construction contract” in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, “Equal Employment Opportunity: (30FR 12319, 12935, 3CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” and implementing regulations at 41 CFR part 60, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor.”

SC-19.09 Add the following after Article 19.08.A with the title “Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)”:

- A. Contractors that apply or bid for an award exceeding \$100,000 must file the required certification (RD Instruction 1940-Q, Exhibit A-1). The Contractor certifies to the Owner and every subcontractor certifies to the Contractor that is will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, office or employee of Congress, or an employee of a member of Congress in connection with obtaining the Contract if it is covered by 31 U.S.C. 1352. The Contractor and every subcontractor must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining and Federal award. Such Disclosures are forwarded from tier up to the Owner. Necessary certification and disclosure forms shall be provided by owner.

SC-19.10 Add the following after Article 19.09.A with the title “Environmental Requirements”:
When constructing a Project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental conditions:

- A. Wetlands –When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.

- B. Floodplains –When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100-year floodplain areas (Standard Flood Hazard Area) delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, e.g., alluvial soils on NRCS Soil Survey Maps.
- C. Historic Preservation – Any excavation by Contractor that uncovers an historical or archaeological artifact or human remains shall be immediately reported to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the State Historic Preservation Officer (SHPO).
- D. Endangered Species – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.
- E. Mitigation Measures – The following environmental mitigation measures are required on this Project:
 - 1. Soils: Under Section 402 of the Clean Water Act (CWA) all construction site operators engaged in clearing, grading and excavating activities that disturb one-half acre or more must obtain coverage under a National Pollutant Discharge Elimination System (NPDES) permit for storm water discharges to minimize potential erosion and subsequent stream sedimentation. The General Contractor will be responsible for developing and implementing a Storm Water Pollution Prevention Plan (SWPPP) and obtaining permit from U.S. EPA. The SWPPP shall outline best management practice(s) for minimizing impacts to soil erosion. Thereafter, the impact to the soils will be minor and short term.
 - 2. Cultural Resources: Resource (AZ-P-20-37) must be flagged by a qualified archaeologist and will be avoided by a minimum of 50 feet.”
 - 3. Biological Resources: If any proposed undertakings require the disturbance of vegetation, construction shall begin before the onset of the migratory bird breeding season extending from April 15 to August 15. Construction may extend into the breeding season if needed as birds will typically not establish a nest site with an active construction zone. If this seasonal avoidance recommendation is followed, the project will not result in the ‘take of birds’ protected under the MBTA. If the construction activities cannot avoid MBTA breeding season, the project sponsor may contact NFWD to determine if preconstruction surveys can be conducted to identify any nests that have been established.

4. **Water Quality:** Identify best management practices to prevent surface runoff from the construction site. Develop a SWPPP and obtain coverage under a NPDES permit from the Navajo Nation in coordination with the U.S. EPA.

As part of the operation and maintenance activities there will be occasional need to backwash the water system (i.e., discharge of small amount of water from the system). The contractor will be required to place discharge into a containment area for evaporation. This discharge is not considered toxic and there are no rules for this type of discharge under Navajo Nation jurisdiction.

SC19.11 Add the following after Article 19.10.E with the title “Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3705)”:

- A. Where applicable, for contracts awarded by the Owner in excess of \$100,000 that involve the employment of mechanics or laborers, the Contractor must comply with 40 U.S.C 3702 and 3704, as supplemented by Department of Labor Regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, the Contractor must compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchase of supplies or materials or articles ordinarily available on the open market, or contracts for the transportation or transmission of intelligence.

SC19.12 Add the following after Article 19.11A with the title “Debarment and Suspension (Executive Orders 12549 and 12689)”

- A. A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), Debarment and Suspension.” SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

SC19.13 Add the following after Article 19.12 with the title “Procurement of recovered materials”:

- A. The Contractor must comply with 2 CFR Part 200.322, “Procurement of recovered materials”.

ARTICLE 20 – NAVAJO PREFERENCE

SC-20 Add Article 20 titled “NAVAJO PREFERENCE”

SC-20.01 Add the following language as Paragraph 20.01 with the title “Navajo Preference”:

- A. In performing the work under this agreement, the Contractor shall comply with all applicable laws, policies, rules and regulations of the Navajo Nation and the NTUA, including without limitation the Navajo Preference in Employment Law, codified at 15 N.N.C. §601, et seq., (the "NPEA"), and the Navajo Nation Business Opportunity Act, codified at 15 N.N.C. §201, et seq., (the "NNBOA"). The terms and provisions of the NPEA and NNBOA are specifically incorporated herein, and become a part of this agreement, and breach by the Contractor of any terms and provisions of such law shall constitute a breach of this agreement and provide grounds for the suspension or termination of the agreement or other remedy as specified in the NPEA and NNBOA.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

Change Order No. _____

Date of Issuance:	Effective Date:
Owner: Navajo Tribal Utility Authority (NTUA)	Owner's Contract No.:
Contractor:	Contractor's Project No.:
Engineer: Brown and Caldwell	Engineer's Project No.: 143956
Project: Navajo Nation Lower Greasewood Water System Improvements	Contract Name: Contract No. 2: Water Treatment Plant, Pipelines, and Well Houses

The Contract is modified as follows upon execution of this Change Order:
Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ____ to No. ____: Substantial Completion: _____ Ready for Final Payment: _____ days
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ days or dates
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for Final Payment: _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____
Title: _____

****END OF SECTION****

Change Order
00941-1

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

Date of Issuance:	Effective Date:	
Owner: Navajo Tribal Utility Authority (NTUA)	Owner's Contract No.:	
Contractor:	Contractor's Project No.:	
Engineer: Brown and Caldwell	Engineer's Project No.:	143956
Project: Navajo Nation Lower Greasewood Water System Improvements	Contract Name:	Contract No. 2: Water Treatment Plant, Pipelines, and Well Houses

Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, ~~submit a Change Proposal~~ **please notify Engineer immediately and** before proceeding with this Work.

Reference: _____
Specification(s) Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:	RECEIVED:
By: _____ Engineer (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

****END OF SECTION****

Field Order
00942-1

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

Appendix A: Rights-of-way and Easements Obtained by Owner

THIS PAGE LEFT INTENTIONALLY BLANK



United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
NAVAJO REGION
P. O. Box 1060
Gallup, New Mexico 87305

In Reply, Refer to:
6N420 – Real Estate Services

MAY 23 2017

Mr. Walter W. Haase, P.E., General Manager
Navajo Tribal Utility Authority
P.O. Box 170
Fort Defiance, AZ 86504

Dear Mr. Haase:

Enclosed for your information and use is an approved Grant of Easement for Right-of-Way for the Lower Greasewood Water Supply Improvement Project. The easement is for improvement, construction, operation and maintenance of a distribution water line, two well sites including an access road, and water treatment plant located within the vicinities of Lower Greasewood and Ganado Chapters, Apache and Navajo Counties, Arizona.

Special attention is directed to the Navajo Nation Right-of-Way Terms and Conditions. Upon completion of construction, an Affidavit of Completion must be submitted within 30 days in accordance with 25 CFR 169.

If you have any questions, please contact Ms. April Bowman, Fort Defiance Agency, at (928)729-7235.

Sincerely,

Regional Director, Navajo Region

Enclosures

cc: Project Review Office, Navajo Land Department w/ enclosures

**UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS**

GRANT OF EASEMENT FOR RIGHT-OF-WAY

KNOW ALL MEN BY THESE PRESENTS:

That the United States of America, acting by and through the Bureau of Indian Affairs, Department of the Interior, Navajo Region, P.O. Box 1060 Gallup, New Mexico 87305 for, and on behalf of: the Navajo Nation, hereinafter referred to as GRANTOR, under authority contained in 209 DM 8 dated November 17, 1981, 230 DM 1 and 3 IAM 4 dated July 19, 2000 and pursuant to the provisions of the Act of February 5, 1948 (62 Stat. 17; 25 USC 323-328); and Part 169, Title 25, *Code of Federal Regulations*, which by reference are made a part hereof, in consideration of \$258,421.85¹*, the receipt of which is hereby acknowledged, does hereby grant to: Navajo Tribal Utility Authority, P.O. Box 170, Fort Defiance, Arizona 86504, its successors and assigns, hereinafter referred to as GRANTEE, an easement for right-of-way for the following purposes, specifically: for improvement, construction, operation and maintenance of a distribution water line, 2 wells sites including an access road, and a water treatment plant, over the land embraced within a right-of-way situated on the following described lands: Sections 24 and 25, Township 25 North, Range 23 East; Sections 18 and 19, Township 25 North, Range 24 East; and Section 10, Township 26 North, Range 26 East, G&SRM, Navajo and Apache Counties, State of Arizona.

<u>Parcels</u>	<u>Length</u>	<u>Width</u>	<u>Acreage</u>
6" Water Line Intertie	13,860.35	30'	9.54
Well No. 1 Site	100'	100'	0.23
Water Treatment Plant			2.50
Well N0 Site	100'	100'	0.23
<u>Access Road</u>			<u>0.18</u>
TOTAL			12.68

Said right-of way is limited to and more particularly described to be 12.68 acres, more or less, in area, as shown on Exhibit "A", attached hereto, and made a part hereof.

^{*} Consideration for the right-of-way shall be the Navajo Nation's contribution to the project to improve the water supply system to the Navajo Communities.

To have and to hold the said easement and right-of-way unto the GRANTEE and unto its successors and assigns subject to the following provisions:

1. GRANTEE agrees to indemnify the landowners and authorized users and occupants against any liability for loss of life, personal injury and property damage arising from the construction, maintenance, occupancy or use of the lands by the applicant, his employees, contractors and their employees, or subcontractors and their employees.
2. GRANTEE agrees to restore the land to its original condition, as far as is reasonably possible, upon termination or revocation of this easement for any reason. Failing to comply with this stipulation, GRANTEE agrees to bear all expenses and costs incurred by the owner and/or the United States in accomplishing said restoration.
3. GRANTEE agrees to pay all damages and compensation, in additions to the deposit made pursuant to 169.4, determined by the Secretary to be due the landowners and authorized users and occupants of the land due to the survey, granting, construction and maintenance of the right-of-way.
4. GRANTEE agrees to that during the term of this Grant of Easement, if any previously unidentified cultural resources are discovered within the easement area, work should be halted immediately and the BIA and/or Tribal Contractor should be contacted immediately.
5. GRANTEE agrees to construct and maintain the right-of-way in a workmanlike manner.
6. GRANTEE agrees to clear and keep clear the lands within the right-of-way to the extent compatible with the purpose of the right-of-way; and dispose of all vegetative and other material cut, uprooted or otherwise accumulated during construction and maintenance of the project.
7. GRANTEE agrees to take soil and resources conservation protection measures, including weed control, on the land covered by the right-of-way.
8. GRANTEE agrees to do everything reasonable within its power to prevent and suppress fires on or near the lands to be occupied under the right-of-way.
9. GRANTEE agrees to build and repair such roads, fences and trails as may be destroyed or injured by construction work and to build and maintain necessary and suitable crossings for all roads and trails that intersect the works constructed, maintained, or operated under the right-of-way.
10. GRANTEE agrees to that upon revocation or termination of the right-of-way, the applicant shall, so far as is reasonably possible, restore the land to its original condition. The determination of "reasonably possible" is subject to Secretary's approval.
11. GRANTEE agrees at all times to keep the Secretary informed of its address, and in case of corporations, of the address of its principal place of business and the names and addresses of its principal officers.

12. GRANTEE agrees to not interfere with the use of the lands by or under the authority of the landowners for any purpose not inconsistent with the primary purpose for which the right-of-way is granted.

This easement is subject to any prior valid existing right or adverse claim and is [for a term of twenty (20) years] and shall take effect on the date approved by the United States, so long as said easement shall be actually used for the purpose above specified; PROVIDED, that this right-of-way may be terminated in whole or in part by the GRANTOR for any of the following causes upon 30 days written notice, and failure of the GRANTEE within said notice period to correct the basis for termination (25 CFR 169.20):


1. Failure to comply with any term or condition of the Grant, or the applicable regulations.
2. A non-use of the right-of-way for any consecutive two-year period (for the purpose for which it was granted).
3. An abandonment of the right-of-way, as determined by the BIA.
4. Failure to comply with Navajo Nation Right-Of-Way Terms and Conditions.

The condition for this easement shall extend to and be binding upon and shall inure to the benefit of the successors and assigns of the GRANTEE.

IN WITNESS WHEREOF, GRANTOR has executed this grant of easement this 23rd day of May, 2017.

UNITED STATES OF AMERICA

BY




Regional Director, Navajo Region
U.S. Department of the Interior
Bureau of Indian Affairs

ACKNOWLEDGEMENT

STATE OF New Mexico :
COUNTY OF McKinley : ss.

Subscribed and sworn to before me this 23rd day of May, 2017.


Signature of Notary Public

My commission expires on August 01, 2020.



OFFICIAL SEAL
STEPHEN S. HASKIE
NOTARY PUBLIC STATE OF NEW MEXICO

My Commission Expires: Aug. 01, 2020



United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
NAVAJO REGION
P. O. Box 1060
Gallup, New Mexico 87305

In Reply, Refer to:
6N420 – Real Estate Services

MAY 23 2017

Mr. Walter W. Haase, P.E., General Manager
Navajo Tribal Utility Authority
P.O. Box 170
Fort Defiance, AZ 86504

Dear Mr. Haase:

Enclosed for your information and use is an approved Temporary Construction Easement (TCE) for the Lower Greasewood Water Supply Improvement Project. The temporary construction easement is to conduct horizontal directional drilling for road and wash crossings located within the vicinities of Lower Greasewood and Cornfields Chapters, Apache and Navajo Counties, Arizona.

Special attention is directed to the Navajo Nation Temporary Construction Easement Terms and Conditions. Upon completion of construction, an Affidavit of Completion must be submitted within 30 days in accordance with 25 CFR 169.

If you have any questions, please contact Ms. April Bowman, Fort Defiance Agency, at (928)729-7235.

Sincerely,

Regional Director, Navajo Region

Enclosures

cc: Project Review Office, Navajo Land Department w/ enclosures

**UNITED STATES OF AMERICA
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS**

TEMPORARY GRANT OF EASEMENT FOR RIGHT-OF-WAY

KNOW ALL MEN BY THESE PRESENTS:

That the United States of America, acting by and through the Bureau of Indian Affairs, Department of the Interior, Navajo Region, P.O. Box 1060 Gallup, New Mexico 87305 for, and on behalf of: the Navajo Nation, hereinafter referred to as GRANTOR, under authority contained in 209 DM 8 dated November 17, 1981, 230 DM 1 and 3 IAM 4 dated July 19, 2000 and pursuant to the provisions of the Act of February 5, 1948 (62 Stat. 17; 25 USC 323-328); and Part 169, Title 25, *Code of Federal Regulations*, which by reference are made a part hereof, in consideration of \$ Waived*, the receipt of which is hereby acknowledged, does hereby grant to: Navajo Tribal Utility Authority, P.O. Box 170, Fort Defiance, Arizona 86504, its successors and assigns, hereinafter referred to as GRANTEE, an easement for right-of-way for the following purposes, specifically: Temporary construction easements for horizontal directional drilling to cross 1). B.I.A. Route N15; 2). B.I.A. Route N28; and 3). Pueblo Colorado wash crossing, over the land embraced within a right-of-way situated on the following described lands: Sections 25 and 34, Township 25 North, Range 23 East; Sections 19 and 20, Township 26 North, Range 25 East, G&SRM, Navajo and Apache Counties, State of Arizona.

<u>Temporary Construction Easement</u>	<u>Parcels</u>	<u>Acreage</u>
No. 1 - BIA Route N15	A	0.17
No. 1 - BIA Route N15	B	0.27
No. 2 - BIA Route N28	A	0.07
No. 2 - BIA Route N28	B	0.63
No. 3 – Pueblo Colorado Wash Crossing	A	0.35
<u>No. 3 – Pueblo Colorado Wash Crossing</u>	<u>B</u>	<u>0.35</u>
TOTAL		1.84

* Consideration for the right-of-way shall be the Navajo Nation's contribution to the project since it serves a public purpose and will benefit Navajo residents.

Said right-of way is limited to and more particularly described to be 1.84 acres, more or less, in area, as shown on Exhibit "A", attached hereto, and made a part hereof.

To have and to hold the said easement and right-of-way unto the GRANTEE and unto its successors and assigns subject to the following provisions:

1. GRANTEE agrees to indemnify the landowners and authorized users and occupants against any liability for loss of life, personal injury and property damage arising from the construction, maintenance, occupancy or use of the lands by the applicant, his employees, contractors and their employees, or subcontractors and their employees.
2. GRANTEE agrees to restore the land to its original condition, as far as is reasonably possible, upon termination or revocation of this easement for any reason. Failing to comply with this stipulation, GRANTEE agrees to bear all expenses and costs incurred by the owner and/or the United States in accomplishing said restoration.
3. GRANTEE agrees to pay all damages and compensation, in additions to the deposit made pursuant to 169.4, determined by the Secretary to be due the landowners and authorized users and occupants of the land due to the survey, granting, construction and maintenance of the right-of-way.
4. GRANTEE agrees to that during the term of this Grant of Easement, if any previously unidentified cultural resources are discovered within the easement area, work should be halted immediately and the BIA and/or Tribal Contractor should be contacted immediately.
5. GRANTEE agrees to construct and maintain the right-of-way in a workmanlike manner.
6. GRANTEE agrees to clear and keep clear the lands within the right-of-way to the extent compatible with the purpose of the right-of-way; and dispose of all vegetative and other material cut, uprooted or otherwise accumulated during construction and maintenance of the project.
7. GRANTEE agrees to take soil and resources conservation protection measures, including weed control, on the land covered by the right-of-way.
8. GRANTEE agrees to do everything reasonable within its power to prevent and suppress fires on or near the lands to be occupied under the right-of-way.
9. GRANTEE agrees to build and repair such roads, fences and trails as may be destroyed or injured by construction work and to build and maintain necessary and suitable crossings for all roads and trails that intersect the works constructed, maintained, or operated under the right-of-way.
10. GRANTEE agrees to that upon revocation or termination of the right-of-way, the applicant shall, so far as is reasonably possible, restore the land to its original condition. The determination of "reasonably possible" is subject to Secretary's approval.

11. GRANTEE agrees at all times to keep the Secretary informed of its address, and in case of corporations, of the address of its principal place of business and the names and addresses of its principal officers.
12. GRANTEE agrees to not interfere with the use of the lands by or under the authority of the landowners for any purpose not inconsistent with the primary purpose for which the right-of-way is granted.

This easement is subject to any prior valid existing right or adverse claim and is [for a term of 6 months] and shall take effect on the date approved by the United States, so long as said easement shall be actually used for the purpose above specified; PROVIDED, that this right-of-way may be terminated in whole or in part by the GRANTOR for any of the following causes upon 30 days written notice, and failure of the GRANTEE within said notice period to correct the basis for termination (25 CFR 169.20):


1. Failure to comply with any term or condition of the Grant, or the applicable regulations.
2. A non-use of the right-of-way for any consecutive two-year period (for the purpose for which it was granted).
3. An abandonment of the right-of-way, as determined by the BIA.
4. Failure to comply with Navajo Nation Right-Of-Way Terms And Conditions.

The condition for this easement shall extend to and be binding upon and shall inure to the benefit of the successors and assigns of the GRANTEE.

IN WITNESS WHEREOF, GRANTOR has executed this grant of easement this 23rd day of May, 2017.

UNITED STATES OF AMERICA

BY


Regional Director, Navajo Region
U.S. Department of the Interior
Bureau of Indian Affairs

ACKNOWLEDGEMENT

STATE OF New Mexico :
COUNTY OF McKinley : SS.

Subscribed and sworn to before me this 23rd day of May, 20 17.

Stephen S. Haskie
Signature of Notary Public

My commission expires on August 01, 20 20.



OFFICIAL SEAL
STEPHEN S. HASKIE
NOTARY PUBLIC STATE OF NEW MEXICO

My Commission Expires: Aug-01, 2020

Appendix B: Permits Obtained by Owner

THIS PAGE LEFT INTENTIONALLY BLANK



United States Department of the Interior
Bureau of Indian Affairs
Navajo Regional Office Division of Transportation

Application for Permission for Utility crossing within BIA Right-of-Way
(Authorization: 23 USC Part 123, 23 CFR Part 645 Subpart A & B, 25 CFR Part 170)
Rev: 05/15/2012

Background: to be filled out by Agency DOT Office

Agency: FORT DEFANCE
Route No: N15

Date: 07/13/2015

Permit No: 6N370-2015-15-994
(Assigned by Regional DOT Office)

Project No: _____
(Assigned by Regional DOT Office)

Section (A): to be filled out by applicant ROAD CROSSING #1

APPLICATION is hereby made by Navajo Tribal Utility Authority, address: _____
P.O. Box 170, Ft. Defiance, Arizona 86504 Phone: (800) 528-5011 to
construct utility crossing(s) at the following location(s) Cornfields and Lower Greasewood, Arizona
(Attach location map) adjacent to or crossing BIA Route: BIA Route N15
Station/Mile Post: Sta 1137+36 L/Rt Street: _____
for the purpose of (supplying service to): / residence / ☒ Business: NTUA Water Line
/ / School: _____ / / Other: _____

The utility shall be constructed by the applicant on or by (date) August 2015 and shall
take 365 calendar days to complete (attach appropriate engineering sketches of
each utility location). The applicant further agrees (at their entire expense) to comply with all the
conditions, restrictions, and regulations of both the BIA Navajo Regional Division of
Transportation (NRDOT) and the Navajo Nation including the requirements of Section (B) thru
(F) below including the following:

1. All underground utility installations (on asphalt or concrete surfaced roads) shall cross the roadways by a boring method with a minimum cover depth of (1) one meter below the lowest ditch line elevation unless otherwise specified in section (E) below; All overhead utilities shall have a minimum of 5.5 meter clearance above the roadway surface.
2. A traffic control plan shall be prepared and submitted for approval as required in Section (C) below. This traffic control plan must be implemented prior to any work performed within the roadway right-of-way and shall meet the requirements of the "Manual on Uniform Traffic Control Devices" (MUTCD), latest edition;

RECEIVED

MAY 29 2015

Fort Defiance Agency
Division of Transportation

RECEIVED

JUL - 6 2015

Navajo Region
Division of Transportation

during utility installations and shall maintain at least one lane of traffic open for the public at all times.

4. All components of the above utility installation shall comply with applicable federal, state, tribal, and other local governing body laws and regulations and industry codes;
5. Any and all damages to the roadway right-of-way and appurtenances shall be repaired and/or replaced to the satisfaction of the (NRDOT) Manager;
6. The applicant shall restore the lands within the roadway right-of-way to its natural conditions including drainage, re-seeding and mulching;
7. Relocate any and all utilities within the roadway right-of-way if the NRDOT Manager determines that the utility crossing will interfere with future roadway construction and maintenance or poses a safety hazard to the traveling public;
8. Construct exposed utility lines, poles, anchors, and facility appurtenances outside the clear recovery zones of the roadway as determined by the NRDOT Manager (*preferably next to the right-of-way lines whenever possible*);
9. All utility lines crossing the roadway shall be installed in a casing pipe per attached details. Casing pipe shall be steel, ductile iron, or reinforced concrete or other approved material. Electrical, cable TV or telephone lines may be encased in non-metallic conduit. High pressure and/or hazardous liquid utility lines may call for additional protection requirements;
10. Mark all utility crossings with approved permanent markers next to the road right-of-way lines;
11. Maintain the utility lines, and all utility appurtenances, at all times so as not to allow a condition to exist which would be a safety hazard to the traveling public and/or maintenance problem to the roadway or associated structures. Promptly repair any damages to the facilities with an emergency traffic control plan implemented in accordance with the procedures outlined in the MUTCD Manual, latest edition. Prior to any utility repairs or maintenance, the utility owner must notify the appropriate Agency DOT Engineer as soon as possible after any emergency is discovered or 3 days in advance of all other routine maintenance work;
12. Upgrading of existing permitted utility lines is allowed provided the utility line does not change location with respect to the roadway. If the utility line is to be moved or the angle of the crossing with respect to the road changes substantially, the utility owner must apply for a new permit crossing;
13. Should at any time in the future the utility line(s), stated herein, no longer are to be used, these line(s) shall be removed or abandoned in place, as directed by the

Agency DOT Engineer. The applicant shall submit a letter, to the NRDOT Agency Road Engineer, requesting that the utility owner/applicant be relieved of the requirements of this permit. The Agency DOT Engineer shall promptly forward with his/her recommendation this request to the NRDOT Manager for action. All overhead lines and poles shall be removed from the roadway rights-of-way limits by the owner/applicant as directed by the NRDOT Manager;

14. On pressure lines, shut-off valves, shall be located at the roadway rights-of-way lines where such utility enters and leaves the roadway rights-of-way.

Section (B): *to be filled out by the Agency DOT Engineer (check all that apply)*

The above utility encroachment(s) shall require the following appurtenances which the applicant agrees to install in accordance with the BIA NRDOT design and construction standards.

The above utility encroachment(s) shall require: / ☒ / construction plans submitted for approval prior to construction; / ☒ / 45.7 meters of casing 203 mm diameter/size (min); / ☒ / manholes, valves, or poles offset 23 meters from roadway shoulder; / ☒ / markers for identification purposes; / ☒ / construct crossing at 90° to the roadway; / ☒ / As-Built drawings in accordance with BIA NRDOT standards. The Applicant shall further comply with the following (please type): No Night Time Work

Section (C): *to be filled out by the NRDOT Manager (check all that apply)*

The above described utilities require (entirely at the applicant's expense) :

- ☒ / complete set of utility crossing drawings reflecting clearances, depth of cover, all pertinent dimensions of proposed facility with respect to the roadway, shoulder ditches, and road rights-of-way lines, structural cover details, etc.
- ☒ / structural analysis
- ☒ / traffic control plan meeting the requirements of the MUTCD
- ☒ / geotechnical analysis & utility installation requirements for special utility installations
- ☒ / archeological & environmental compliance/clearance documents

Any and all analyses shall be performed by registered professionals licensed in the field for which the analysis or documentation is required. The analysis required above shall conform to the BIA NRDOT standards which shall be furnished upon request. The recommendations furnished in the analysis report(s) shall be implemented by the applicant at the time the utility(s) are constructed. **In no case shall the roadway surfacing be structurally less than the adjoining roadway surfacing unless specifically waived or otherwise addressed in Section (E) below when installing utilities in open cut trenches.**

Section (D): *general construction requirements*

The applicant shall (*at his/her entire expense*) install the utility(s) to the lines and grades as shown on attached details or as required in the (*approved*) utility drawings. The work shall conform to the **Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP)**, latest edition, relevant national, state, tribal, or local codes approved by NRDOT office, and the following:

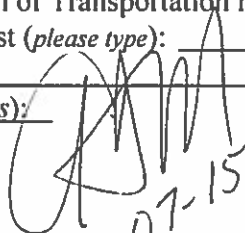
- Open cut trenches through roadways shall be backfilled and compacted as per attached details and the FP, section 209. Boring pits and other excavations shall be backfilled and compacted as per attached details and the FP, section 209 with the compaction being 90% of maximum density.
- The top 152mm (6 inches) of natural ground and subgrade of road crossings shall be scarified, adjusted for optimum moisture and compacted in accordance with applicable provisions of section 204 of the FP. All subgrade construction shall be in accordance with section 204 of the FP.
- If the natural ground underneath the proposed utility crossing under the roadway prism shows unstable material, the area shall be excavated to the depths required and stabilized with structural backfill in accordance with section 704 and/or section 213 of the FP.
- The applicant shall furnish test results, certifications for all materials, and copies of all pertinent inspection records to the Agency Road Engineer to review in the field for acceptance of the work.
- The applicant shall notify the Agency DOT Engineer at least 5 working days prior to start of work and upon completion of work within the BIA right-of-way.
- The applicant shall be responsible for developing and implementing a Traffic Control Plan that meets the requirements of the MUTCD (*latest edition with supplements*) and properly maintain this plan for all work within the BIA road right-of-way.
- Any buried non-metallic utility lines shall have a metallic tape or other approved method of effectively locating the lines.

The applicant shall further comply with the following (*please type*): _____

Section (E): *to be filled in by NRDOT Manager*

The Regional Division of Transportation hereby grants the following exception(s) to this utility crossing permit request (*please type*): _____

NRDOT Mgr (initials): _____


7-07-15

Section (F): approvals

This permit is hereby issued to the foregoing applicant for the expressed purpose set forth in this application and upon expressed condition that every requirement herein is faithfully performed and all the work to be performed in accordance with the plans, specifications, and requirements stipulated herein.

This permit shall have a term of perpetuity from the date approved below or unless item (13) of Section (A) is executed. This permit shall be canceled if installation within the road right-of-way is not completed by August 2016. The permit is transferrable and enforceable to all future owners/heirs/ successors of the utility described above.

Signed:

Recommend for Approval:

Navajo Tribal Utility Authority

Name of utility owner (print)

 4/8/15
Applicant (owner) signature Date

 7/6/2015
Agency Road Engineer Date

Deputy General Manager

Applicant Title

Concurred by:

Approved By:

 7/8/15
Regional NRDOT Manager Date

 7-9-15
Acting Navajo Regional Director Date

AGENCY	AGENCY ROAD ENGINEER	AGENCY MTN. SUPV.
2N370-SHIPROCK AGENCY Division of Transportation P. O. Box 3538 Shiprock, NM 87420	Norman R. Yazzie 505/368-3347 Secretary-Esther Lewis -3341 FAX No. 505/368-3348	VACANT 505/368-3360
3N370-WESTERN NAVAJO Division of Transportation P.O. Box 127 Tuba City, AZ 86045	Roland G. Becenti 928/283-2298 Clerk-Alberta M. - 2297 FAX No. 928/283-2227	VACANT 928/283-2299 FAX No. 928/283-4658
4N370-EASTERN NAVAJO Division of Transportation P.O. Box 328 Crownpoint, NM 87313	Barry Lytle 505/786-6039 Secretary- VACANT - 6183 FAX No. 505/786-6111	Aaron Jim (Acting) 505/786-6181
5N370-CHINLE AGENCY Division of Transportation P.O. Box 7-H Chinle, AZ 86503	Garret Silversmith 928/674-5176 Secretary- VACANT - 5175 FAX No. 928/674-5184	Clyde Yellowhair (Acting) 928/674-5170 Clerk- VACANT -5171
6N370-FT. DEFIANCE AGENCY Division of Transportation P.O. Box 619 Ft. Defiance, AZ 86504	Calvin Castillo 928/729-7222 Secretary- VACANT - 7221 FAX No. 928/729-7225	Franklin Sandoval 928/729-7332 Clerk-Kathy F. -7334
N370F-FARMINGTON SECTION Division of Transportation P.O. Box 2206 Farmington, NM 87499	VACANT 505/325-8806/8807 Secretary-VACANT FAX No. 505/325-4620	Supervisor - VACANT 505/327-2783

NAVAJO REGIONAL OFFICE

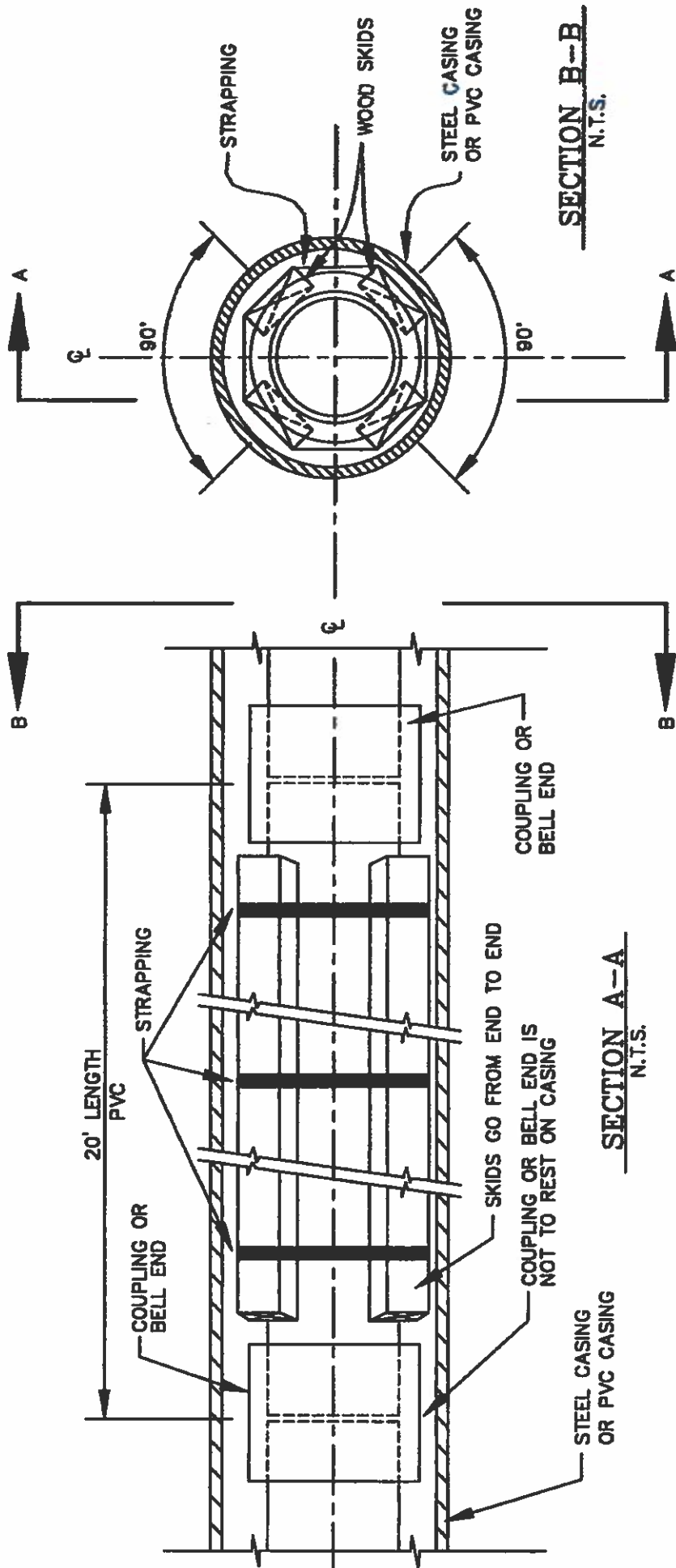
Division of Transportation

P.O. Box 1060

Gallup, NM 87305

505/863-8281

FAX No. 505/863-8355



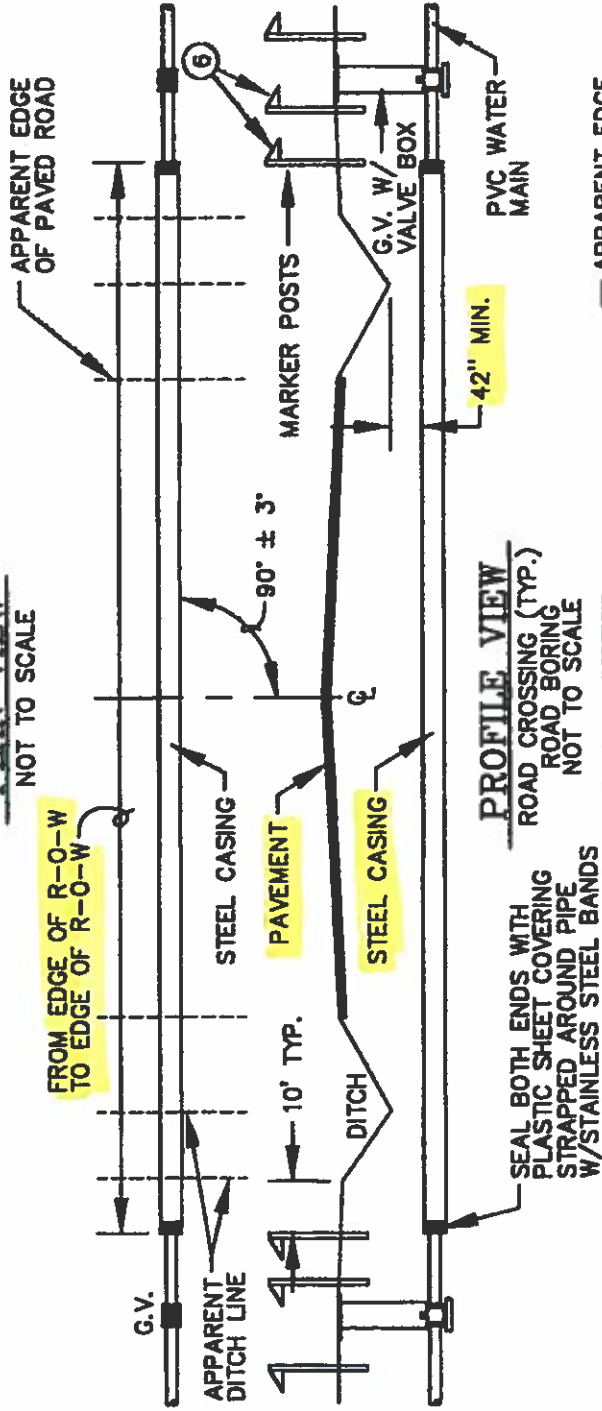
INSTALLATION OF PVC PIPE IN CASING N.T.S.

FOR CASING SIZES, REFER TO THE FOLLOWING TABLE						
PIPE SIZE:	2"	4"	6"	8"	10"	12"
CASING SIZE:	8"	8"	12"	14"	14"	20"

- NOTES: 1. SEAL ENDS OF CASING.
2. AT MINIMUM, STRAP AT BOTH ENDS AND MIDDLE OF EACH JOINT OF PIPE.
3. ROAD BORING BY NECA IS 8" OR 14".

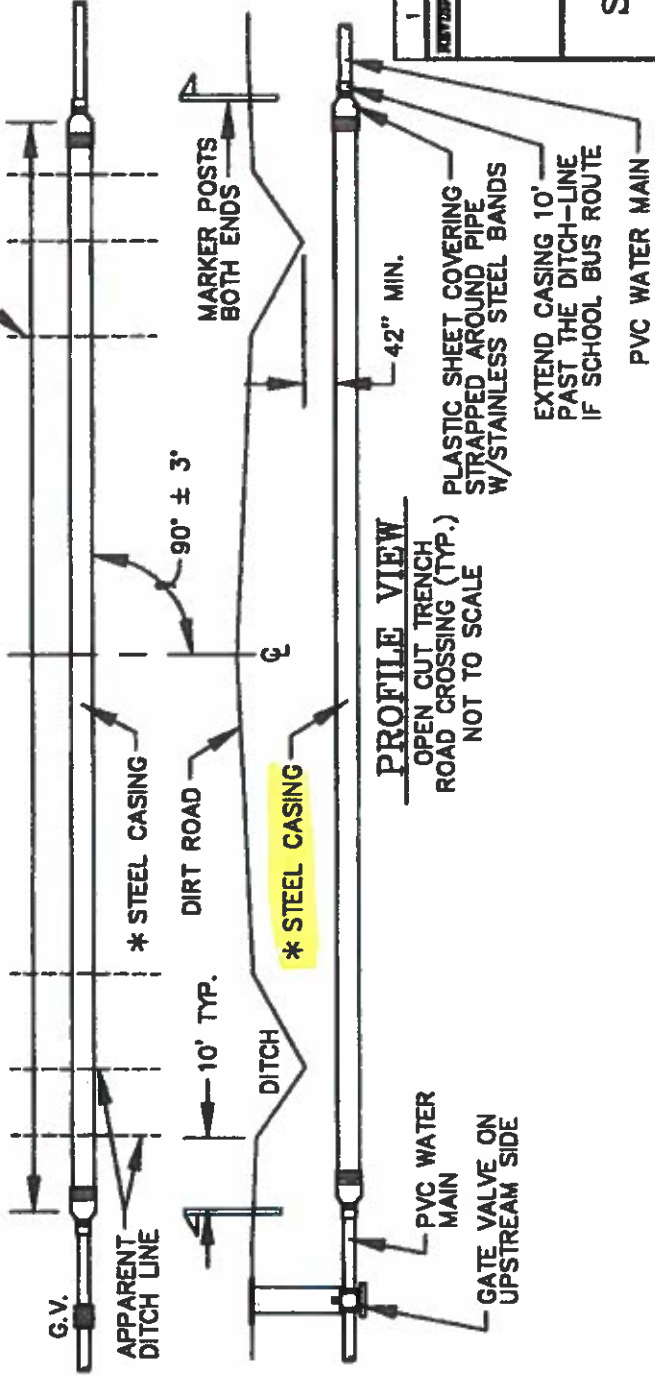
1	7/96	STANDARD	B.L.
REVISION	DATE	BY	BY
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE INDIAN HEALTH SERVICE NAVAJO NATION NAVAJO NATION, STANDARD DRAWING NO. W-24 INSTALLATION OF PVC PIPE IN CASING			
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA DRAWN BY: L.S. CHECKED BY: P.S. APPR. BY: B.H. APPROVED			

PLAN VIEW NOT TO SCALE



PROFILE VIEW ROAD CROSSING (TYP.) ROAD BORING NOT TO SCALE

PLAN VIEW NOT TO SCALE



PROFILE VIEW OPEN CUT TRENCH ROAD CROSSING (TYP.) NOT TO SCALE

NOTES:

1. SEE GATE VALVE & TEE THRUST BLOCK DETAIL W-16 & W-11.
2. BACKFILL SHALL BE COMPACTED TO 95% OF STANDARD PROCTOR DENSITY IN 6-INCH LIFTS.
3. ROAD CROSINGS UNDER PAVEMENT SHALL BE BORED BY MACHINE AND REMAINDER OPEN CUT.
4. SEE DETAIL W-24 FOR PVC PIPE SKID INFORMATION.
5. THE LIMIT OF CASING FOR ROADS THAT HAVE ROW MUST BE ROW TO ROW UNLESS PERMISSION FOR LESS CASING IS GRANTED.
6. INSTALL 1 MARKER AT END OF CASING AND 2 FOR GATE VALVES.

* CONDITIONS:

1. FOR BIA MAINTAINED DIRT SCHOOL BUS ROUTES METAL CONDUIT MUST BE INSTALLED. EITHER STEEL CASING, CORRUGATED GALVANIZED STEEL CASING, OR DUCTILE IRON PIPE IS APPROPRIATE.
2. FOR BIA GRAVEL ROADS WITH FORMAL RIGHTS-OF-WAY ONLY STEEL OR CORRUGATED GALVANIZED STEEL CASING IS ALLOWED.
3. FOR COUNTY ROADS CASINGS SHALL ADHERE TO SPECIFIC COUNTY REQUIREMENTS.

REVISION	DATE	STANDARDIZED	BY	DATE
1	7/96	8/97		

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE
NAVAJO NATION
NAVAJO NATION,
NAVAJO NATION,

STANDARD DRAWING NO. W-35 ROAD CROSSING DETAILS

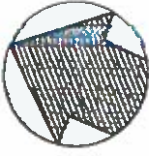
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING
NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA

DRAWN BY: L.S. | CHECKED BY: P.S. | APPR. BY: P.S. | AUTOCAD

Water Line Crossing #1

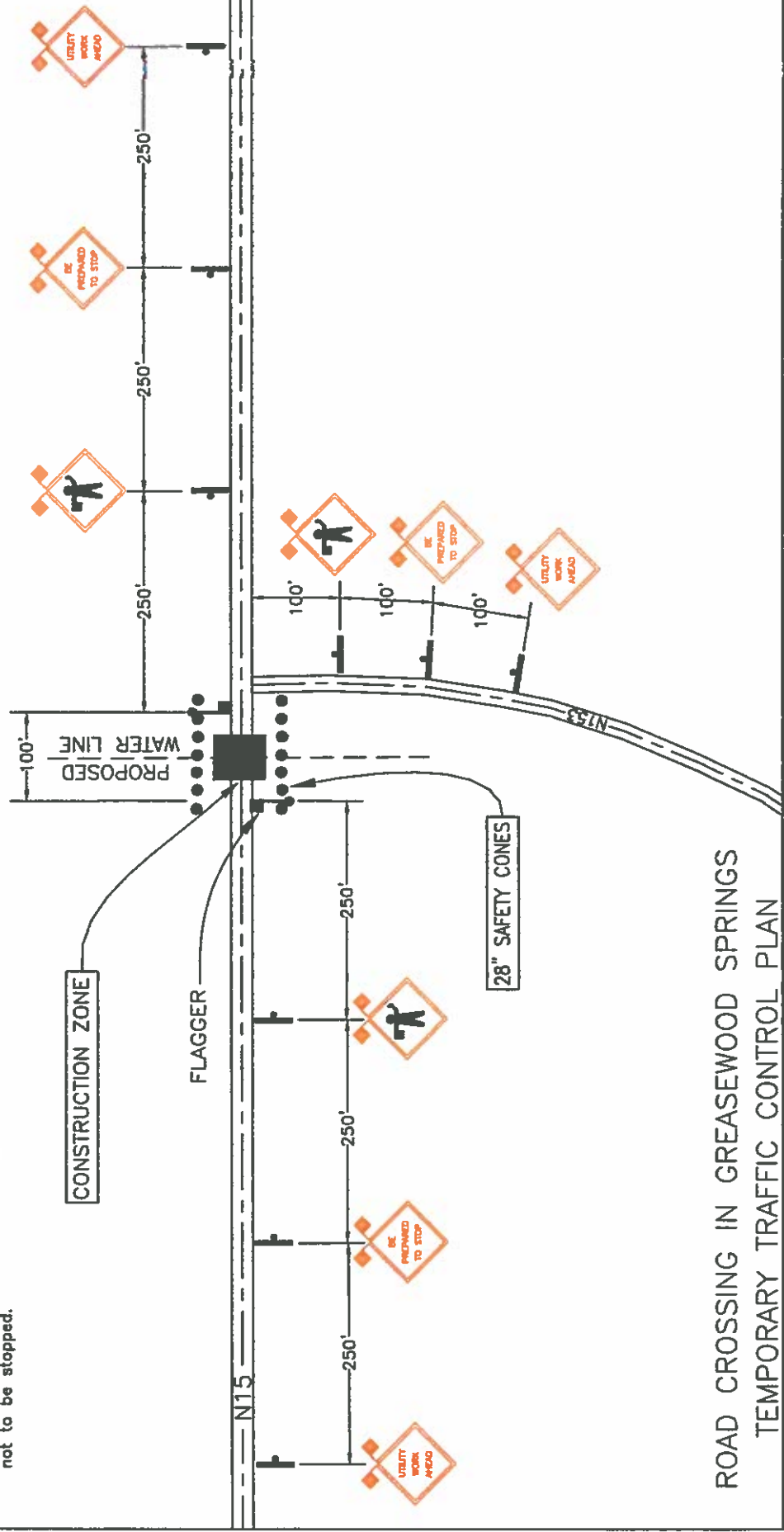
BIA Route N15

n.t.s.

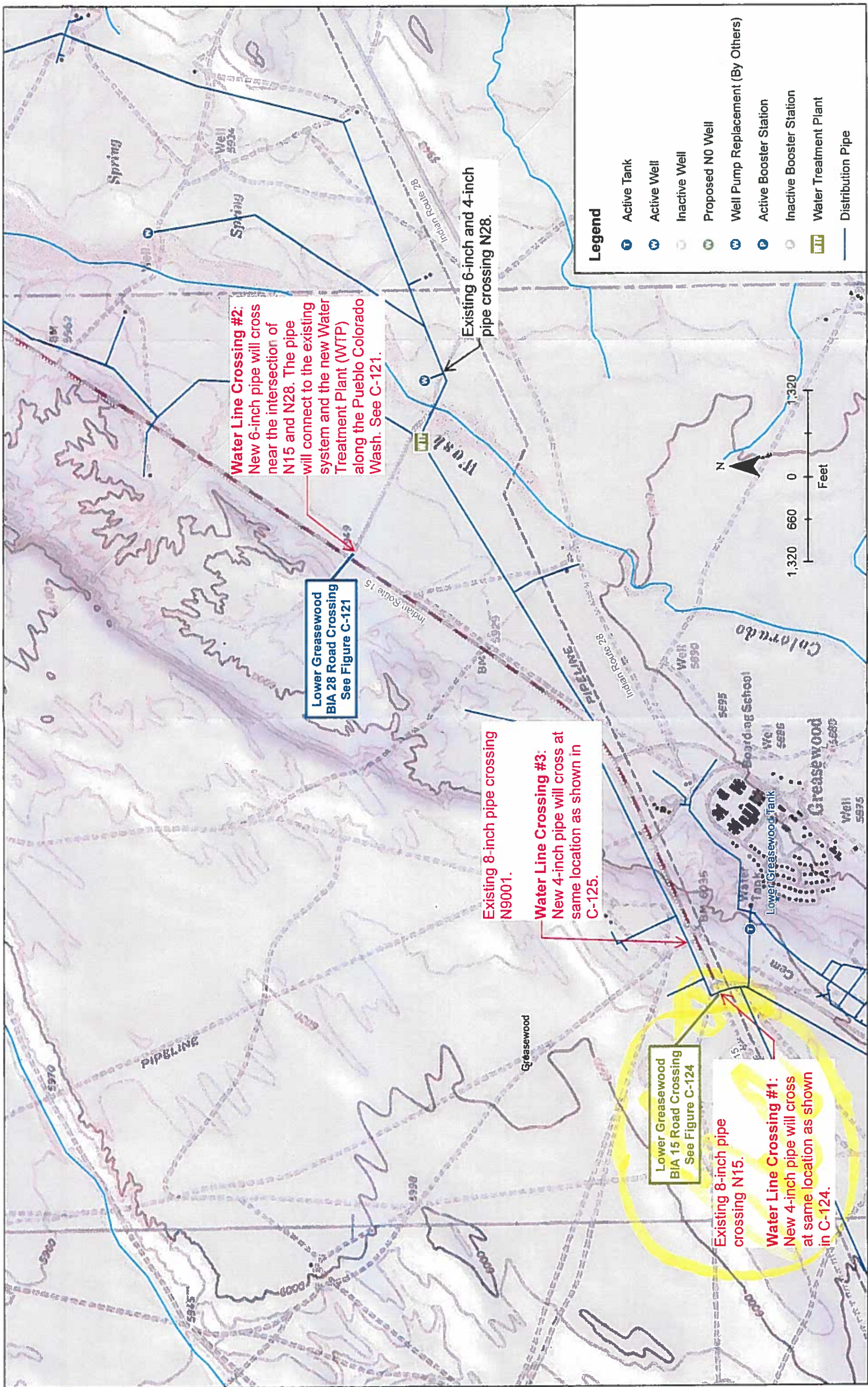


NOTES:

- All traffic control signs will be re-moved at the end of the working day.
- No work during night time hours.
- The Applicant's responsible for any needed construction easements outside the BIA N15 maintenance corridor.
- Traffic won't be stopped for more than ten minutes. Emergency vehicles not to be stopped.



ROAD CROSSING IN GREASEWOOD SPRINGS
TEMPORARY TRAFFIC CONTROL PLAN



Brown AND Caldwell

**Lower Greasewood Water Supply Improvement Project:
Preliminary Design Report**

Figure 1-1. Project Area, Lower Greasewood

-

-





United States Department of the Interior
Bureau of Indian Affairs
Navajo Regional Office Division of Transportation

Application for Permission for Utility crossing within BIA Right-of-Way
(Authorization: 23 USC Part 123, 23 CFR Part 645 Subpart A & B, 25 CFR Part 170)
Rev:05/15/2012

Background: to be filled out by Agency DOT Office

Agency: FORT DEFENCE
Route No: N28

Date: 07/13/2015

Permit No: 6N370-2015-28-995
(Assigned by Regional DOT Office)

Project No: _____
(Assigned by Regional DOT Office)

Section (A): to be filled out by applicant ROAD CROSSING #2

APPLICATION is hereby made by Navajo Tribal Utility Authority, address: _____
P.O. Box 170, Ft. Defiance, Arizona 86504 Phone: (800) 528-5011 to
construct utility crossing(s) at the following location(s) Cornfields and Lower Greasewood, Arizona
(Attach location map) adjacent to or crossing BIA Route: BIA Route N28
Station/Mile Post: 105 ft SW from N28 + N15 Jct. Street: _____
for the purpose of (supplying service to): / / residence / X / Business: NTUA Water Line
/ / School: _____ / / Other: _____

. The utility shall be constructed by the applicant on or by (date) August 2015 and shall
take 365 calendar days to complete (attach appropriate engineering sketches of
each utility location). The applicant further agrees (at their entire expense) to comply with all the
conditions, restrictions, and regulations of both the BIA Navajo Regional Division of
Transportation (NRDOT) and the Navajo Nation including the requirements of Section (B) thru
(F) below including the following:

1. All underground utility installations (on asphalt or concrete surfaced roads) shall cross the roadways by a boring method with a minimum cover depth of (1) one meter below the lowest ditch line elevation unless otherwise specified in section (E) below; All overhead utilities shall have a minimum of 5.5 meter clearance above the roadway surface.
2. A traffic control plan shall be prepared and submitted for approval as required in Section (C) below. This traffic control plan must be implemented prior to any work performed within the roadway right-of-way and shall meet the requirements of the "Manual on Uniform Traffic Control Devices" (MUTCD), latest edition;

RECEIVED

MAY 29 2015

Defiance Agency
Division of Transportation

RECEIVED

JUL - 6 2015

Navajo Region
Division of Transportation

The Utility Owner accepts full responsibility for the safety of the traveling public

during utility installations and shall maintain at least one lane of traffic open for the public at all times.

4. All components of the above utility installation shall comply with applicable federal, state, tribal, and other local governing body laws and regulations and industry codes;
5. Any and all damages to the roadway right-of-way and appurtenances shall be repaired and/or replaced to the satisfaction of the (NRDOT) Manager;
6. The applicant shall restore the lands within the roadway right-of-way to its natural conditions including drainage, re-seeding and mulching;
7. Relocate any and all utilities within the roadway right-of-way if the NRDOT Manager determines that the utility crossing will interfere with future roadway construction and maintenance or poses a safety hazard to the traveling public;
8. Construct exposed utility lines, poles, anchors, and facility appurtenances outside the clear recovery zones of the roadway as determined by the NRDOT Manager (*preferably next to the right-of-way lines whenever possible*);
9. All utility lines crossing the roadway shall be installed in a casing pipe per attached details. Casing pipe shall be steel, ductile iron, or reinforced concrete or other approved material. Electrical, cable TV or telephone lines may be encased in non-metallic conduit. High pressure and/or hazardous liquid utility lines may call for additional protection requirements;
10. Mark all utility crossings with approved permanent markers next to the road right-of-way lines;
11. Maintain the utility lines, and all utility appurtenances, at all times so as not to allow a condition to exist which would be a safety hazard to the traveling public and/or maintenance problem to the roadway or associated structures. Promptly repair any damages to the facilities with an emergency traffic control plan implemented in accordance with the procedures outlined in the MUTCD Manual, latest edition. Prior to any utility repairs or maintenance, the utility owner must notify the appropriate Agency DOT Engineer as soon as possible after any emergency is discovered or 3 days in advance of all other routine maintenance work;
12. Upgrading of existing permitted utility lines is allowed provided the utility line does not change location with respect to the roadway. If the utility line is to be moved or the angle of the crossing with respect to the road changes substantially, the utility owner must apply for a new permit crossing;
13. Should at any time in the future the utility line(s), stated herein, no longer are to be used, these line(s) shall be removed or abandoned in place, as directed by the

Agency DOT Engineer. The applicant shall submit a letter, to the NRDOT Agency Road Engineer, requesting that the utility owner/applicant be relieved of the requirements of this permit. The Agency DOT Engineer shall promptly forward with his/her recommendation this request to the NRDOT Manager for action. All overhead lines and poles shall be removed from the roadway rights-of-way limits by the owner/applicant as directed by the NRDOT Manager;

14. On pressure lines, shut-off valves, shall be located at the roadway rights-of-way lines where such utility enters and leaves the roadway rights-of-way.

Section (B): *to be filled out by the Agency DOT Engineer (check all that apply)*

The above utility encroachment(s) shall require the following appurtenances which the applicant agrees to install in accordance with the BIA NRDOT design and construction standards.

The above utility encroachment(s) shall require: / ☒ / construction plans submitted for approval prior to construction; / ☒ / 30.5 meters of casing 203 mm diameter/size (min); / ☒ / manholes, valves, or poles offset 15.24 meters from roadway shoulder; / ☒ / markers for identification purposes; / ☒ / construct crossing at 90° to the roadway; / ☒ / As-Built drawings in accordance with BIA NRDOT standards. The Applicant shall further comply with the following (please type): No Night Time Work

Section (C): *to be filled out by the NRDOT Manager (check all that apply)*

The above described utilities require (entirely at the applicant's expense) :

- / ☒ / complete set of utility crossing drawings reflecting clearances, depth of cover, all pertinent dimensions of proposed facility with respect to the roadway, shoulder ditches, and road rights-of-way lines, structural cover details, etc.
- / ☒ / structural analysis
- / ☒ / traffic control plan meeting the requirements of the MUTCD
- / ☒ / geotechnical analysis & utility installation requirements for special utility installations
- / ☒ / archeological & environmental compliance/clearance documents

Any and all analyses shall be performed by registered professionals licensed in the field for which the analysis or documentation is required. The analysis required above shall conform to the BIA NRDOT standards which shall be furnished upon request. The recommendations furnished in the analysis report(s) shall be implemented by the applicant at the time the utility(s) are constructed. **In no case shall the roadway surfacing be structurally less than the adjoining roadway surfacing unless specifically waived or otherwise addressed in Section (E) below when installing utilities in open cut trenches.**

Section (D): *general construction requirements*

The applicant shall (*at his/her entire expense*) install the utility(s) to the lines and grades as shown on attached details or as required in the (*approved*) utility drawings. The work shall conform to the **Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP)**, latest edition, relevant national, state, tribal, or local codes approved by NRDOT office, and the following:

- Open cut trenches through roadways shall be backfilled and compacted as per attached details and the FP, section 209. Boring pits and other excavations shall be backfilled and compacted as per attached details and the FP, section 209 with the compaction being 90% of maximum density.
- The top 152mm (6 inches) of natural ground and subgrade of road crossings shall be scarified, adjusted for optimum moisture and compacted in accordance with applicable provisions of section 204 of the FP. All subgrade construction shall be in accordance with section 204 of the FP.
- If the natural ground underneath the proposed utility crossing under the roadway prism shows unstable material, the area shall be excavated to the depths required and stabilized with structural backfill in accordance with section 704 and/or section 213 of the FP.
- The applicant shall furnish test results, certifications for all materials, and copies of all pertinent inspection records to the Agency Road Engineer to review in the field for acceptance of the work.
- The applicant shall notify the Agency DOT Engineer at least 5 working days prior to start of work and upon completion of work within the BIA right-of-way.
- The applicant shall be responsible for developing and implementing a Traffic Control Plan that meets the requirements of the MUTCD (*latest edition with supplements*) and properly maintain this plan for all work within the BIA road right-of-way.
- Any buried non-metallic utility lines shall have a metallic tape or other approved method of effectively locating the lines.

The applicant shall further comply with the following (*please type*): _____

Section (E): *to be filled in by NRDOT Manager*

The Regional Division of Transportation hereby grants the following exception(s) to this utility crossing permit request (*please type*): _____

NRDOT Mgr (initials): _____

[Handwritten signature and date 7-07-13]

Section (F): approvals

This permit is hereby issued to the foregoing applicant for the expressed purpose set forth in this application and upon expressed condition that every requirement herein is faithfully performed and all the work to be performed in accordance with the plans, specifications, and requirements stipulated herein.

This permit shall have a term of perpetuity from the date approved below or unless item (13) of Section (A) is executed. This permit shall be canceled if installation within the road right-of-way is not completed by August 2016. The permit is transferrable and enforceable to all future owners/heirs/ successors of the utility described above.

Signed:

Recommend for Approval:

Navajo Tribal Utility Authority

Name of utility owner (print)

Max P. [Signature] 7/8/15 [Signature] 7/6/2015
Applicant (owner) signature Date Agency Road Engineer Date

Deputy General Manager

Applicant Title

Concurred by:

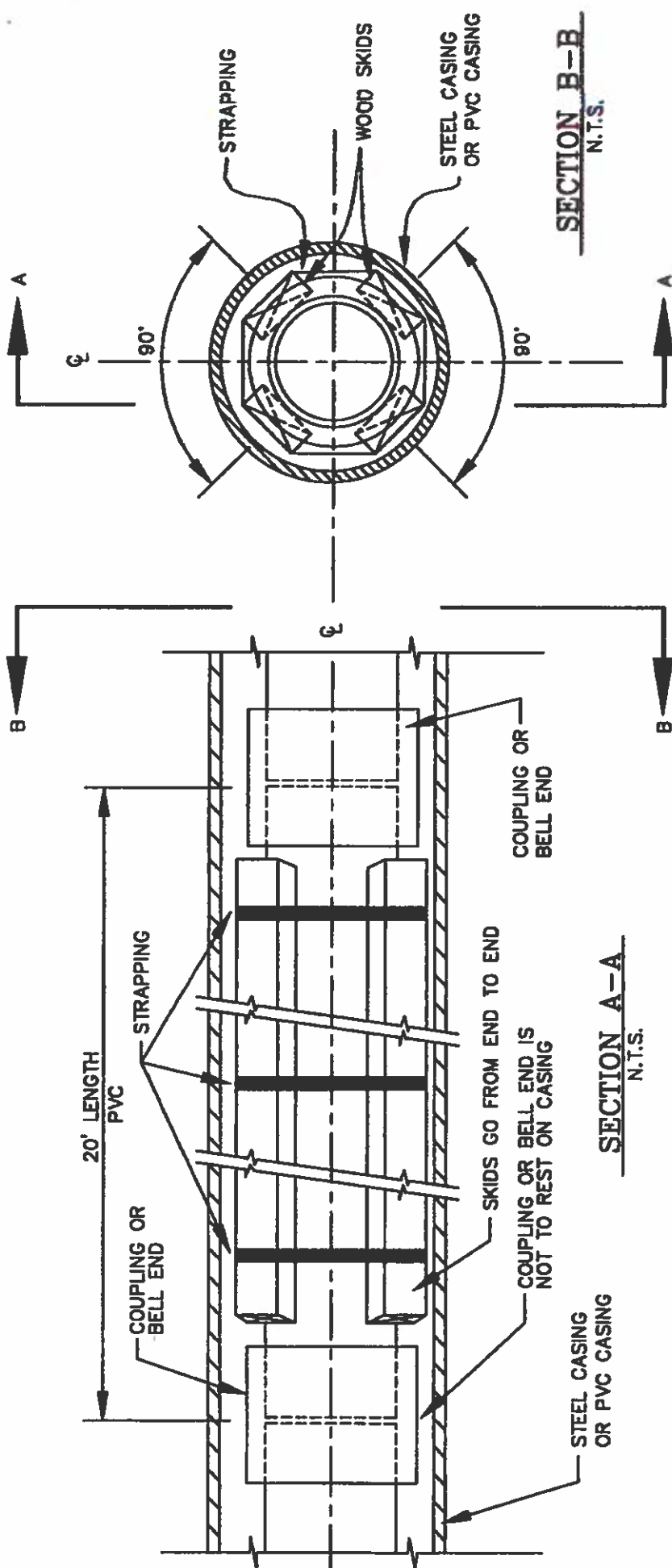
Approved By:

[Signature] 7/8/15 10/2/15 7-9-15
Regional NRDOT Manager Date Acting Navajo Regional Director Date

AGENCY	AGENCY ROAD ENGINEER	AGENCY MTN. SUPV.
2N370-SHIPROCK AGENCY Division of Transportation P. O. Box 3538 Shiprock, NM 87420	Norman R. Yazzie 505/368-3347 Secretary-Esther Lewis -3341 FAX No. 505/368-3348	VACANT 505/368-3360
3N370-WESTERN NAVAJO Division of Transportation P.O. Box 127 Tuba City, AZ 86045	Roland G. Becenti 928/283-2298 Clerk-Alberta M. - 2297 FAX No. 928/283-2227	VACANT 928/283-2299 FAX No. 928/283-4658
4N370-EASTERN NAVAJO Division of Transportation P.O. Box 328 Crownpoint, NM 87313	Barry Lytle 505/786-6039 Secretary- VACANT - 6183 FAX No. 505/786-6111	Aaron Jim (Acting) 505/786-6181
5N370-CHINLE AGENCY Division of Transportation P.O. Box 7-H Chinle, AZ 86503	Garret Silversmith 928/674-5176 Secretary- VACANT - 5175 FAX No. 928/674-5184	Clyde Yellowhair (Acting) 928/674-5170 Clerk- VACANT -5171
6N370-FT. DEFIANCE AGENCY Division of Transportation P.O. Box 619 Ft. Defiance, AZ 86504	Calvin Castillo 928/729-7222 Secretary- VACANT - 7221 FAX No. 928/729-7225	Franklin Sandoval 928/729-7332 Clerk-Kathy F. -7334
N370F-FARMINGTON SECTION Division of Transportation P.O. Box 2206 Farmington, NM 87499	VACANT 505/325-8806/8807 Secretary-VACANT FAX No. 505/325-4620	Supervisor - VACANT 505/327-2783

NAVAJO REGIONAL OFFICE

Division of Transportation
P.O. Box 1060
Gallup, NM 87305
505/863-8281
FAX No. 505/863-8355



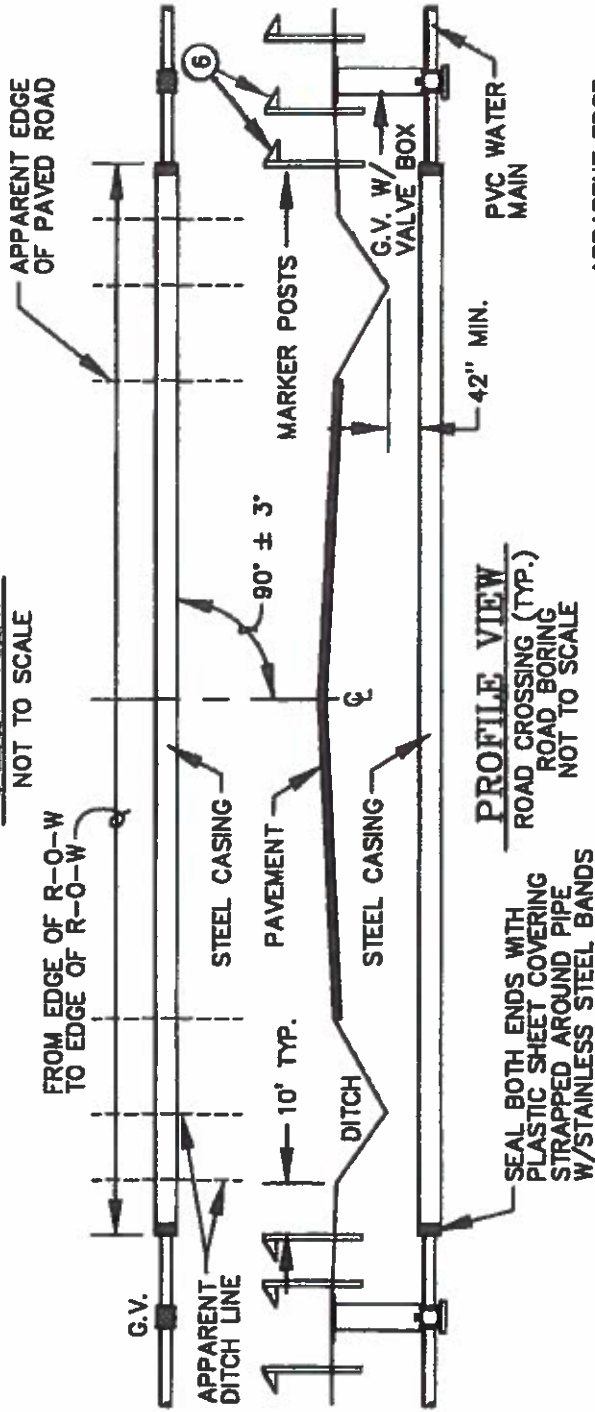
INSTALLATION OF PVC PIPE IN CASING N.T.S.

FOR CASING SIZES, REFER TO THE FOLLOWING TABLE						
PIPE SIZE:	2"	4"	6"	8"	10"	12"
CASING SIZE:	8"	8"	12"	14"	14"	20"

- NOTES: 1. SEAL ENDS OF CASING.
 2. AT MINIMUM, STRAP AT BOTH ENDS AND MIDDLE OF EACH JOINT OF PIPE.
 3. ROAD BORING BY NECA IS 8" OR 14".

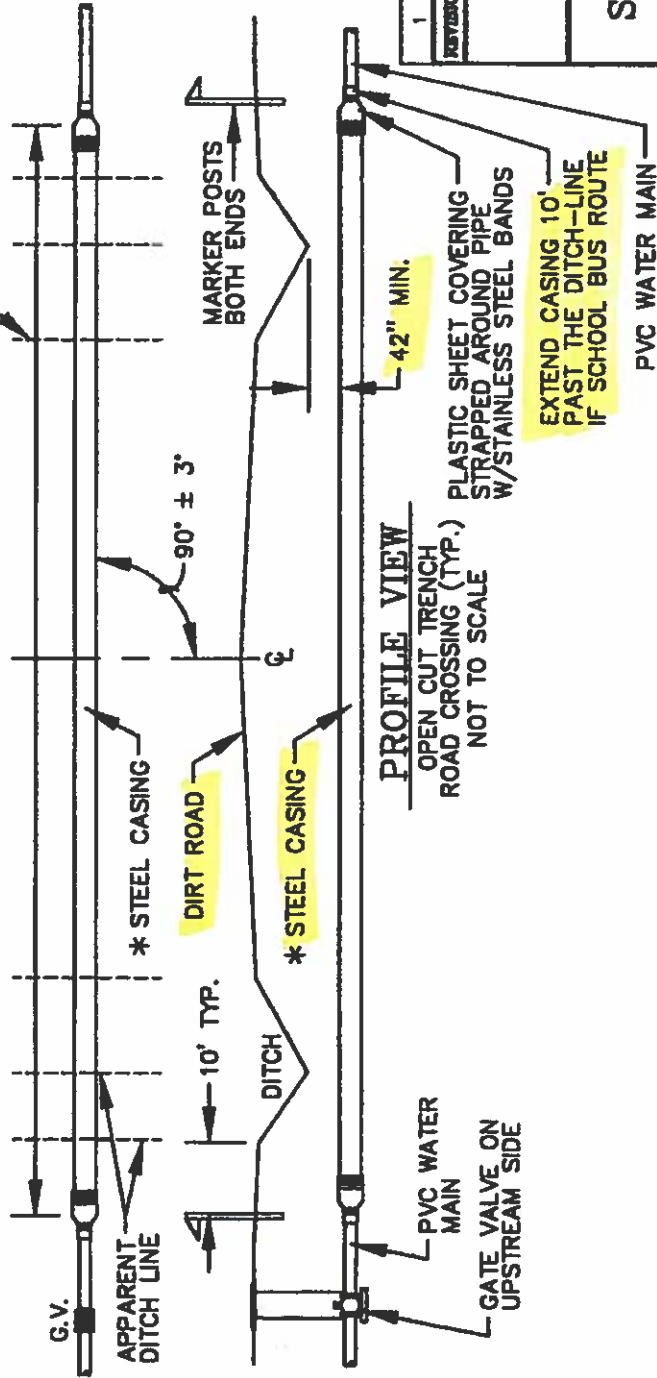
1	7/98	STANDARD	S.U.
REVISION	DATE	REMARK	BY
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES PUBLIC HEALTH SERVICE INDIAN HEALTH SERVICE NAVAJO NATION NAVAJO NATION,			
STANDARD DRAWING NO. W-24 INSTALLATION OF PVC PIPE IN CASING			
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA			
DRAWN BY: L.S. CHECKED BY: P.S. APPR. BY: B.H. APPROVED			

PLAN VIEW NOT TO SCALE



PROFILE VIEW ROAD CROSSING (TYP.) ROAD BORING NOT TO SCALE

PLAN VIEW NOT TO SCALE



PROFILE VIEW OPEN CUT TRENCH ROAD CROSSING (TYP.) NOT TO SCALE

NOTES:

1. SEE GATE VALVE & TEE THRU BLOCK DETAIL W-16 & W-11.
2. BACKFILL SHALL BE COMPACTED TO 95% OF STANDARD PROCTOR DENSITY IN 6-INCH LIFTS.
3. ROAD CROSINGS UNDER PAVEMENT SHALL BE BORED BY MACHINE AND REMAINDER OPEN CUT.
4. SEE DETAIL W-24 FOR PVC PIPE SKID INFORMATION.
5. THE LIMIT OF CASING FOR ROADS THAT HAVE ROW MUST BE ROW TO ROW UNLESS PERMISSION FOR LESS CASING IS GRANTED.
6. INSTALL 1 MARKER AT END OF CASING AND 2 FOR GATE VALVES.

* CONDITIONS:

1. FOR BIA MAINTAINED DIRT SCHOOL BUS ROUTES METAL CONDUIT MUST BE INSTALLED. EITHER STEEL CASING, CORRUGATED GALVANIZED STEEL CASING, OR DUCTILE IRON PIPE IS APPROPRIATE.
2. FOR BIA GRAVEL ROADS WITH FORMAL RIGHTS-OF-WAY ONLY STEEL OR CORRUGATED GALVANIZED STEEL CASING IS ALLOWED.
3. FOR COUNTY ROADS CASINGS SHALL ADHERE TO SPECIFIC COUNTY REQUIREMENTS.

REVISION	DATE	STANDARD	BY	IT
1	7/96			

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE
NAVAJO NATION

NAVAJO NATION,

STANDARD DRAWING NO. W-35 ROAD CROSSING DETAILS

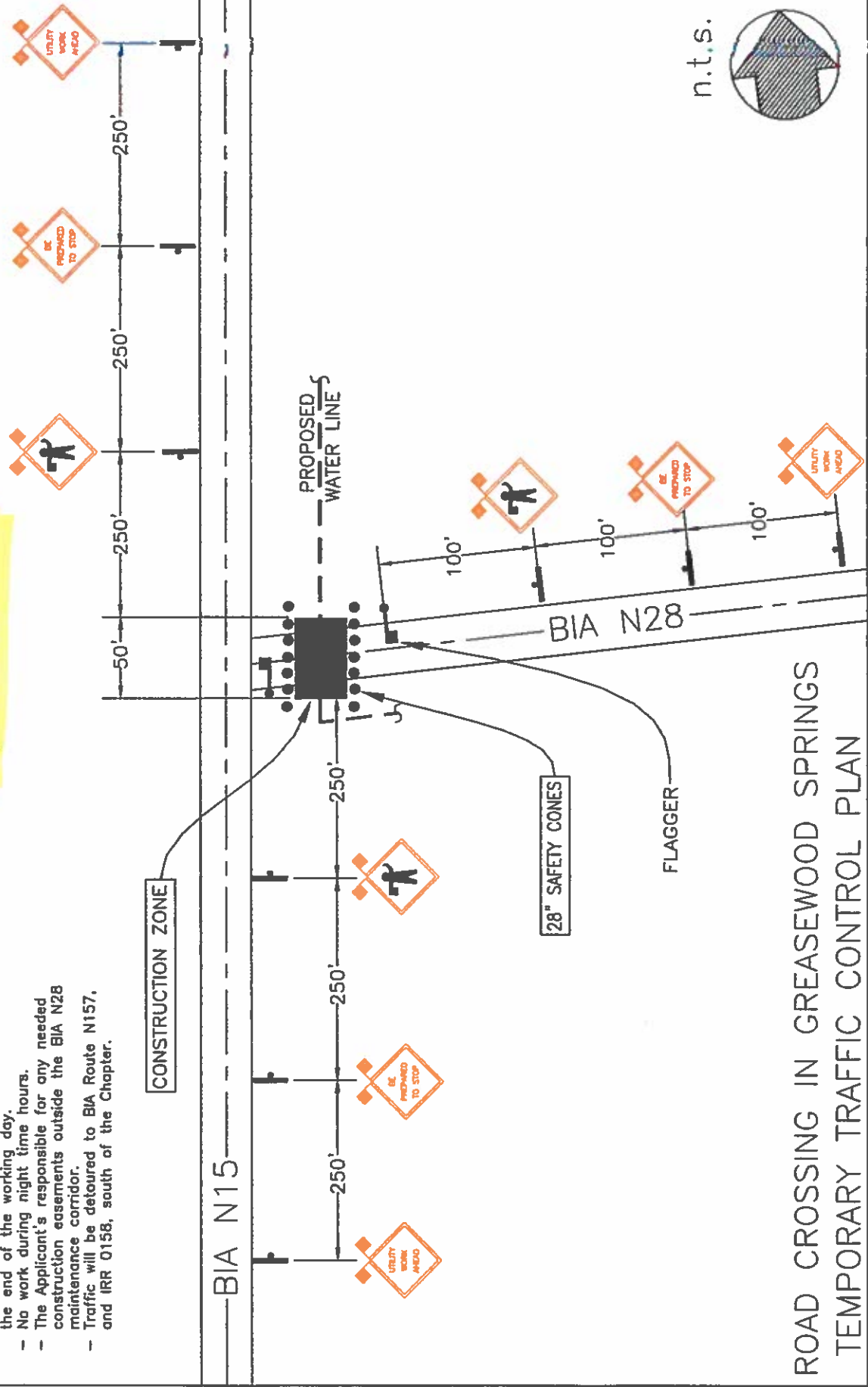
OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING
NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA
DRAWN BY: L.S. | CHECKED BY: P.S. | APPR. BY: P.S. | AUTOCAD

NOTES:

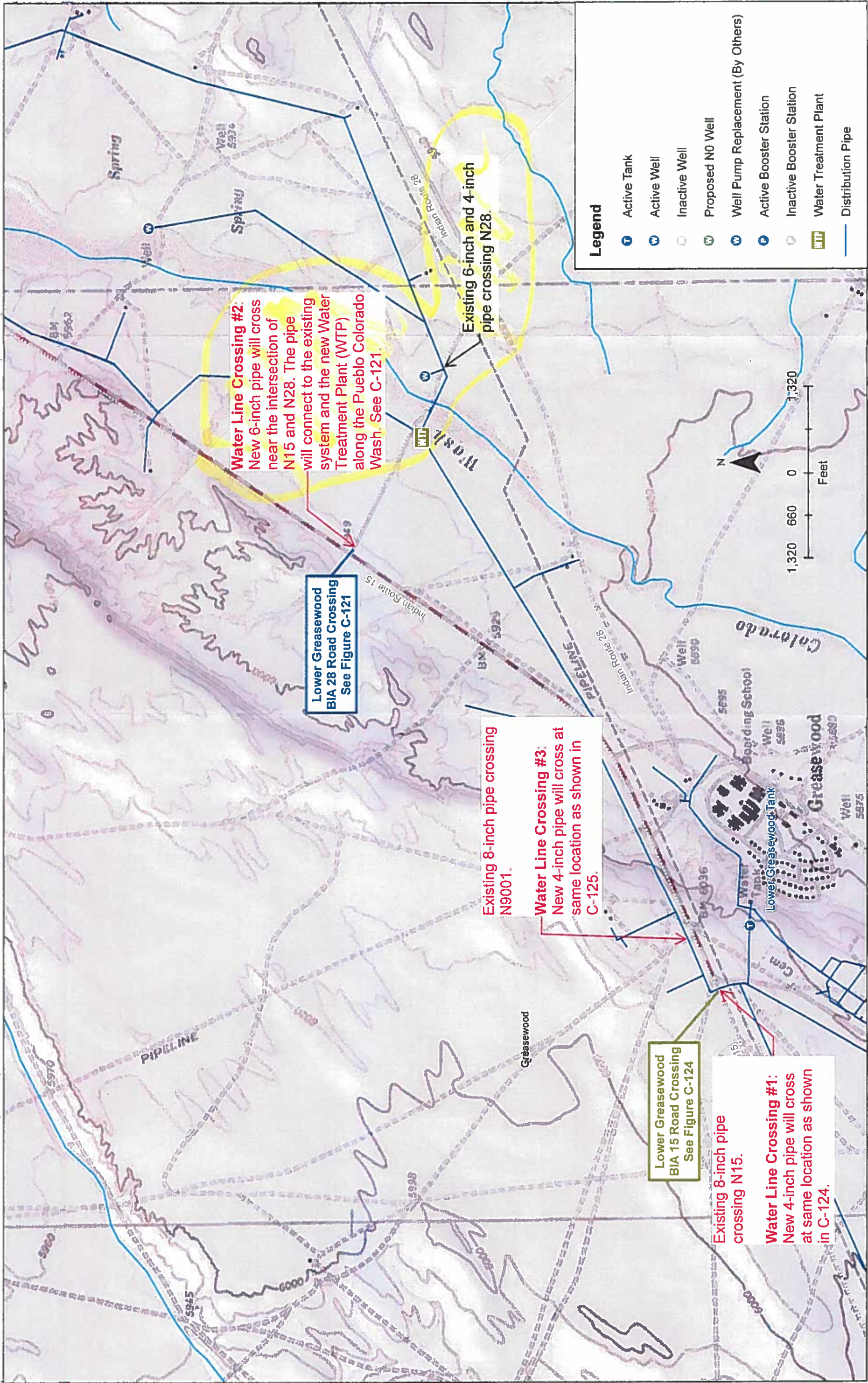
- All traffic control signs will be removed at the end of the working day.
- No work during night time hours.
- The Applicant's responsible for any needed construction easements outside the BIA N28 maintenance corridor.
- Traffic will be detoured to BIA Route N157, and IRR 0158, south of the Chapter.

Utility Crossing #2

BIA Route N28



ROAD CROSSING IN GREASEWOOD SPRINGS TEMPORARY TRAFFIC CONTROL PLAN





United States Department of the Interior
Bureau of Indian Affairs
Navajo Regional Office Division of Transportation

Application for Permission for Utility crossing within BIA Right-of-Way
(Authorization: 23 USC Part 123, 23 CFR Part 645 Subpart A & B, 25 CFR Part 170)
Rev:05/15/2012

Background: to be filled out by Agency DOT Office

Agency: FORT DEFENCE
Route No: N9001

Date: 07/13/2015

Permit No: 6N370-2015-9001-996
(Assigned by Regional DOT Office)

Project No: _____
(Assigned by Regional DOT Office)

Section (A): to be filled out by applicant ROAD CROSSING #3

APPLICATION is hereby made by Navajo Tribal Utility Authority, address: _____
P.O. Box 170, Ft. Defiance, Arizona 86504 Phone: (800) 528-5011 to
construct utility crossing(s) at the following location(s) Cornfields and Lower Greasewood, Arizona
(Attach location map) adjacent to or crossing BIA Route: BIA Route N9001 ✓
Station/Mile Post: 88.6 ft Northwest N15/N9001 Street: _____
for the purpose of (supplying service to): / / residence / X / Business: NTUA Water Line
/ / School: _____ / / Other: _____

. The utility shall be constructed by the applicant on or by (date) August 2015 and shall
take 365 calendar days to complete (attach appropriate engineering sketches of
each utility location). The applicant further agrees (at their entire expense) to comply with all the
conditions, restrictions, and regulations of both the BIA Navajo Regional Division of
Transportation (NRDOT) and the Navajo Nation including the requirements of Section (B) thru
(F) below including the following:

1. All underground utility installations (on asphalt or concrete surfaced roads) shall cross the roadways by a boring method with a minimum cover depth of (1) one meter below the lowest ditch line elevation unless otherwise specified in section (E) below; All overhead utilities shall have a minimum of 5.5 meter clearance above the roadway surface.
2. A traffic control plan shall be prepared and submitted for approval as required in Section (C) below. This traffic control plan must be implemented prior to any work performed within the roadway right-of-way and shall meet the requirements of the "Manual on Uniform Traffic Control Devices" (MUTCD), latest edition;
3. The Utility Owner accepts full responsibility for the safety of the traveling public

RECEIVED

MAY 29 2015

Defiance Ag: 7
Division of Transportation

RECEIVED

JUL - 6 2015

Navajo Region
Division of Transportation

during utility installations and shall maintain at least one lane of traffic open for the public at all times.

4. All components of the above utility installation shall comply with applicable federal, state, tribal, and other local governing body laws and regulations and industry codes;
5. Any and all damages to the roadway right-of-way and appurtenances shall be repaired and/or replaced to the satisfaction of the (NRDOT) Manager;
6. The applicant shall restore the lands within the roadway right-of-way to its natural conditions including drainage, re-seeding and mulching;
7. Relocate any and all utilities within the roadway right-of-way if the NRDOT Manager determines that the utility crossing will interfere with future roadway construction and maintenance or poses a safety hazard to the traveling public;
8. Construct exposed utility lines, poles, anchors, and facility appurtenances outside the clear recovery zones of the roadway as determined by the NRDOT Manager (*preferably next to the right-of-way lines whenever possible*);
9. All utility lines crossing the roadway shall be installed in a casing pipe per attached details. Casing pipe shall be steel, ductile iron, or reinforced concrete or other approved material. Electrical, cable TV or telephone lines may be encased in non-metallic conduit. High pressure and/or hazardous liquid utility lines may call for additional protection requirements;
10. Mark all utility crossings with approved permanent markers next to the road right-of-way lines;
11. Maintain the utility lines, and all utility appurtenances, at all times so as not to allow a condition to exist which would be a safety hazard to the traveling public and/or maintenance problem to the roadway or associated structures. Promptly repair any damages to the facilities with an emergency traffic control plan implemented in accordance with the procedures outlined in the MUTCD Manual, latest edition. Prior to any utility repairs or maintenance, the utility owner must notify the appropriate Agency DOT Engineer as soon as possible after any emergency is discovered or 3 days in advance of all other routine maintenance work;
12. Upgrading of existing permitted utility lines is allowed provided the utility line does not change location with respect to the roadway. If the utility line is to be moved or the angle of the crossing with respect to the road changes substantially, the utility owner must apply for a new permit crossing;
13. Should at any time in the future the utility line(s), stated herein, no longer are to be used, these line(s) shall be removed or abandoned in place, as directed by the

Agency DOT Engineer. The applicant shall submit a letter, to the NRDOT Agency Road Engineer, requesting that the utility owner/applicant be relieved of the requirements of this permit. The Agency DOT Engineer shall promptly forward with his/her recommendation this request to the NRDOT Manager for action. All overhead lines and poles shall be removed from the roadway rights-of-way limits by the owner/applicant as directed by the NRDOT Manager;

14. On pressure lines, shut-off valves, shall be located at the roadway rights-of-way lines where such utility enters and leaves the roadway rights-of-way.

Section (B): *to be filled out by the Agency DOT Engineer (check all that apply)*

The above utility encroachment(s) shall require the following appurtenances which the applicant agrees to install in accordance with the BIA NRDOT design and construction standards.

The above utility encroachment(s) shall require: / ☒ / construction plans submitted for approval prior to construction; / ☒ / 30.5 meters of casing 203 mm diameter/size (min); / ☒ / manholes, valves, or poles offset 15.24 meters from roadway shoulder; / ☒ / markers for identification purposes; / ☒ / construct crossing at 90° to the roadway; / ☒ / As-Built drawings in accordance with BIA NRDOT standards. The Applicant shall further comply with the following (please type): No Night Time Work

Section (C): *to be filled out by the NRDOT Manager (check all that apply)*

The above described utilities require (entirely at the applicant's expense) :

- / ☒ / complete set of utility crossing drawings reflecting clearances, depth of cover, all pertinent dimensions of proposed facility with respect to the roadway, shoulder ditches, and road rights-of-way lines, structural cover details, etc.
- / ☒ / structural analysis
- / ☒ / traffic control plan meeting the requirements of the MUTCD
- / ☒ / geotechnical analysis & utility installation requirements for special utility installations
- / ☒ / archeological & environmental compliance/clearance documents

Any and all analyses shall be performed by registered professionals licensed in the field for which the analysis or documentation is required. The analysis required above shall conform to the BIA NRDOT standards which shall be furnished upon request. The recommendations furnished in the analysis report(s) shall be implemented by the applicant at the time the utility(s) are constructed. **In no case shall the roadway surfacing be structurally less than the adjoining roadway surfacing unless specifically waived or otherwise addressed in Section (E) below when installing utilities in open cut trenches.**

Section (D): *general construction requirements*

The applicant shall (*at his/her entire expense*) install the utility(s) to the lines and grades as shown on attached details or as required in the (*approved*) utility drawings. The work shall conform to the **Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP)**, latest edition, relevant national, state, tribal, or local codes approved by NRDOT office, and the following:

- Open cut trenches through roadways shall be backfilled and compacted as per attached details and the FP, section 209. Boring pits and other excavations shall be backfilled and compacted as per attached details and the FP, section 209 with the compaction being 90% of maximum density.
- The top 152mm (6 inches) of natural ground and subgrade of road crossings shall be scarified, adjusted for optimum moisture and compacted in accordance with applicable provisions of section 204 of the FP. All subgrade construction shall be in accordance with section 204 of the FP.
- If the natural ground underneath the proposed utility crossing under the roadway prism shows unstable material, the area shall be excavated to the depths required and stabilized with structural backfill in accordance with section 704 and/or section 213 of the FP.
- The applicant shall furnish test results, certifications for all materials, and copies of all pertinent inspection records to the Agency Road Engineer to review in the field for acceptance of the work.
- The applicant shall notify the Agency DOT Engineer at least 5 working days prior to start of work and upon completion of work within the BIA right-of-way.
- The applicant shall be responsible for developing and implementing a Traffic Control Plan that meets the requirements of the MUTCD (*latest edition with supplements*) and properly maintain this plan for all work within the BIA road right-of-way.
- Any buried non-metallic utility lines shall have a metallic tape or other approved method of effectively locating the lines.

The applicant shall further comply with the following (*please type*): _____

Section (E): *to be filled in by NRDOT Manager*

The Regional Division of Transportation hereby grants the following exception(s) to this utility crossing permit request (*please type*): _____

NRDOT Mgr (initials): _____

[Handwritten signature]
7-07-15

Section (F): approvals

This permit is hereby issued to the foregoing applicant for the expressed purpose set forth in this application and upon expressed condition that every requirement herein is faithfully performed and all the work to be performed in accordance with the plans, specifications, and requirements stipulated herein.

This permit shall have a term of perpetuity from the date approved below or unless item (13) of Section (A) is executed. This permit shall be canceled if installation within the road right-of-way is not completed by August 2016. The permit is transferrable and enforceable to all future owners/heirs/ successors of the utility described above.

Signed:

Recommend for Approval:

Navajo Tribal Utility Authority

Name of utility owner (print)

 4/27/15
Applicant (owner) signature Date

 7/8/2015
Agency Road Engineer Date

Deputy General Manager

Applicant Title

Concurred by:

Approved By:

 7/8/15
Regional NRDOT Manager Date

 7-9-15
Acting Navajo Regional Director Date

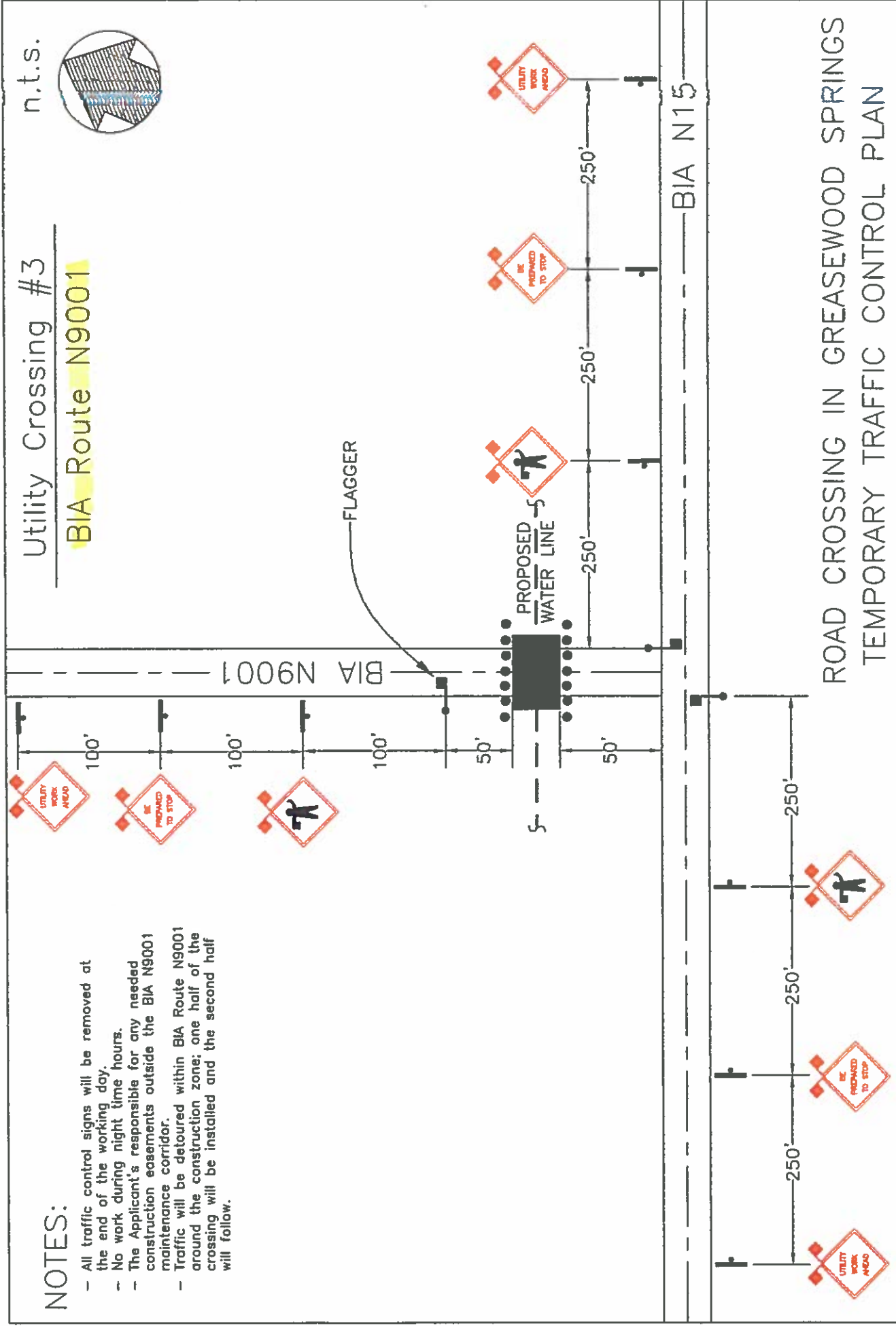
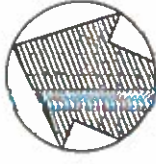
NOTES:

- All traffic control signs will be removed at the end of the working day.
- No work during night time hours.
- The Applicant's responsible for any needed construction easements outside the BIA N9001 maintenance corridor.
- Traffic will be detoured within BIA Route N9001 around the construction zone; one half of the crossing will be installed and the second half will follow.

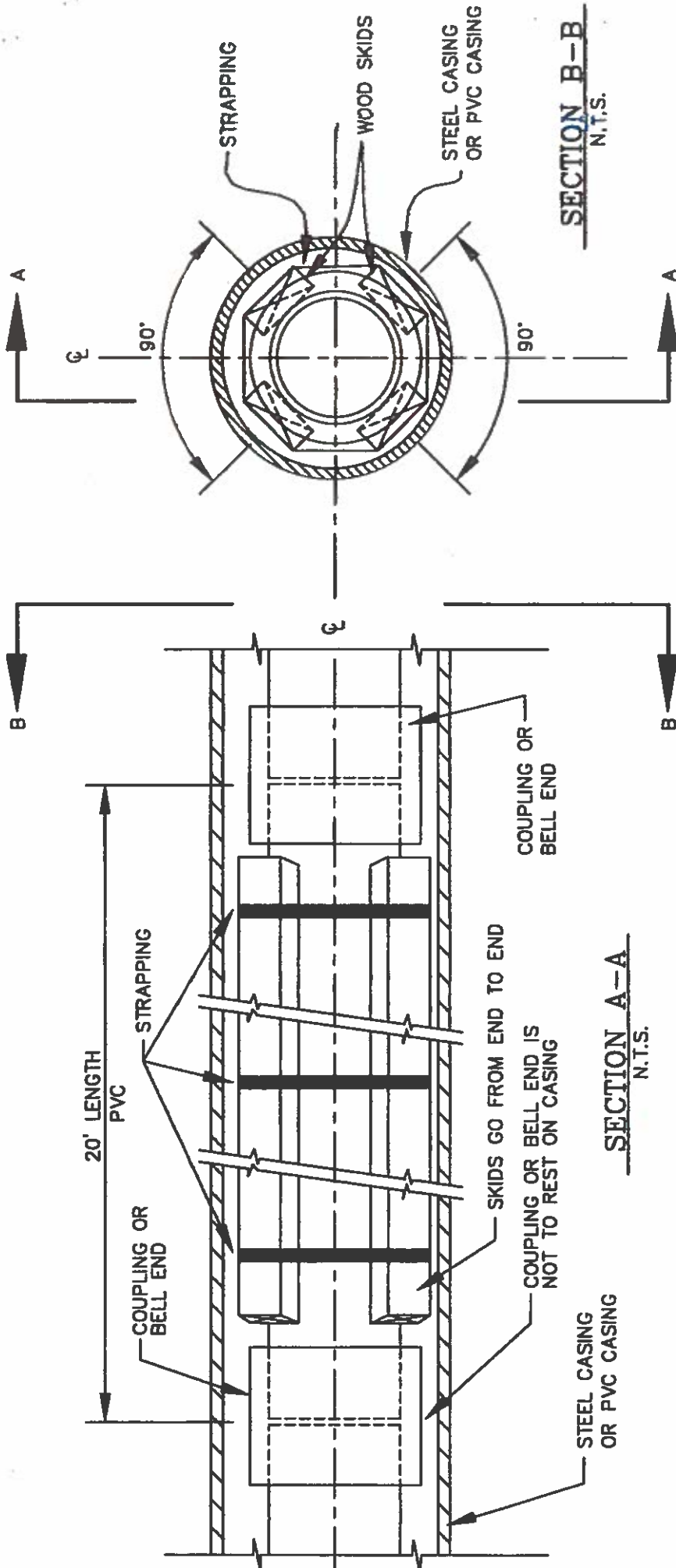
Utility Crossing #3

BIA Route N9001

n.t.s.



ROAD CROSSING IN GREASEWOOD SPRINGS
TEMPORARY TRAFFIC CONTROL PLAN



INSTALLATION OF PVC PIPE IN CASING

FOR CASING SIZES, REFER TO THE FOLLOWING TABLE						
PIPE SIZE:	2"	4"	6"	8"	10"	12"
CASING SIZE:	8"	8"	12"	14"	14"	20"

- NOTES: 1. SEAL ENDS OF CASING.
 2. AT MINIMUM, STRAP AT BOTH ENDS AND MIDDLE OF EACH JOINT OF PIPE.
 3. ROAD BORING BY NECA IS 8" OR 14".

REVISION	DATE	7/90	STANDARDIZED	BY
1				

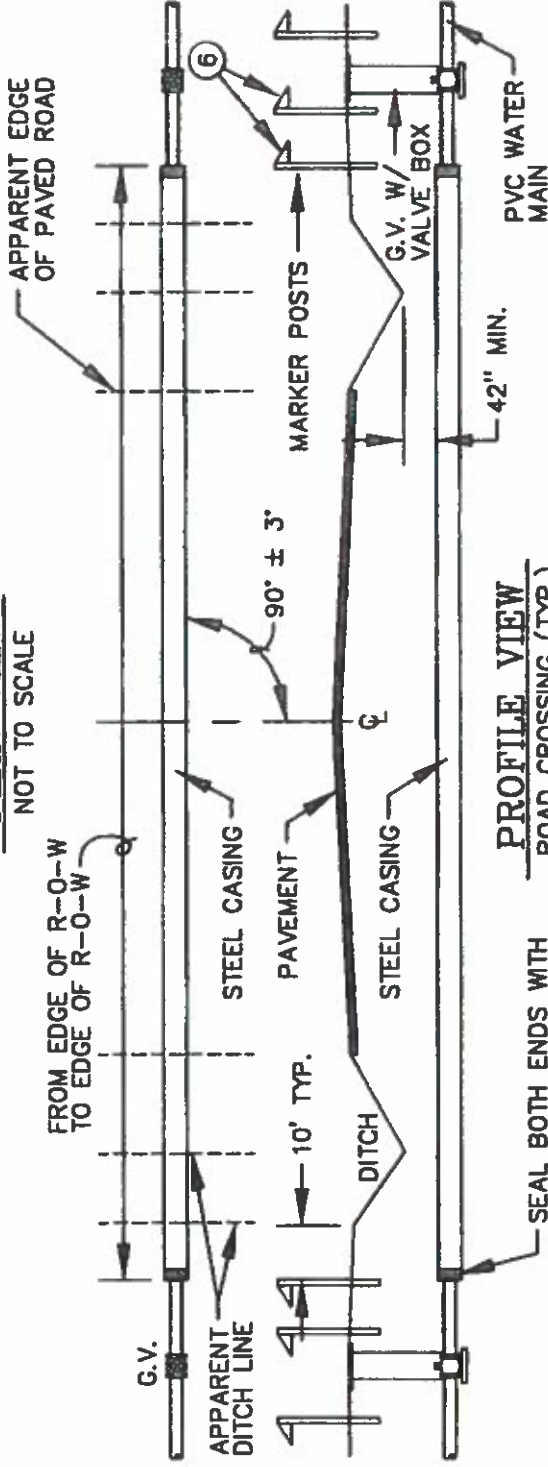
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
 PUBLIC HEALTH SERVICE
 INDIAN HEALTH SERVICE
 NAVAJO NATION
 NAVAJO NATION

STANDARD DRAWING NO. W-24 INSTALLATION OF PVC PIPE IN CASING

OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING
 NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA

PLAN VIEW

NOT TO SCALE



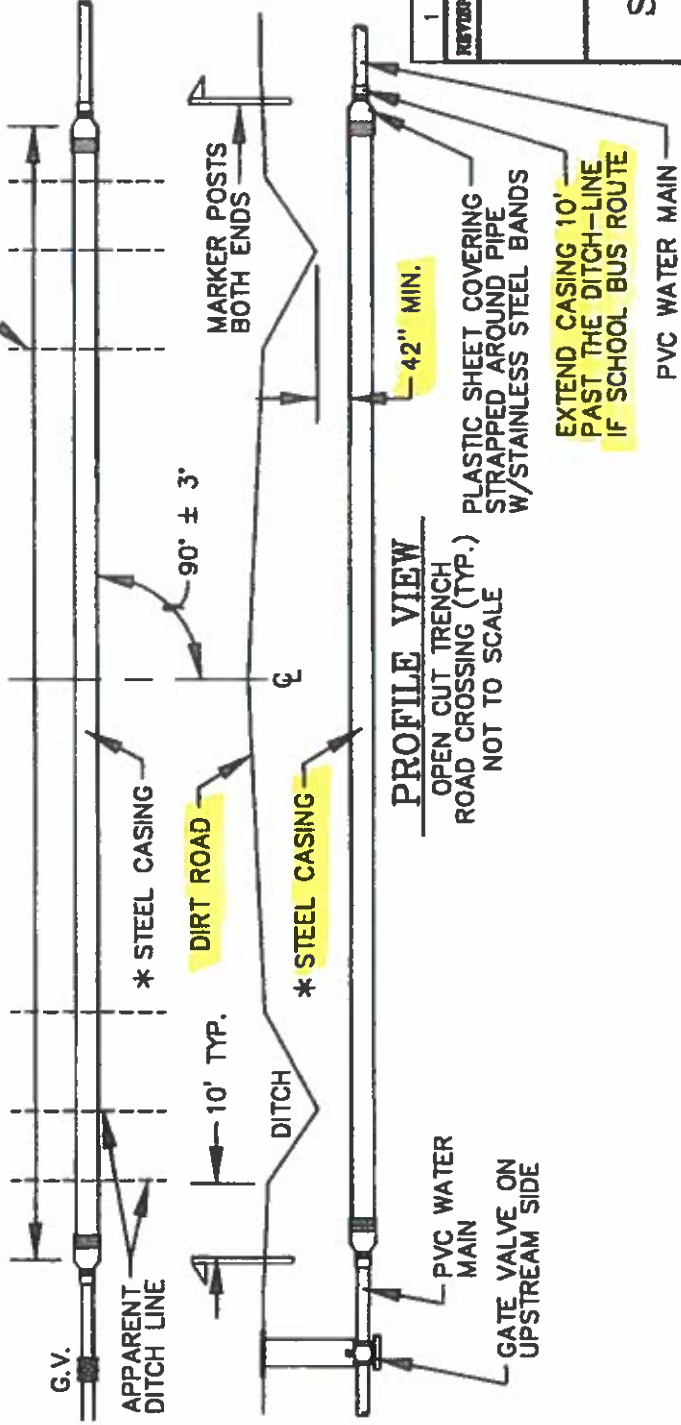
PROFILE VIEW

ROAD CROSSING (TYP.)
ROAD BORING
NOT TO SCALE

SEAL BOTH ENDS WITH
PLASTIC SHEET COVERING
ROAD BORING
W/STAINLESS STEEL BANDS

PLAN VIEW

NOT TO SCALE



PROFILE VIEW

OPEN CUT TRENCH
ROAD CROSSING (TYP.)
NOT TO SCALE

PLASTIC SHEET COVERING
STRAPPED AROUND PIPE
W/STAINLESS STEEL BANDS

GATE VALVE ON
UPSTREAM SIDE

NOTES:

1. SEE GATE VALVE & TEE THRUST BLOCK DETAIL W-16 & W-11.
2. BACKFILL SHALL BE COMPACTED TO 95% OF STANDARD PROCTOR DENSITY IN 6-INCH LIFTS.
3. ROAD CROSSINGS UNDER PAVEMENT SHALL BE BORED BY MACHINE AND REMAINDER OPEN CUT.
4. SEE DETAIL W-24 FOR PVC PIPE SKID INFORMATION.
5. THE LIMIT OF CASING FOR ROADS THAT HAVE ROW MUST BE ROW TO ROW UNLESS PERMISSION FOR LESS CASING IS GRANTED.
6. INSTALL 1 MARKER AT END OF CASING AND 2 FOR GATE VALVES.

* CONDITIONS:

1. FOR BIA MAINTAINED DIRT SCHOOL BUS ROUTES METAL CONDUIT MUST BE INSTALLED. EITHER STEEL CASING, CORRUGATED GALVANIZED STEEL CASING, OR DUCTILE IRON PIPE IS APPROPRIATE.
2. FOR BIA GRAVEL ROADS WITH FORMAL RIGHTS-OF-WAY ONLY STEEL OR CORRUGATED GALVANIZED STEEL CASING IS ALLOWED.
3. FOR COUNTY ROADS CASINGS SHALL ADHERE TO SPECIFIC COUNTY REQUIREMENTS.

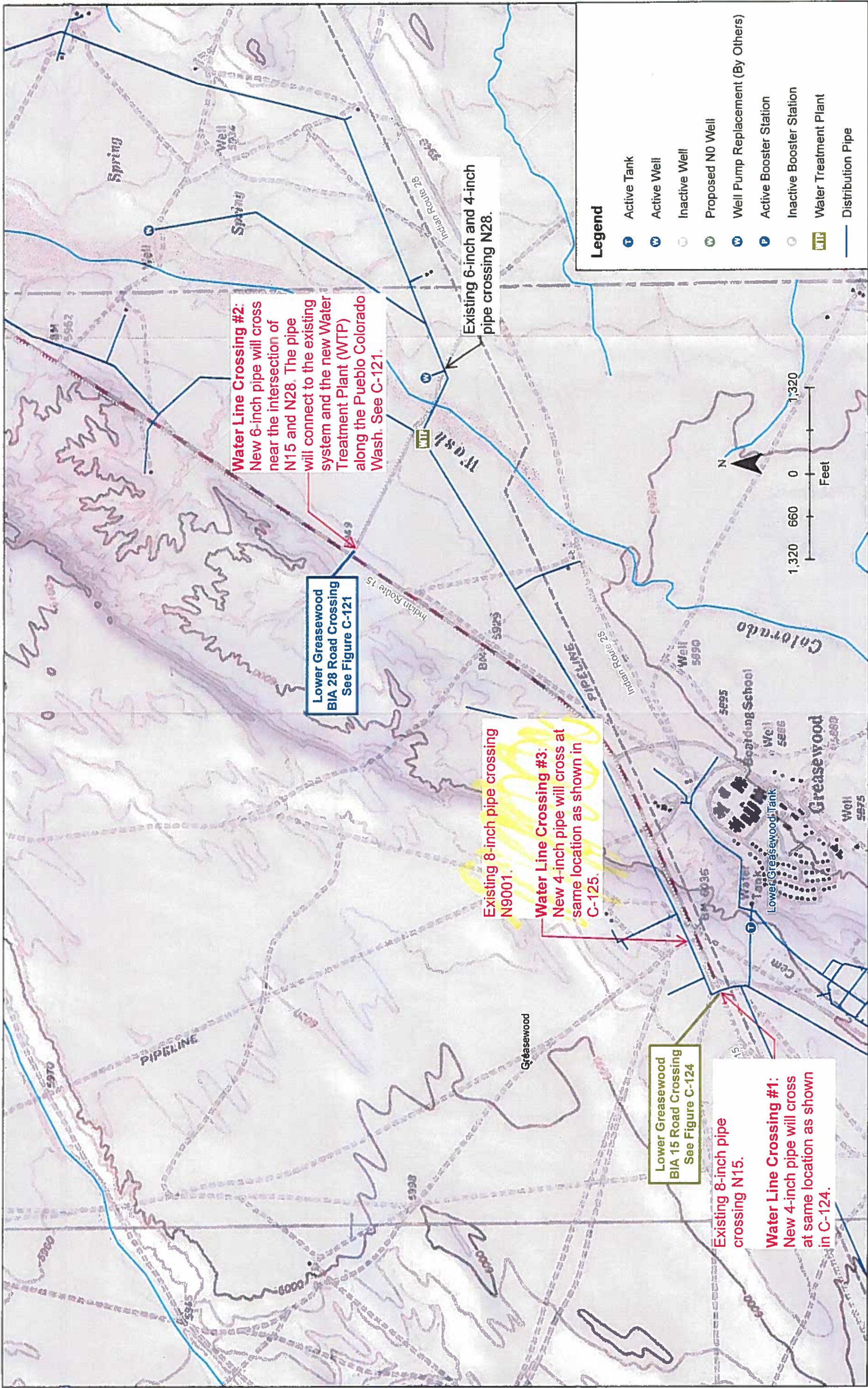
REVISION	DATE	STANDARDIZED	B.Y.
1	7/98	BRIDGE	BY

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
INDIAN HEALTH SERVICE
NAVAJO NATION

NAVAJO NATION,

STANDARD DRAWING NO. W-35 ROAD CROSSING DETAILS

OFFICE OF ENVIRONMENTAL HEALTH AND ENGINEERING
NAVAJO AREA OFFICE, WINDOW ROCK, ARIZONA





A vertical scale bar labeled "SCALE IN FEET" with markings at 0, 40, and 80.

GENERAL NOTES:	<p>1. ALL LOCATIONS OF UTILITIES SHOWN ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY AND POTHOLE AS REQUIRED TO COMPLETE THE WORK.</p> <p>2. CONTRACTOR TO FIELD VERIFY PHYSICAL LOCATION, ELEVATIONS AND INVERTS' ELEVATIONS ARE BASED ON A LOCAL COORDINATE SYSTEM MODIFIED FROM NAVD 83 INTERNATIONAL FEET.</p> <p>3. CONTRACTOR TO PROVIDE THRUST BLOCKS AT ALL ELBOWS, TEES, CROSSES PER IHS STANDARD DRAWING W-11.</p> <p>4. CONTRACTOR TO INSTALL PIPE IN TRENCH PER IHS STANDARD DRAWING W-27.</p> <p>5. CONTRACTOR TO INSTALL MARKER POSTS PER IHS STANDARD DRAWING W-36.</p> <p>6. EASEMENT DIMENSIONS AND PIPELINE OFFSETS ARE SHOWN IN DETAIL A ON SHEET C-002</p>
KEY NOTES:	<p>1. CONTRACTOR SHALL INSTALL STEEL CASING PER IHS STANDARD DRAWING W-35</p> <p>2. LOCATE PIPELINE IN EASEMENT PER DETAIL A/C-002 (TYP).</p> <p>3. CONTRACTOR SHALL PROVIDE WATER BARS PER SECTION 02200</p> <p>4. SEE IHS STD DWG W-1.</p> <p>5. SEE IHS STD DWG W-2</p> <p>6. SEE IHS STD DWG W-16.</p> <p>7. SEE CONNECTION DETAIL C/C-004</p>

KEY NOTES:

- 1 CONTRACTOR SHALL INSTALL STEEL CASING PER IHS STANDARD DRAWING W-35
- 2 LOCATE PIPELINE IN EASEMENT PER DETAIL AC-002 (TYP.)
- 3 CONTRACTOR SHALL PROVIDE WATER BARS PER SECTION 02200
- 4 SEE IHS STD DWG W-1
- 5 SEE IHS STD DWG W-2
- 6 SEE IHS STD DWG W-16
- 7 SEE CONNECTION DETAIL C/C-004

SALT LAKE CITY, UTAH					
SUBMITTED _____	DATE 10/14/14	DRAWN JV	DESIGNED JY	SCALE NONE	
APPROVED _____	DATE 10/14/14	CHECKED TR			
PROJECT NUMBER 9876 BY 9876 INFORM AND CALDWELL LLC					

BID ISSUE

[illegible]

LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS
CONTRACT NO. 2
CIVIL

STA 3007+00 TO STA 3017+00
PLAN AND PROFILE

ELECTRONIC COPY OF FINAL DOCUMENT, SEALED ORIGINAL DOCUMENT IS WITH MICHAEL P KOBE NO. 54069

PERMIT EXTENSION REQUEST FORM

(Effective Date: April 2004)



A Permit Extension is required to extend the validity of a Construction Permit beyond its expiration date. The Permit Extension must be applied for at least 15 days prior to expiration of the Construction Permit. If a Permit Extension is not obtained from the PWSSP within thirty (30) days after the expiration of the Construction Permit, then all construction must terminate until further notice from the PWSSP.

Project Name/Number: Lower Greasewood Water System Improvements/ Proj. # 143956 PWSSP File # NN0400342

Water System Name: _____ PWSSP # _____

Construction Permit # WCP-0019 Date of Issue: 01-12-2015

Anticipated Date of Completion: November 2018

Project Owner		Project Engineer	
Name:	<u>Navajo Tribal Utility Authority</u>	Name:	<u>Brown & Caldwell</u>
Address:	<u>P.O. Box 170, Ft. Defiance AZ 86504</u>	Address:	<u>6795 Union Park Center, Midvale UT</u>
Phone/Fax #	<u>(928) 729-5721</u>	Phone/Fax #	<u>(801) 316-9800</u>

Time extension is requested for the following reason: (Check One)

- ☒ Construction could not be started within a year from the date of issue of the Construction Permit; the construction will begin on DECEMBER 2017
- ☐ Construction halted for more than a year; expected date construction will be resumed _____
- ☐ Construction could not be completed within three years from the date it began

Explanation: (Please, explain the above reason in detail. Use separate sheet(s) if the space below is not sufficient)

This project did not enter the construction phase due to the lack of funding.

I certify that the above information is correct to the best of my knowledge.

THOMAS BAYLES
Owner's Name/Title

[Signature]
Signature

4-18-17
Date

I certify that the construction of the project has been delayed due to the reasons stated above.

Michael Koke
Engineer's Name

[Signature]
Signature

4/24/17
Date

AZ 54069
Registration No.



January 12, 2015

Jay Yazzie, Engineer
Brown and Caldwell
6955 Union Park Center, Suite 270
Midvale, UT. 84047

Re: Construction Permit for Lower Greasewood Water System Improvement

Dear Mr. Mortensen,

The Engineering Section of the Public Water Systems Supervision Program has completed a review of the above referenced project. The construction permit is attached herewith. Please address the following comment:

1. After completion of the construction, the Project Engineer must verify/confirm, by field measurements, the design/control measures for the different construction activities associated with the approved projects versus the design parameters/assumptions as per regulations. This will assure compliance with the minimum design requirements per Navajo Nation Primary Drinking Water Regulations.

The project engineer can proceed with the construction work. Please submit a construction completion report and schedule a field inspection after the construction is complete.

Attached is invoice K151101-1094 for \$7,445.79, there was a 5% Navajo Nation tax charge added as indicated on the invoice. If you have any question, please call the Engineering Section of the Public Water Systems Supervision Program at (928) 871-7755.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronnie Ben".

Ronnie Ben, Department Director
Surface and Ground Water Protection Department
Navajo Nation Environmental Protection Agency

Attachments: Construction Permit
Invoice for Construction Permit Fee
Fee Schedule for Construction Permit

xc: Rex Kontz, Deputy General Manager, NTUA, P.O. Box 170, Ft. Defiance, AZ 86504.
PWSSP file – Dilkon/Indian Wells/ White Cone – NTUA. NN0400342.



Invoice #: K151101-1094Construction Permit # WCP-0019**Navajo Nation Environmental Protection Agency
Public Water Systems Supervision Program**

P.O. Box 339

Window Rock, Arizona 86515

Phone #: (928) 871-7755

Fax #: (928) 871-7818

Website: <http://www.NavajoPublicWater.org>E-mail: Engineers@NavajoPublicWater.org**Construction Permit for Public Water System**Project Name/Number: Lower Greasewood Water System Improvements/ Proj. #143956PWSSP File: NN0400342Project Location: Dilkon/Indian Wells/Lower Greasewood/White Cone - NTUA

Project Type: (Check all that apply)

<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>

New Public Water System

Extension/Modification to Existing System

New Ground/Surface Water Source

Water Treatment Plant

<input type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>

Bottle Water System

Water Line and Appurtenances

Booster Station

Other Inter-tie to NN0403001PWS Name: Dilkon/Indian Wells/Lower Greasewood/White Cone - NTUAPWSID: NN0400342

Project Owner:

Name	Navajo Tribal Utility Authority
Address	HC 63 Box D
Contact Person	
Phone/Fax	

Project Engineer:

Name	Jay Yazzie
Company	Brown and Caldwell
Address	6955 Union Park Center, Midvale, UT. 84047
Phone/Fax	800-528-5011

This is to certify that the application package of the above-mentioned project has been reviewed by the Engineering Section of the Public Water Systems Supervision Program of the Navajo Nation Environmental Protection Agency and is found to comply with the Navajo Nation Safe Drinking Water Act and the Navajo Nation Primary Drinking Water Regulations. The project is approved for the construction on this day of Monday with the conditions set forth on the cover letter dated January 12, 2015.



Ronnie Ben, Department Director
Navajo Nation Environmental Protection Agency

Note:

1. This certificate shall be void if construction does not start within one year of the approval date, or is halted for more than one year, or is not completed within three years after the date construction begins, unless a permit extension is obtained from the NNEPA.
2. The NNEPA must be notified of the construction start date at least seven (7) days in advance of construction.
3. The NNEPA personnel may enter the construction site at any time to conduct inspection and sampling.
4. Any deviation from the approved plans and specifications which could potentially affect capacity, hydraulic conditions, operating units, functioning of water treatment process, or the quality of water to be delivered must be approved by the NNEPA through a permit modification.

Disclaimer: This permit shall not diminish the duty of owners and operators to comply with applicable statutes and regulations and industry standards and to provide adequate system design and performance.



Navajo Nation Environmental Protection Agency
Public Water Systems Supervision Program
PO Box 339
Window Rock, AZ. 86515

Invoice

Invoice #: K151101-1094

Bill To:

Brown and Caldwell
6955 Union Park Center
Midvale, UT. 84047

Invoice Date: January 12, 2015

Return To:

Navajo Nation EPA
PWSS Program
PO Box 339
Window Rock, AZ. 86515

Item	PWSID#	Description	Total
Construction Permit	0400342	Lower Greasewood Water Sys. Improv. – Const. Permit	\$7,091.23

Subtotal:	\$7,091.23
Navajo Nation Tax @ 5%:	\$354.56
Balance Due:	\$7,445.79

Please remit to above address
Phone: (928) 871-7755
Fax: (928) 871-7818
Email: ybarney@navajopublicwater.org

FEE SCHEDULE FOR CONSTRUCTION PERMIT

(Effective Date: April 2004)

Print Form



Please check the appropriate box(es) for your public water system or bottled water system.

Administrative Fee:

- ☐ New public water system: \$1480
☐ Bottled water system: \$1480
☒ Extension/modification to existing public water system: \$1040
☒ Interconnection with another public water system: \$670

Technical Review Fee:

- ☒ Groundwater well: \$160 per well ☐ Booster station: \$160 per station ☐ Storage tank: \$80 per tank
☒ Basic groundwater treatment: \$80 per station (Includes chlorination, fluoridation and iron sequestering)

Water lines:

- ☐ up to 500' — No fee
☐ 500' up to 1000' — \$25
☒ above 1000 ft. — \$25 + \$0.01 for each foot over 1000' (maximum \$1000)

Treatment plants:

- ☒ Single treatment unit: (Iron-Manganese removal unit / Arsenic removal unit / Reverse-osmosis / Ultra filtration / Ion exchange / Electrodialysis, Lime softening)

- ☐ up to 0.1 MGD — \$160
☐ 0.1 up to 0.25 MGD — \$480
☒ 0.25 up to 1.0 MGD — \$800
☐ 1.0 MGD and above — \$1440

Conventional filtration treatment:

- ☒ (A series of processes including coagulation, flocculation, sedimentation, and filtration. It also includes non-conventional series of processes employing various treatments).

- ☐ up to 0.1 MGD — \$1000
☐ 0.1 up to 0.25 MGD — \$2000
☒ 0.25 up to 1.0 MGD — \$4000
☐ 1 up to 5 MGD — \$6000
☐ 5 MGD and above — \$7500

- ☐ Minor modifications not covered above: \$50

Navajo Nation 5% Tax: 354.56

Total Amount = \$ 7445.79

PAYMENT METHOD

Make payment payable of check or money order to:

NAVAJO NATION ENVIRONMENTAL PROTECTION AGENCY

Public Water Systems Supervision Program

P.O. Box 339

Window Rock, AZ 86515

Phone #: (928) 871-7755 Fax #: (928) 871-7818

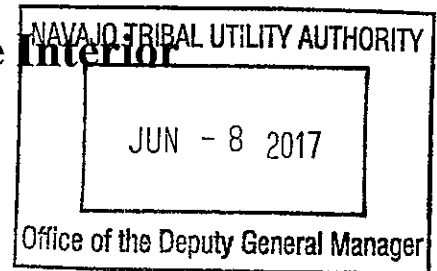
engineers@navajopublicwater.org



In Reply Refer To:
Division of Transportation
M/C: N370

United States Department of the Interior

Bureau of Indian Affairs
Navajo Region
P. O. Box 1060
Gallup, New Mexico 87305



JUN - 6 2017

Mr. Kevin Jacob
Navajo Tribal Utility Authority
P.O. Box 170
Ft. Defiance, AZ 86504

Ref: Utility Permit No. 6N370-2015-15-994; No. 6N370-2015-28-995 & No. 6N370-2015-9001-996 on BIA Route N15, N28 & N9001, Cornfields and Lower Greasewood, AZ

Mr. Jacob:

The Navajo Region, Division of Transportation is in receipt of your email dated May 29, 2017 wherein you are requesting an extension of the permit expiration date. Your request is for a new expiration date of August 31, 2019.

Your request is approved. The above utility permits will expire on **August 31, 2019**.

If you have any questions or require additional information, please contact Mr. Harold Riley at (505) 863-8284.

Sincerely,

Division Manager, Transportation

cc: Mr. Calvin Castillo, Ft. Defiance DOT Manager

**Navajo Nation
Lower Greasewood Water System Improvements**

PROJECT MANUAL

**CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND
WELL HOUSES**

VOLUME 2 OF 2

DIVISIONS 1 THRU 17 – TECHNICAL SPECIFICATIONS

Bid Issue

**Navajo Tribal
Utility Authority
USDA-RD AZ**

February 2019

Brown and Caldwell
6975 Union Park Center, Suite 490
Midvale, UT 84047



Cover
00010

PROJECT MANUAL
FOR CONSTRUCTION OF
Navajo Nation
LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS
CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND WELL HOUSES
Volume 2 of 2
Divisions 1 thru 17 – Technical Specifications
Navajo Tribal Utility Authority
USDA-RD AZ

Prepared by:

Brown and Caldwell
6975 Union Park Center, Suite 490
Midvale, UT 84047

Project No. 143956



Title Sheet
00015-1

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 00017

TABLE OF CONTENTS

Navajo Nation

LOWER GREASEWOOD WATER SYSTEM IMPROVEMENTS

CONTRACT NO. 2: WATER TREATMENT PLANT, PIPELINES, AND WELL HOUSES

**Reference
Number**

Title

VOLUME 1

DIVISION 0 – BIDDING AND CONTRACTING REQUIREMENTS

00010	Cover
00015	Title Sheet
00016	Seals Page
00017	Table of Contents

Bidding

00111	Advertisement for Bids
00200	Instructions to Bidders
00410	Bid Form
00430	Bid Bond
00440	List of Proposed Subcontractors
00451	Qualifications Statement
00461	Compliance Statement
00462	Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
00463	Certification for Contract, Grants and Loans
XP-315	Davis Bacon Certification 4
Wage Rates	Federal Wage Rates

Contract

00510	Notice of Award
00520	Agreement between Owner and Contractor for Construction Contract
00550	Notice to Proceed
00610	Performance Bond
00615	Payment Bond
00620	Application for Payment
00625	Certificate of Substantial Completion
00700	Standard General Conditions of the Construction Contract
00800	Supplementary Conditions
00941	Change Order
00942	Field Order

Table Of Contents
00017-1

Contract 2
Bid Issue

Appendix A	Rights-of-way and Easements Obtained by Owner
Appendix B	Permits Obtained by Owner

VOLUME 2 – TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

01010	Summary of Work
01014	Work Sequence
01071	Standard References
01200	Project Meetings
01300	Submittals
01310	Construction Schedule
01400	Quality Assurance, Inspection, and Testing
01410	Testing Laboratory and Special Inspection Services
01500	Contractor's Utilities
01560	Environmental Controls
01561	Storm water Pollution Prevention Plan (SWPPP)
01580	Project Identification Signs
01605	Shipment, Protection and Storage
01660	Equipment and System Performance and Operational Testing
01662	Commissioning
01664	Training
01710	Final Cleanup
01720	Record Drawings
01730	Operating and Maintenance Information
01800	Environmental Conditions
01900	Structural Design and Anchorage Requirements for Nonstructural Components and Nonbuilding Structures
01999	Reference Forms

DIVISION 2- SITE CONSTRUCTION

02100	Site Preparation
02160	Horizontal Directional Drilling
02200	Earthwork
02270	Erosion Control (Vegetative)
02743	Asphalt Concrete Pavement

DIVISION 3- CONCRETE

03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-In-Place Concrete
03600	Grout

DIVISION 4- MASONRY

04200 Unit Masonry

DIVISION 5- METALS

05100 Structural Metals
05210 Steel Joist Framing
05311 Steel Roof Deck
05501 Anchors to Concrete and Masonry
05505 Miscellaneous Metalwork
05530 Grating, Floor Plates, Stair Treads, and Safety Stair Nosing's
05910 Zinc Coating

DIVISION 6- WOOD AND PLASTICS

06100 Rough Carpentry
06160 Sheathing

DIVISION 7- THERMAL AND MOISTURE PRETECTION

07190 Water Repellants
07410 Standing-Seam Metal Roof Panels
07620 Sheet Metal Flashing and Trim
07905 Preformed Joint Fillers
07920 Joint Sealants

DIVISION 8- DOORS AND WINDOWS

08110 Hollow Metal Doors and Frames
08330 Overhead Coiling Doors
08710 Door Hardware
08800 Glazing

DIVISION 9- FINISHES

09900 Coating Systems
09901 Coating for Steel Water Storage Reservoir

DIVISION 10- SPECIALTIES

10441 Warning Signs
10520 Fire Protection Specialties

DIVISION 11- EQUIPMENT

11000	General Requirements for Equipment
11002	Rigid Equipment Mounts
11100	Sluice Gates
11324	Submersible Turbine Pumps for Water Well Service
11700	Chlorine Containment System and Accessories
11727	Chlorine Gas Feed System
11825	Package Granular Activated Carbon Adsorption System for Drinking Water Treatment
11830	Pressure Filters – Iron and Manganese Removal

DIVISION 12- FURNISHINGS

NOT USED

DIVISION 13- SPECIAL CONSTRUCTION

13201	Welded Steel Backwash Water Storage Tank
13540	Granular Activated Carbon

DIVISION 14- CONVEYING SYSTEMS

14611	Monorail and Hoist
-------	--------------------

DIVISION 15- MECHANICAL

15050	Piping Systems
15061	Steel Pipe
15062	Ductile Iron Pipe
15064	Plastic Pipe
15065	HDPE Pipe
15066	Copper Piping
15075	Joint Gaskets
15085	Piping Connections
15096	Pipe Hangers and Supports
15097	Seismic Restraints for Piping
15102	Resilient-Seated Gate Valves
15103	Butterfly Valves
15110	Eccentric Plug Valves
15118	Spring Loaded Swing Check Valves
15125	Steel Pipe Casing

15150	Air Release and Vacuum Valves for Clean Water Service
15154	Pressure Relief Valves
15184	Manual Valve and Gate Operators and Operator Appurtenances
15632	Electric Unit Heaters
15863	Propeller Wall Fans
15944	Louvers

DIVISION 16- ELECTRICAL

16000	General Requirements for Electrical Work
16030	Electrical Acceptance Testing
16124	Single Mode Fiber Optic Data Communication System
16155	Individual Motor Starters
16431	Arc Flash Analysis, Short Circuit Study, and Protective Device Coordination Report

DIVISION 17- INSTRUMENTATION

17000	General Requirements for Instrumentation and Control
17030	Process Instrumentation and Control System Testing
17110	Instrument and Control Panels
17900	Control Specifications

END OF TABLE OF CONTENTS

DRAWINGS SETS (BOUND SEPARATELY)

DRAWINGS FOR CORNFIELDS PARALLEL AND LOWER GREASEWOOD
INTERCONNECTION PIPELINES

DRAWINGS FOR LOWER GREASEWOOD TREATMENT PLANT, LOWER
GREASEWOOD WELL 1 PUMP HOUSE, AND GANADO N0 WELL PUMP
HOUSE

END OF SECTION

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01010

SUMMARY OF WORK

1.0 GENERAL

The work covered under this contract will be performed at multiple sites of the Lower Greasewood and Ganado Community Water Systems operated by the Navajo Tribal Utility Authority.

2.0 DESCRIPTION OF OWNER'S PROJECT

The overall project will provide additional water supply to the Dilkon Water System by adding a new supply well near Ganado and interconnecting pipelines from the Ganado Water System to the Lower Greasewood Water System, as well as and a new groundwater treatment plant and well improvements in the Lower Greasewood Water System to address water quality issues in order to comply with an TTHM based Administrative Compliance Order.

3.0 WORK OF THIS CONTRACT

The work to be performed under this contract (Contract No. 2) includes the Base Bid and five (5) Bid Add Alternatives:

- Base Bid - Lower Greasewood Treatment Plant, Lower Greasewood Well 1 Pump House, and Ganado N0 Well Pump House:
 - Construction of a new 700 gpm groundwater treatment plant with pressure filter treatment equipment for removal of iron and manganese, as well as granular activated carbon treatment equipment for removal of organics, new pump houses and well site improvements at Lower Greasewood Well 1 and Ganado N0 Well, equipping of N0 Well with pump and motor, chlorination system for N0 Well House, and miscellaneous telemetry system improvements in Lower Greasewood System.
 - Refurbish and return the existing Lower Greasewood 220,000 gall tank to service.
- Bid Add Alternatives 1 through 5 – Cornfields Parallel and Lower Greasewood Interconnect Pipelines (Overview of Alternatives 1 through 4 are shown on Sheet C-100 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines):
 - Alternative No. 1 Greasewood South Pipeline: Construction of approximately 2,183 feet of 4-inch PVC pipeline. This includes coordination with Indian Health Service (IHS) on the Lower Greasewood Tank to Wood Chop Tank

pipeline and pump station project they are constructing that is in conjunction with this project (See Sheets C-124, C-125, C-126 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines).

- Alternative No. 2 Cornfields East Altitude Valve Station and Pipeline: Construction of a new altitude valve station and approximately 200 feet of 4-inch pipeline (See Sheet C-101 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines).
- Alternative No. 3 Cornfields West Pipeline: Construction of approximately 7,879 feet of 6-inch PVC pipeline and a Pressure Reducing Valve (PRV) station (See Sheets C-102 through C-109 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines).
- Alternative No. 4 Greasewood North Pipeline: Construction of approximately 13,938 feet of 6-inch PVC pipeline (See Sheets C-110 through C-123 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines).
- Alternative No. 5 Fiber Optic system for Water Treatment Plant and N0 Well House. This includes:
 - Connection to NTUA fiber optic junction box and extension to Water Treatment Plant (See Sheets C-121, C-122, C-123 Drawings for Cornfields Parallel and Lower Greasewood Interconnection Pipelines).
 - Connection to NTUA fiber optic junction box and extension to N0 Well House (See Sheet E-600 Drawings for Lower Greasewood Water Treatment Plant, Lower Greasewood Well 1 Pump House and Ganado N0 Well Pump House).

4.0 WORK OF OTHER CONTRACTS

- Contract No. 1 – Ganado N0 Well: Construction of the new N0 drinking water supply well (approximately 1500 ft deep, 200 gpm) in the Ganado Community Drinking Water System.

5.0 CLARIFICATIONS REGARDING THE WORK

- These drawings and specifications were originally prepared as 3 separate bid packages, which the Owner intended to bid as 3 separate contracts; however, the Owner has since elected to bid the Work as 2 separate contracts. As part of repackaging the drawings and specs, references to other contracts have been updated. The Contractor is advised that the Work includes everything in the Project Manual and on the Drawings and is further

advised to clarify any questions regarding references to other contracts that may have been missed during repackaging.

****END OF SECTION****

SECTION 01014

WORK SEQUENCE

PART 1--GENERAL

1.01 CONTINUITY OF PLANT OPERATIONS

A. GENERAL:

The existing Lower Greasewood water system is currently and continuously providing potable water, and that function shall not be interrupted except as specified herein. The Contractor shall coordinate the work to avoid any interference with normal operation of water production, disinfection, and storage processes.

1.02 SEQUENCE AND SCHEDULE OF CONSTRUCTION

A. General:

1. To permit continuous production and disinfection of water and compliance with water quality requirements, the construction schedule shall provide for the following specific conditions:
 - a. Installation and modification of various control systems within this project will require temporary partial shutdown of these systems. Works shall be planned and scheduled in advance in order to minimize downtime.
2. To facilitate the required temporary modifications to allow production and treatment operations to continue during construction of the work of this project, the Contractor shall coordinate with the Owner and Engineer

B. To permit potable water system operation and disinfection, the construction schedule required in in the General Conditions or Section 01310 of the Contract Documents shall provide for the following specific conditions.

C. Existing Lower Greasewood System.

1. Potable water is produced by existing Wells 1, 2, and 3 to the Lower Greasewood Tank.
2. Chlorination is provided at Well 2 only.

3. The Lower Greasewood Tank existing Telemetry PLC provides tank level information for start/stop and chlorinator control to the three Wells.
4. The existing system with at least two wells in operation shall be maintained in operation until such time as the Lower Greasewood Treatment Plant is ready for operation.
5. The Contractor shall propose and submit any required well, tank, piping, telemetry, or other process outage plans required.

D. Lower Greasewood System with Treatment Plant.

1. The Treatment Plant and piping modifications shall be tested, disinfected, disinfection approval obtained, and made operational prior to revision to the system disinfection means and Telemetry operations for Treatment Plant operation.
2. Water from the Wells shall now flow through the Treatment Plant.
3. Chlorination shall be provided at the Treatment Plant instead of at each well.
4. The Treatment Plant Telemetry PLC shall obtain tank level information from the Lower Greasewood Tank, and provide start/stop control of the Wells instead of from the Tank.
5. The system with treatment and at least two wells in operation shall be maintained throughout the remainder of the work.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. OUTAGE PLAN:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining

acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Submit a detailed outage plan and time schedule for operations which will make it necessary to remove any facility, piping, well, electrical or control circuit, or equipment from service. The schedule shall be coordinated with the construction schedule specified in the General Conditions of the Contract Documents and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the means and methods to maintain potable water system operational and disinfected, the length of time required to complete said operation, and the necessary personnel and equipment which the Contractor shall provide in order to prevent extended duration loss of available potable water.

PART 2—PRODUCTS – NOT USED

PART 3—EXECUTION

- A. During Construction, Indian Health Service (IHS) will be constructing a new booster pump station and 10-inch pipeline. The Lower Greasewood project includes the connection of a new 4-inch pipeline to the IHS 10-inch pipeline. Coordinate with IHS to connect the 4-inch pipeline to the 10-inch pipeline.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01071

STANDARD REFERENCES

Wherever used in the project manual, the following abbreviations will have the meanings listed:

AA	Aluminum Association Incorporated P.O. Box 753 Waldorf, MD 20604
AABC	Associated Air Balance Council 1518 K Street N.W. Washington, DC 20005
AAMA	American Architectural Manufacturers Association 1540 East Dundee Road, Suite 310 Palatine, IL 60067
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W., Suite 249 Washington, DC 20001
ABMA	American Bearing Manufacturers Association 1200 19th Street N.W., Suite 300 Washington, DC 20036
ACI	American Concrete Institute 22400 West Seven Mile Road P.O. Box 19150, Redford Station Detroit, MI 48219
AEIC	Association of Edison Illuminating Companies 600 North 18th Street P.O. Box 2641 Birmingham, AL 35291
AGA	American Gas Association ATTN: Records 1515 Wilson Boulevard Arlington, VA 22209
AGMA	American Gear Manufacturer's Association, Inc. 1500 King Street, Suite 201 Alexandria, VA 22314
AHA	American Hardboard Association 1210 West Northwest Highway Palatine, IL 60067
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601

AISI	American Iron and Steel Institute 1101 Seventeenth Street, NW, Suite 1300 Washington, DC 20036
AITC	American Institute of Timber Construction 7012 South Revere Parkway, Suite 140 Englewood, CO 80112
ALSC	American Lumber Standard Committee P.O. Box 210 Germantown, MD 20875
AMCA	Air Movement and Control Association, Inc. 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036
APA	American Plywood Association 7011 South 19th Street Tacoma, WA 98466
API	American Petroleum Institute 1220 "L" Street N.W. Washington, DC 20005
ARI	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, VA 22203
ASCE	American Society of Civil Engineers United Engineering Center 345 East 47th Street New York, NY 10017
ASCII	American Standard Code for Information Interchange United States of America Standards Institute 10 East 40th Street New York, NY 10016
ASE Code	American Standard Safety Code for Elevators, Dumbwaiter and Escalators American National Standards Institute 1430 Broadway New York, NY 10018
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. 1791 Tullie Circle, NE Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive

Standard References
01071-2

	West Conshohocken, PA 19428
AWPA	American Wood-Preservers' Association 9549 Old Fredrick Road Ellicott City, MD 21042 or P.O. Box 286 Woodstock, MD 21163-0286
AWS	American Welding Society 550 NW LeJeune Road P.O. Box 351040 Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BOCA	Building Officials and Code Administrators, International, Inc. 4051 West Flossmoor Road Country Club Hills, IL 60478
CALTEST	Materials Manual, State of California, Business and Transportation Agency Department of Public Works State of California, Department of Transportation 6002 Folsom Boulevard Sacramento, CA 95819
CALTRANS	Standard Specifications, State of California, Department of Transportation State of California, Business and Transportation Agency P.O. Box 1499 Sacramento, CA 95807
CBM	Certified Ballast Manufacturers 2120 Keith Building Cleveland, OH 44115
CMAA	Crane Manufacturers Association of America, Inc. (Formerly called: Overhead Electrical Crane Institute) (OECI) 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217
CRSI	Concrete Reinforcing Steel Institute 933 N Plum Grove Road Schaumburg, IL 60173
CSA	Canadian Standards Association 178 Rexdale Boulevard Rexdale, Ontario, M9W 1R3, Canada
DEMA	Diesel Engine Manufacturer's Association 30200 Detroit Road Cleveland, OH 44145
DHI	Door and Hardware Institute 14170 Newbrook Drive Chantilly, VA 22021

Standard References
01071-3

DIS	Division of Industrial Safety California Department of Industrial Relations 2422 Arden Way Sacramento, CA 95825
EEI	Edison Electric Institute 90 Park Avenue New York, NY 10016
EIA	Electronic Industries Association Order from: Global Engineering Documents 18201 McDermott West Irvine, CA 92714
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
ESO	Electrical Safety Orders California Administrative Code, Title 8, Chap. 4, Subarticle 5 Office of Procurement, Publications Section P.O. Box 20191 8141 Elder Creek Road Sacramento, CA 95820
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch Washington Navy Yard, Bldg. 197 Washington, DC 20407
FEDSTDS	Federal Standards (see FEDSPECS)
FM	Factory Mutual Engineering and Research Corporation 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062
HEI	Heat Exchange Institute 1300 Sumner Avenue Cleveland, OH 44115
HI	Hydraulic Institute 9 Sylvan Way, Suite 180 Parsippany, NJ 07054
HPVA	Hardwood Plywood & Veneer Association 1825 Michael Faraday Drive P.O. Box 2789 Reston, VA 22090-2789
IAPMO	International Association of Plumbing and Mechanical Officials 20001 Walnut Drive S

Standard References
01071-4

	Walnut, CA 91789
ICBO	International Conference of Building Officials 5360 Workman Mill Road Whittier, CA 90601
ICEA	Insulated Cable Engineers Association P.O. Box 440 South Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 1331 Piscataway, NJ 08855
IES	Illuminating Engineering Society of North America 120 Wall Street New York, NY 10017
ISA	Instrument Society of America 67 Alexander Drive P.O. Box 12277 Research Triangle Park, NC 27709
JIC	Joint Industrial Council 7901 West Park Drive McLean, VA 22101
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Avenue Chicago, IL 60611
MILSPEC	Military Specifications Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
MSS	Manufacturers Standardization Society of the Valve & Fittings Industry, Inc. 127 Park Street, N.E. Vienna, VA 22180
NAAMM	National Association of Architectural Metal Manufacturers 11 South La Salle Street, Suite 1400 Chicago, IL 60603
NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 77084
NBC	National Building Code Published by BOCA
NEC	National Electric Code National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NELMA	Northeastern Lumber Manufacturers Association, Inc.

Standard References
01071-5

	P.O. Box 87A Cumberland Center, ME 04021
NEMA	National Electrical Manufacturer's Association 2101 L Street, NW, Suite 300 Washington, DC 20037
NESC	National Electric Safety Code American National Standards Institute 1430 Broadway New York, NY 10018
NFOR	National Forest Products Association (Formerly National Lumber Manufacturer's Association) 1111 19 Street NW, Suite 700 Washington, DC 20036
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269
NHLA	National Hardwood Lumber Association 6830 Raleigh LaGrange P.O. Box 34518 Memphis, TN 38184-0518
NSF	National Sanitation Foundation 3475 Plymouth Road P.O. Box 130140 Ann Arbor, MI 48113
OSHA	Occupational Safety and Health Act U.S. Department of Labor Occupational and Health Administration San Francisco Regional Office 450 Golden Gate Avenue, Box 36017 San Francisco, CA 94102
PCI	Precast/Prestressed Concrete Institute 175 West Jackson Blvd., Suite 1859 Chicago, IL 60604
PPIC	The Plumbing & Piping Industry Council, Inc. 510 Shatto Place, Suite 402 Los Angeles, CA 90020
RIS	Redwood Inspection Service California Redwood Association 405 Enfrente Dr., Suite 200 Novato, CA 94949
RMA	Rubber Manufacturers Association 1400 K Street NW, Suite 900 Washington, DC 20005
SAE	Society of Automotive Engineers, Inc.

Standard References
01071-6

	400 Commonwealth Drive Warrendale, PA 15096
SAMA	Scientific Apparatus Makers Association One Thomas Circle Washington, DC 20005
SBC	Standard Building Code Published by SBCCI
SBCCI	Southern Building Code Congress International Inc. 900 Montclair Road Birmingham, AL 35213
SCMA	Southern Cypress Manufacturers Association 400 Penn Center Boulevard, Suite 530 Pittsburg, PA 15235
SDI	Steel Door Institute 30200 Detroit Road Cleveland, OH 44145
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc. P.O. Box 221230 Chantilly, VA 22021
SPI	Society of the Plastics Industry, Inc. 1275 K Street NW, Suite 400 Washington, DC 20005
SPIB	Southern Pine Inspection Bureau 4709 Scenic Highway Pensacola, FL 32504
SSPC	Society for Protective Coatings 40 24 th Street, 6 th Floor Pittsburgh, PA 15222
SSPWC	Standard Specifications for Public Works Construction Building News, Inc. 3055 Overland Avenue Los Angeles, CA 90034
TEMA	Tubular Exchanger Manufacturer's Association 25 North Broadway Tarrytown, NY 10591
TPI	Truss Plate Institute 583 D'Onofrio Drive, Suite 200 Madison, WI 53719
UBC	Uniform Building Code Published by ICBO
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062
UMC	Uniform Mechanical Code Published by ICBO

Standard References
01071-7

UPC	Uniform Plumbing Code Published by IAPMO
USBR	Bureau of Reclamation U.S. Department of Interior Engineering and Research Center Denver Federal Center, Building 67 Denver, CO 80225
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns St. P.O. Box 23145 Portland, OR 97223
WWPA	Western Wood Products Association (Formerly called: West Coast Lumbermen's Association (WCLA)) Yeon Building 522 SW 5th Avenue Portland, OR 97204

END OF SECTION

SECTION 01200

PROJECT MEETINGS

1.0 PRECONSTRUCTION CONFERENCE

The Construction Manager will schedule and conduct one preconstruction conference prior to the commencement of any work at the site, to which all interested agencies and utility companies will be invited to discuss their interests and requirements relating to the project. Contractor and all subcontractor representatives shall attend.

2.0 CONSTRUCTION PERIOD MEETINGS

Construction period meetings will be conducted at weekly intervals or at some other frequency if approved by the Contractor and Construction Manager. These meetings shall be attended by the Construction Manager and the Contractor's Project Manager and any others that are invited by these people.

The agenda of these project meetings will include reports on construction progress, the status of submittal reviews, the status of information requests, and any general business. The meetings will be conducted by the Construction Manager. Construction Manager shall keep minutes of the proceedings. The minutes shall be typed and distributed to all attendees within 48 hours of each meeting.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01300

SUBMITTALS

1.0 GENERAL

Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

2.0 CONTRACTOR'S RESPONSIBILITIES

A. GENERAL

The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Construction Manager in each case where his submittal may affect the work of another contractor or the Owner. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements specified in paragraph 11000-1.02 C and applicable technical sections.

The Contractor shall coordinate submittals with the work so that work will not be delayed. He shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."

The Contractor shall certify on each submittal document that he has reviewed the submittal, verified field conditions, and complied with the contract documents.

The Contractor may authorize in writing a material or equipment supplier to deal directly with the Construction Manager or with the Owner with regard to a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

3.0 CATEGORIES OF SUBMITTALS

A. GENERAL:

Submittals fall into two general categories; submittals for review and comment, and submittals which are primarily for information only. Submittals which are for information only are generally specified as PRODUCT DATA in Part 2 of applicable specification sections.

At the beginning of work, the Construction Manager will furnish the Contractor lists of those submittals specified in the project manual. Two separate lists will be provided: submittals for review and comment and product data (submittals) for information only.

B. SUBMITTALS FOR REVIEW AND COMMENT:

All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Construction Manager for review and comment.

C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY:

Where specified, the Contractor shall furnish submittals (product data) to the Construction Manager for Information only. Submittal requirements for operation and maintenance manuals, which are included in this category, are specified in Section 01730.

4.0 TRANSMITTAL PROCEDURE

A. GENERAL:

Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01300-A specified in Section 01999. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01730-A specified in Section 01999. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

B. DEVIATION FROM CONTRACT:

If the Contractor proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.

C. SUBMITTAL COMPLETENESS:

Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

5.0 REVIEW PROCEDURE

A. GENERAL:

Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.

When the contract documents require a submittal, the Contractor shall submit the specified information as follows:

1. Unless otherwise specified, (4) hard copies and one (1) electronic copy in Adobe ".pdf" format of all submitted information. Consolidate electronic format submittals with multiple pages into a single file. Include an electronic submittal transmittal form 01300-A as the first page in the electronic file.
2. 2. Unless otherwise specified, one (1) electronic copy in Adobe ".pdf" format of all submitted information shall be transmitted for submittals (Product Data) for information only.
3. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.
4. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

5. Where required, three (3) samples of submitted information shall be provided to the Construction Manager. Samples will not be returned. Provide samples from manufacturer's standard colors, materials, products, or equipment lines. Clearly label samples to indicate any that represent non standard colors, materials, products, or equipment lines and that if selected, will require an increase in Contract Time or Contract Price.
6. If requested by Engineer, Contractor shall provide hardcopies of any submittals or shop drawings.

B. SUBMITTALS FOR REVIEW AND COMMENT:

Unless otherwise specified, within 10 working days after receipt of a submittal for review and comment, the Construction Manager shall review the submittal and return 1 electronic copy of the marked-up reproducible original noted in 1 above. Thirty (30) calendar days shall be allowed for review and response to shop drawings pertaining to the Iron and Manganese Removal Treatment System and GAC Treatment System. The reproducible original will be retained by the Construction Manager. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the material, equipment or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
2. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.
3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
4. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

C. SUBMITTALS (PRODUCT DATA) FOR INFORMATION ONLY:

Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

6.0 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Construction Manager or the Owner, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Owner has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01310

CONSTRUCTION SCHEDULE

1.0 SCOPE

This section specifies reports and schedules for planning and monitoring the progress of the work.

2.0 DESCRIPTION

The Contractor shall provide a graphic construction schedule indicating the various subdivisions of the work and the dates of commencing and finishing each. The schedule shall show the time allowed for testing and for other procedures which must be completed prior to the work being put into operation. The schedule will take into account the time of completion and the specific dates given in Section 00520.

3.0 SUBMITTAL PROCEDURES

Within 20 days after the date of the Notice to Proceed, the Contractor shall submit in accordance with Section 01300, a construction schedule conforming to paragraph 01310-2.0. The submittal shall consist of a reproducible original and two copies.

Within 7 calendar days after receipt of the submittal, the Construction Manager shall review the submitted schedule and return one copy of the marked up original to the Contractor. If the Construction Manager finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy returned to the Contractor.

4.0 SCHEDULE REVISIONS

Revisions to the accepted construction schedule may be made only with the written approval of the Contractor and Owner. A change affecting the contract value of any activity, the completion time, and specific dates and sequencing may be made only in accordance with applicable provisions of Sections 00700 and 00800.

5.0 PROJECT STATUS UPDATE

Project status review and update shall be provided each month.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01400

QUALITY ASSURANCE, INSPECTION, AND TESTING

PART 1 GENERAL

1.01 SUMMARY

This section specifies administrative and procedural requirements for quality assurance and control services, special inspections, field testing and structural observations required for this project. This Section is supplementary to the applicable testing and inspection program in the Contract, and describes the responsibilities of all parties pertaining to testing and inspections.

This section covers requirements for quality assurance and inspection required in accordance with the latest version of the International Building Code and is in addition to and supplements the quality assurance requirements contained on the Contract Drawings.

The Contractor is responsible for providing quality workmanship and materials for the construction of this project in accordance with the Contract Documents.

The Contractor will engage and pay for the services of an Owner-approved Special Inspector and Laboratory Service. The Special Inspector shall be qualified to the satisfaction of the Building Official in accordance with Chapter 17 of the International Building Code. The Special Inspector shall be acceptable to the Owner in its sole discretion.

1.02 DEFINITIONS

- A. Approved Agency: An agency approved by the Building Official to engage in furnishing testing or inspection services.
- B. Certificate of Compliance: A certificate stating that materials and products meet specified standards or that work was performed in compliance with approved construction documents.
- C. Registered Design Professional in Responsible Charge: An architect or engineer, licensed to practice in the State of Arizona, acting as the Owner's agent.
- D. Resident Project Representative: The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative. The term "Construction Manager," as used in this and other technical specifications, refers to the Resident Project Representative.

- D. Special Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.
- E. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved Special Inspector who is present in the area where the work is being performed.
- F. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved Special Inspector who is present in the area where the work is being performed and at the completion of the work.
- G. Special Inspector: A qualified person who has demonstrated competence, to the satisfaction of the Building Official, to perform inspection of the particular type of construction or operation requiring special inspection.
- H. Statement of Special Inspections: The quality assurance plan contained on the contract drawings establishing the systems and components subject to special inspection and testing, as well as the frequency of testing and extent and duration of the special inspection.
- I. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.03 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

References to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
-----------	-------

Quality Assurance, Inspection and Testing
01400-2

Contract 2
Bid Issue

Reference	Title
ASCE 7-5	Minimum Design Loads for Buildings and Other Structures
ASTM C1093	Practice for Accreditation of Testing Agencies for Unit Masonry
ASTM E329	Practice for Use in Evaluation of Inspection and Testing Agencies as Used in Construction
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.3	Structural Welding Code – Sheet Steel
AWS D1.4	Structural Welding Code – Reinforcing Steel
AWS D1.6	Structural Welding Code – Stainless Steel
AWS QC 1	Standard for AWS Certification of Welding Inspectors
IBC	International Building Code with local amendments
ICC-ES	International Code Council – Evaluation Service Reports and Legacy Reports

1.04 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Fabricator Approval: Certification showing that fabricator is registered and approved to perform shop fabrication without special inspection.
2. Certificates of Compliance: Certificates of compliance shall be submitted stating that materials and products meet specified standards.
3. Contractor Statement: Prior to start of construction, Contractor shall submit statement of responsibility containing the following:
 - a. Acknowledgement of awareness of special inspection requirements.
 - b. Acknowledgement that control will be exercised to obtain conformance with documents approved by the Building Official.
 - c. Procedures for exercising control within the Contractor's organization.
 - d. Identification and qualifications of persons exercising control.
4. Testing Laboratory Qualifications: Prior to start of construction, submit latest inspection report of testing laboratory facilities indicating current accreditation by the accreditation authority.

1.05 STRUCTURAL OBSERVATION

A licensed engineer acting as the Owner's agent shall make visual inspections of the work to assess general conformance with the Contract Documents at significant construction stages and at completion of the structural system.

The following structural milestones shall be considered significant construction stages:

1. Structural fill.
2. Foundations prepared for concrete placement.
3. Preparation of masonry walls with reinforcing in place prior to placement of grout.
4. Completion of cmu bearing walls.
5. Steel roof framing, prior to cover-up with non-structural elements.
6. Completion of lateral force resisting elements including diaphragms, shear walls, and other elements.
7. Completion of structural system after all significant architectural, mechanical, plumbing, heating/ventilation equipment, electrical, and finish elements are installed.

1.06 INSPECTION AND TESTING

The Construction Manager/Resident Project Representative may throughout the duration of construction, inspect construction and require the Contractor to test materials to assure Contractor conformance with these specifications. Special inspections and associated testing, as shown on the drawings, will also be performed by approved Special Inspectors for compliance with IBC. This testing will be in addition to that otherwise required of the Contractor in this and other specification sections.

1.07 COSTS

- A. Paid by the Owner: None
- B. Paid by the Contractor:
 1. Testing to demonstrate and document conformance with the Contract Documents and applicable permits and codes, with the exception of Special Inspections and associated testing for compliance with IBC, Chapter 17 as identified in paragraph 1.07A above.
 2. Retesting and re-inspections required due to defective work.

Quality Assurance, Inspection and Testing

01400-4

3. Testing performed for the convenience of the Contractor.
4. Mechanical and electrical component testing and certification.
5. Required inspections of fabricator(s) not registered and approved to perform shop fabrication without special inspection.
6. Special inspections and testing, as specified in this Section, will be paid by the Contractor. A cash allowance in the bid form has been included to cover these costs. Retests and re-inspections required due to defective work are also included.

1.08 CONTRACTOR'S RESPONSIBILITIES

Contractor shall cooperate with testing personnel. Contractor shall provide access to the work and supplier's operations.

Contractor shall deliver adequate samples of materials proposed to be used and which require testing to the Testing Laboratory or as otherwise directed by the Construction Manager/Resident Project Representative.

Contractor shall furnish casual labor and facilities, including but not limited to obtaining and handling samples, repairing of test areas to match original conditions, storage and curing of samples, etc.

Contractor shall provide all testing required to demonstrate compliance with the Contract Documents as well as all special inspections. Additional testing requirements are specified in the technical specification sections.

For all Contractor-required testing, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329.

1.09 SPECIAL INSPECTOR'S RESPONSIBILITIES

Special Inspector shall keep records of inspections.

Special Inspector shall provide inspection reports to the Resident Project Representative/Construction Manager and Building Official.

Special Inspector shall provide a final report documenting special inspections and correction of any discrepancies noted in the inspections to the Resident Project Representative/Construction Manager and Building Official.

Special Inspector shall attend pre-construction conferences and construction progress meetings if requested by the Resident Project Representative/Construction Manager.

1.10 APPROVED AGENCY'S RESPONSIBILITIES

The Approved Agency shall employ personnel experienced and trained to perform the types of tests or inspections required for this project.

The Approved Agency personnel performing testing of welds shall be certified in accordance with AWS QC 1.

1.11 SPECIAL INSPECTION AND TESTING REPORTS

A. REPORT CONTENTS:

At a minimum, Special Inspection and Testing Reports shall include the following:

1. Project name and date of report.
2. Testing laboratory name, address, telephone number, name of laboratory field sampling personnel, and name of lab testing personnel, as applicable.
3. Date, time, and location of sampling, testing, and inspecting.
4. Ambient temperature and weather conditions at the site or shop and curing conditions of samples.
5. Product identification and referenced specification section number.
6. Type of sample, test, and inspection and industry standard for sampling and testing.
7. Results of sample, test, and inspection.
8. Evaluation of compliance with requirements in Contract Documents.

B. DISTRIBUTION OF REPORTS:

Test and Inspection reports shall be submitted to the Resident Project Representative/Construction Manager and distributed by the Testing Laboratory as directed by the Resident Project Representative/Construction Manager. Draft field test and inspection reports shall be submitted to the Resident Project Representative/Construction Manager prior to the Special Inspector departing the project site. Final test and inspection reports shall be submitted not more than three days after completion of required tests and inspections. Inspection reports shall be submitted immediately to the Resident Project Representative/Construction Manager if deficiencies or significant irregularities are noted. Provide two legible reproducible copies of all draft field reports and one copy of all final reports.

PART 2 PRODUCTS

Quality Assurance, Inspection and Testing
01400-6

Contract 2
Bid Issue

NOT USED.

PART 3 EXECUTION

3.01 GENERAL:

The Contractor shall furnish access to the Work as required for special inspections, testing and structural observations.

The Contractor shall notify the Resident Project Representative/Construction Manager in advance of required special inspections and structural observation no later than 3 days prior to the date of the inspection.

Contractor shall correct defective work at no additional cost to the Owner.

Structural observation will be performed by a registered professional engineer.

3.02 TESTING

Component and attachment testing shall be required of component manufacturers for mechanical and electrical components subject to special inspections for seismic resistance. The Contractor shall submit a certificate of compliance prepared by the component manufacturer.

Certificates of Compliance shall include the manufacturer's name and address; applicable Drawing and Detail number, products, units and assemblies, and system equipment identification.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01410

TESTING LABORATORY AND SPECIAL INSPECTION SERVICES

PART 1--GENERAL

1.01 DESCRIPTION

- A. This Section specifies Quality Control testing and reporting performed by the Testing Laboratory and Special Inspector. The CONTRACTOR shall select a qualified Testing Laboratory and Special Inspector(s) and contract for the services specified herein. Such an arrangement does not relieve the Contractor from their responsibility to provide the completed project as specified, and to perform Quality Assurance according to the QCS as reviewed and accepted.

1.02 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A880	Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C802	Conducting an Inter-laboratory Test Program to Determine the Precision of Test Methods for Construction Materials
ASTM C1077	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1093	Accreditation of Testing Agencies for Unit Masonry
ASTM D3666	Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D3740	Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4561	Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
ASTM E4	Force Verification of Testing Machines
ASTM E329	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E543	Agencies Performing Nondestructive Testing
ASTM E994	Calibration and Testing Laboratory Accreditation Systems General Requirements for Operation and Recognition.
IBC	International Building Code with local amendments

2.01 TESTING LABORATORY QUALIFICATIONS

A. Testing Laboratory shall satisfy the following qualifications:

1. Recommended Requirements for Independent Laboratory Qualification, published by American Council of Independent Laboratories.
2. Conform to the requirements of ASTM E329 in particular, and other reference standards as generally pertain to this project.

Testing Laboratory and Special Inspection Services
01410-2

3. Authorized to operate in the State of Arizona, with personnel and equipment based sufficiently close to the project to allow short-notice site access for sampling and testing.
4. Acceptable to OWNER, RESIDENT PROJECT REPRESENTATIVE/CONSTRUCTION MANAGER, and local building authorities.

2.02 TESTING LABORATORY RESPONSIBILITIES

- A. Testing Laboratory shall provide qualified personnel at the site and cooperate with Resident Project Representative/Construction Manager and Contractor in performance of the following services:
 1. Perform specified independent inspection, sampling, and testing of products in accordance with specified standards, to determine compliance with requirements of Contract Documents.
 2. Provide sampling equipment and personnel, deliver samples to the testing laboratory, record field measurements, and cure samples as required by Contract Documents.
 3. Perform Building Department required tests and inspections, including Special Inspection as specified in Section 01400.
 4. Timely prepare and deliver reports summarizing results of tests and inspections.
 5. Attend pre-construction conferences and, if requested, a limited number of progress meetings where Quality Control, testing, and inspection issues require discussion.
 6. When directed by the Resident Project Representative/Construction Manager or requested by the Contractor, provide special and additional tests and inspections to verify material compliance with requirements of Contract Documents.
 - a. Contractor shall pay for special tests and inspections where work conforms to the Contract Document requirements.
 - b. Contractor shall pay for additional tests and inspections where work fails to comply with Contract Document requirements (re-inspection) and for costs associated with cancelled or short-notice re-scheduling of requested sampling, testing, and inspection. Testing Laboratory work requested by Contractor to fulfill submittal requirements shall also be considered additional tests.

2.03 SPECIAL INSPECTOR'S RESPONSIBILITIES – SEE SECTION 01400.

2.04 CONTRACTOR RESPONSIBILITIES

- A. Contractor shall coordinate with the Testing Laboratory to ensure adequate samples of materials proposed to be used and which require testing are tested in accordance with Section 01400, 02200, 02743, 03300. Contractor shall provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
- B. Contractor shall notify Resident Project Representative/Construction Manager 24 hours prior to expected time for operations requiring inspection, sampling and testing services unless otherwise noted.

2.05 TEST AND INSPECTION REPORTS

- A. REPORT CONTENTS. At a minimum, Test and Inspection Reports shall include the following:
 - 1. Project name and date of report.
 - 2. Testing Laboratory name, address, telephone number, name of laboratory field sampling personnel, and name lab testing personnel, as applicable.
 - 3. Date, time, and location of sampling, testing, and inspecting.
 - 4. Ambient temperature and weather conditions at the site or shop and curing conditions of samples.
 - 5. Product identification and referenced specification Section number.
 - 6. Type of sample, test, and inspection and industry standard for sampling and testing.
 - 7. Results of sample, test, and inspection.
 - 8. Evaluation of compliance with requirements in Contract Documents.
 - 9. Certified Inspection Reports shall specifically indicate the qualification of the inspector to render judgment and certify said inspection.
 - 10. When requested by Resident Project Representative/Construction Manager, interpretation of test results.
- B. Distribution of test and inspection reports

1. Test and Inspection reports shall be submitted to the Resident Project Representative/Construction Manager for distribution as directed by the Resident Project Representative/Construction Manager. Test reports shall be submitted not more than two days after completion of required tests. Inspection reports shall be submitted immediately if deficiencies or significant irregularities are noted, and in no case less than two working days after said inspection. Provide two (2) copies of all reports.

2.06 SUBMITTALS

A. The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Documentation of conformance with Testing Laboratory Qualifications as specified in paragraph 1.03 herein.
3. Form A described in paragraph 3.03 herein, by both Testing Laboratory and Contractor.

2.07 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Testing Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents. Testing Laboratory may not approve or accept any portion of the work, nor assume any duties of Contractor. Testing Laboratory has no authority to stop the work

PART 3--PRODUCTS

3.01 SOURCE QUALITY CONTROL

A. GENERAL

1. This Section provides general guidelines as to the sampling, tests, and inspections required of products and manufactures prior to delivery to the project site, and should be considered a minimum. Additional information and requirements are provided in each technical specification Section and those requirements shall control over this Section when in conflict. Absence of a test, inspection or requirement listed herein from a subsequent specification Section does not relieve the Testing Laboratory or the Contractor from their respective responsibilities specified in this Section.

B. REFERENCE STANDARDS IN OTHER SECTIONS

1. Codes, standards, and other references called out below, but which are not listed in paragraph 1.02 are described in other specification Sections and not repeated herein.

C. FILL MATERIALS

1. IMPORTED FILL MATERIALS: Testing Laboratory may conduct additional testing on behalf of Contractor to prepare required submittals specified in Standard Drawings and Specifications and/or Section 02200.
2. "UNCLASSIFIED" FILL MATERIAL: Testing Laboratory shall conduct required testing to verify on-site materials proposed for fill conforms to specification Section 02200. Contractor shall pay Testing Laboratory for such sampling and testing. Sampling and testing shall determine Liquid Limit, Plasticity Index, optimum moisture content and density relationship, and other data as required for proper use of this material.

D. PAVING MATERIALS

1. Provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to the Contract Documents and specification Sections 02200 and 02743.

E. CONCRETE REINFORCING

1. Provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by

Testing Laboratory and Special Inspection Services
01410-6

Contractor to verify materials proposed for use conform to the Contract Documents.

F. CAST-IN-PLACE CONCRETE

1. Provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to the Contract Documents. At Contractor's expense, Testing Laboratory may assist Contractor in formulating concrete mix designs, testing and reporting same, and providing the services of a Professional Engineer to review and seal the mix design.

G. PRECAST CONCRETE

1. PRECAST YARD INSPECTION: Source quality inspection is not required for PCI Certified facilities unless otherwise directed by the Building Official.
2. NON PCI CERTIFIED FACILITIES: Provide Special Inspection for all facets of operation including reinforcing, prestressing, concrete placing, finishing, and curing, form release and handling.
3. VAULTS, MANHOLES, AND NON-STRUCTURAL PRECAST CONCRETE ITEMS: Precast yard inspection is not required unless so directed by the Resident Project Representative/Construction Manager due to quality concerns or lack of experience by the manufacturer. Such inspection and testing shall be paid for by the Contractor, and conform to this Section's requirements, as well as the Contract Documents.

H. MASONRY

1. CONFIRMATION OF MASONRY ASSEMBLAGE Form: Prism testing shall be used as specified in Section 04200 and shall be tested as Field Quality Control.

I. STRUCTURAL STEEL

1. SHOP WELD INSPECTION FOR STRUCTURAL STEEL, AND STEEL FABRICATIONS: Special Inspector that is a AWS Certified Welding Inspector shall visually inspect 100 percent of structural welds and will inspect 25 percent of fillet welds greater than 5/16 inch, 100 percent of butt welds, moment connection welds, and full penetration groove welds by ultra-sonic or magnetic particle inspection. Acceptance Criteria: AWS D 1.1. Paragraph 8.15.1 for visual inspection and Paragraphs 8.15.2.1 and 8.15.2.2 for ultra-sonic or magnetic particle inspection.

Testing Laboratory and Special Inspection Services
01410-7

2. SHOP INSPECTION OF HIGH-STRENGTH BOLTED CONNECTIONS: Special Inspector will Inspect 100 percent of high-strength bolted connections according to AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts." All such bolts shall be fully tensioned unless otherwise noted on the drawings.
3. MATERIALS' CONFORMANCE TO SPECIFICATIONS: Special Inspector shall sample and test such items to ensure Standard Compliance for any specified steel materials, connection hardware, and details for which mill certificates or other required certificates have not been submitted. Contractor shall pay for the cost of such sampling, additional testing, and reporting.

J. STEEL DECK

1. Special Inspector provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to specification Section 05311.

K. COLD FORMED STEEL FRAMING AND TRUSSES

1. Special Inspector provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to specification Section 05210.

L. ROUGH CARPENTRY

1. Special Inspector provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to specification Sections 06100 and 06160.

M. MISCELLANEOUS METALWORK, GRATING, GUARDRAILING

1. Special Inspector provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to specification Sections 05505, 05520, and 05530

N. PLASTIC LINING FOR STRUCTURES -NOT USED

O. COATING SYSTEMS

1. Special Inspector provide sampling and testing requested by Resident Project Representative/Construction Manager or additional testing as requested by Contractor to verify materials proposed for use conform to Contract Documents.

P. ENGINEERED METAL BUILDINGS – NOT USED

PART 4--EXECUTION

4.01 FIELD QUALITY CONTROL

A. GENERAL

1. This Section provides general guidelines as to the sampling, tests, and inspections required of work in progress or completed in the field, and should be considered a minimum. Additional information and requirements are provided in each technical specification Section and those requirements shall control over this Section when in conflict. Absence of a test, inspection or requirement listed herein from a subsequent specification Section does not relieve the Testing Laboratory, Special Inspector or the Contractor from their respective responsibilities specified in this Section.

B. REFERENCE STANDARDS IN OTHER SECTIONS

1. Codes, standards, and other references called out below, but which are not listed in paragraph 1.02 are described in other specification Sections and not repeated herein.

C. FILL

1. SUBGRADE PREPARATION AND COMPACTION: Verify depth of scarification, moisture content within optimal limits for compaction, and degree of compaction specified in Section 02200. Frequency of testing shall generally conform to 25 foot maximum spacing for strip footings, each isolated pad footing, every 900 square feet for slabs and mat foundations, or as directed by the Resident Project Representative/Construction Manager in light of actual geometry and conditions extent.
2. STRUCTURE FILL: Verify material provided, lift thickness, and compaction density. Frequency of sampling and testing shall be the same as for Subgrade Preparation and Compaction.
3. STRUCTURE BACKFILL: Verify material provided, lift thickness, and compaction density. Frequency of sampling and testing shall be as

Testing Laboratory and Special Inspection Services
01410-9

directed by the Resident Project Representative/Construction Manager but not less than every 2 feet vertical (lifts) and every 1600 square feet of filled area.

4. PIPE TRENCH BACKFILL: Verify material provided, lift thickness, and compaction density. Frequency of sampling and testing for Bedding, pipe zone, and trench back fill shall be at performed intervals no greater than 500 feet. Testing at minimum shall be performed at the spring line on both sides of the pipe and at 12-inches above the crown of the pipe.
5. OTHER FILL MATERIALS: Verify material used, lift thickness, and compaction density. Frequency of sampling and testing shall be as directed by the Resident Project Representative/Construction Manager.

D. PAVING

1. Earthwork and Base Aggregate: Provide sampling and testing same as Fill described above, and specified in Section 02200. Frequency shall conform to Asphalt Concrete Pavement, below.
2. Asphalt Concrete Pavement: Sample and test pavement thickness and installation per Contract Documents and/or the agency with jurisdiction over the Right-of-way. Thickness verification shall be made at a frequency not to exceed 1600 square feet of roadway or parking zones or as directed by the Resident Project Representative/Construction Manager.
3. Sitework Concrete at Pavement: Sitework concrete at pavement consists of curbs, gutters, monolithic curb/sidewalk, inlet structures, catch basins, and other concrete construction in contact with paving or necessary for a complete paving job but not associated with buildings, process structures, or structural work controlled by the IBC. Testing Laboratory shall conduct sampling and testing in accordance with the Contract Documents and governing agency over the Right-of-Way and improvements.

E. CONCRETE REINFORCING

1. Provide Special Inspection for all structural reinforcing in concrete and masonry.
2. Provide Special Inspection for mechanical reinforcing connectors and splicing systems as required by that product's ICBO Evaluation Report, or equivalent.

F. CAST-IN-PLACE CONCRETE

1. Sample the first daily truck load of ready mixed concrete and every 50 cubic yards thereafter, complying with ASTM C 172.
2. Perform one slump test for the first daily truck load of ready mixed concrete and every 50 cubic yards thereafter or as requested by Resident Project Representative/Construction Manager if consistency is in question, complying with ASTM C 143.
3. Perform one air content test for each set of compressive strength specimens, complying with ASTM C 31.
4. Fabricate compressive strength specimens, complying with ASTM C 39.
5. Make one set of 6 of compressive strength specimens for each day of structural concrete placing or each 100 cubic yards or fraction thereof for each class of concrete.
6. Test two specimens after curing 7 days, two specimens after curing 28 days, and retain two specimens for later testing if required.
7. Comply with ACI 308 Section 5.6 (ACI 318 for non-water retaining structures) for evaluation and acceptance of concrete.

G. PRECAST CONCRETE

1. SITE INSPECTION OF PRECAST CONCRETE STRUCTURAL ASSEMBLIES: Visually inspect precast plank, beam, hollowcore, or other precast systems after units are set in place, mechanically anchored, reinforcing and details completed but prior to placing concrete or grout which would prevent such inspection. Verify precast pieces conform to expected geometry, bearing conditions and camber.
2. COMPLETION OF PRECAST CONCRETE STRUCTURAL ASSEMBLIES: Inspect reinforcing, placement of concrete or grout fill as specified for those materials.

H. ANCHOR BOLTS AND ANCHORS

1. SPECIAL INSPECTIONS: Provide Special Inspection for wedge anchors, undercut anchors, adhesive anchors, epoxy anchors, and all other anchoring systems installed in hardened concrete and masonry as required by that product's ICBO Evaluation Report, or equivalent.
2. SITE INSPECTION OF STRUCTURAL ANCHOR BOLTS: Visually inspect all structural anchor bolts for grade, diameter, embedment, geometry or type ("J" bolt or hex-head), quantity and general location.

Testing Laboratory and Special Inspection Services
01410-11

Contractor shall assume all responsibility for detailed dimensions locating each individual bolt, each bolt group in total, and locations of bolts within each group (template).

I. GROUT

1. SITE INSPECTION OF MASONRY GROUTING: See Masonry section of this specification.
2. CEMENTITIOUS GROUT FOR EQUIPMENT BEARING: Visually inspect all cementitious grout to verify it has been placed and cured in accordance with the requirements of Section 03600 and the Contract Documents.
3. EPOXY GROUT FOR EQUIPMENT BASES: Visually inspect all epoxy grout for equipment mounting to verify it has been placed and cured in accordance with the requirements of Section 03600 and the Contract Documents.

J. MASONRY

1. CONFIRMATION OF MASONRY ASSEMBLAGE f'm: Demonstrate conformance with specified f'm using prism testing. Prism preparation and testing shall conform to IBC, and be at Contractor's expense as additional testing except for Special Inspection observation, inspection, and reporting defined therein.
2. INSPECTION OF REINFORCING, MASONRY LAYUP, AND GROUTING: Special Inspector shall provide all inspections in accordance with IBC Chapter 17.

K. STRUCTURAL METALS

1. SHOP WELD INSPECTION FOR STRUCTURAL STEEL, AND STEEL FABRICATIONS: AWS Certified Welding Inspector shall visually inspect 100 percent of structural welds and will inspect 25 percent of fillet welds greater than 5/16 inch, 100 percent of butt welds, moment connection welds, and full penetration groove welds by ultra-sonic or magnetic particle inspection. Acceptance Criteria: AWS D 1.1. Paragraph 8.15.1 for visual inspection and Paragraphs 8.15.2.1 and 8.15.2.2 for ultra-sonic or magnetic particle inspection.
2. SHOP INSPECTION OF HIGH-STRENGTH BOLTED CONNECTIONS: Special Inspector - inspect 100 percent of high-strength bolted connections according to AISC "Specification for Structural Joints

Using ASTM A325 or A490 Bolts.” All such bolts shall be fully tensioned unless otherwise noted on the drawings.

3. MATERIALS’ CONFORMANCE TO SPECIFICATIONS: Special Inspector shall sample and test such items to ensure Standard Compliance for any specified steel materials, connection hardware, and details for which mill certificates or other required certificates have not been submitted. Contractor shall pay for the cost of such sampling, additional testing, and reporting.

L. COLD FORMED STEEL FRAMING AND TRUSSES

1. SITE WELD INSPECTIONS FOR STEEL DECK, COLD-FORMED METAL FRAMING, AND STEEL PAN STAIR SYSTEMS: See structural steel requirements except reference AWS D1.3 for light gage metals.
2. SCREWED ATTACHMENTS AND CONNECTIONS: Special Inspector visually confirm fastener grade, size, quantity and location for each truss to support connection, and 25 percent of other screwed connections.
3. BOLTED CONNECTIONS: Special Inspector visually inspect all bolted connections for fastener size, grade, and nut in snug tight condition. For high-strength bolts required to be fully tensioned, see structural steel requirements.

M. STEEL ROOF DECK

1. STEEL ROOF DECK: Special Inspector verify deck depth, gage (thickness), galvanizing, attachment to framing type, size, and frequency, sidelap fastening, and detail connections shown on the Drawings. Provide 100 percent visual inspection of all such decks, or other test method as dictated by supplier of alternate fastening systems, if any.
2. COMPOSITE STEEL DECK: Special Inspector verify deck depth, gage (thickness), galvanizing, attachment to framing type, size, and frequency, sidelap fastening, composite anchors type, size, spacing and attachment to framing, and detail connections shown on the Drawings. Provide 100 percent visual inspection of all such decks, or other test method as dictated by supplier of alternate fastening systems, if any. Inspect composite shear connectors as described in Structural Steel.

N. ROUGH CARPENTRY

1. CONVENTIONAL FRAMING WITH SAWN LUMBER: Special Inspector visually inspect for size and grade of sawn lumber bearing wall

Testing Laboratory and Special Inspection Services
01410-13

elements, joists, rafters, and beams. Visually inspect for adequate bearing on supporting elements.

2. **ENGINEERED AND MANUFACTURED WOOD JOISTS, BEAMS AND POSTS:** Special Inspector visually inspect for size, type, and manufacturer's product grade for all elements using engineered and manufactured wood including glu-laminated members. Verify tension rated lamination of glu-laminated beams is properly oriented. Visually inspect for adequate bearing on supporting elements.
3. **ENGINEERED WOOD TRUSSES:** Special Inspector visually inspect against reviewed and accepted manufacturer's shop drawings, including general shape, chord and web sizes, bridging and bracing, and adequate bearing.
4. **ROOF AND WALL SHEATHING:** Special Inspector visually inspect for specified thickness and plies, Index, APA rating, strength axis across supporting members, staggered layout on roofs and floors, blocking or clips, edge nailing and field nailing.
5. **CONNECTORS:** Special Inspector verify bolted and nailed connections conform to specifications. In particular, visually inspect "gun nails" for conformance to specified common nail diameters and lengths. Inspect cold-formed steel framing connectors, rafter/truss ties, straps and seismic hold-downs according to ICBO Evaluation Report descriptions, controlling Code or specified standard. Inspect split ring connectors and their bolting.

O. MISCELLANEOUS METALWORK, GRATING, GUARDRAILING

1. **MISCELLANEOUS METALWORK:** Special Inspector provide field inspections and testing if requested by Construction Manager for the work specified in Section 05505. Sampling and testing shall conform to the applicable Reference Standard or Code listed in that section.
2. **GRATING AND GUARDRAILING:** Special Inspector provide field inspections and testing if requested by Construction Manager for the work specified in Sections 05505 and 05530. Sampling and testing shall conform to the applicable Reference Standard or Code listed in those sections.

P. PLASTIC LINING FOR STRUCTURES – Not Used

Q. COATING SYSTEMS

1. FLEXIBLE, WATERTIGHT COATINGS ON CONCRETE: Special Inspector provide field inspections specified for coating system per Section 09900.
2. OTHER COATING SYSTEMS: Special Inspector provide inspection as requested by Resident Project Representative/Construction Manager, and additional inspections as requested by Contractor.

R. ENGINEERED METAL BUILDINGS – NOT USED

4.02 EVALUATION AND CORRECTION

A. EVALUATION

1. Satisfactory completion of work will be judged on results of laboratory, shop, and site tests and inspections.

B. CORRECTIONS

1. If results of tests and inspections indicate work is below requirements of Contract Documents, that portion of work is defective and shall be repaired or replaced by the Contractor at no additional expense to the OWNER by methods specified in each material or system's Section. Corrective action shall continue until such work meets the requirements of the Contract Documents.

4.03 SCHEDULE OF INSPECTIONS AND TESTS

- A. Form A below shall be used to coordinate sampling and testing provided by Testing Laboratory, Special Inspector, Resident Project Representative/Construction Manager, Contractor, and other parties, if any. Testing Laboratory shall fill out Form A with anticipated inspections, sampling, and testing, submit for review by Resident Project Representative/Construction Manager and for information to Contractor, and revise as directed. After receipt of Testing Laboratory's/Special Inspector Form 01410-A submittal, Contractor shall submit Form 01410-A to identify sampling and testing requested for submittal preparation, and with an allowance for additional inspections. Such allowance shall not be less than five percent (5%) of the anticipated Field Quality Control budget for the Testing Laboratory and Special Inspector, but shall not contractually commit Contractor to such expenditure, unless additional inspections requested and then only to their extent.

FORM 01410-A

ANTICIPATED SAMPLING, TESTING, AND INSPECTIONS BY TESTING
LABORATORY AND CONTRACTOR

Prepared by: Testing Laboratory, Special Inspector, Contractor (check one).

Electronic version available upon request. Expand each cell as necessary to provide a complete scope description.

Specification Section	Source Quality Control	Field Quality Control
02200 Earthwork		
02743 Asphalt Concrete Pavement		
03200 Concrete Reinforcement		
03300 Cast-In-Place Concrete		
03600 Grout		
04200 Masonry		
05100 Structural Metals		
05210 Steel Joist		
05311 Steel Roof Deck		
05501 Anchors		
05505 Miscellaneous Metalwork		
05530 Grating, Floor Plates, Stairs		
06100 Rough Carpentry		
06160 Sheathing		
09900 Finishes		

****END OF SECTION****

SECTION 01500

CONTRACTOR'S UTILITIES

1.0 OFFICE

The Contractor shall maintain a suitable office at the site of the work.

2.0 POWER

The Contractor shall provide power for construction at the plant site. He shall make arrangements with the electrical utility and with the Owner for power takeoff points, voltage and phasing requirements, transformers and metering and shall pay the costs and fees arising therefrom. The Contractor shall provide the special connections required for his work.

3.0 TELEPHONE

The Contractor shall provide telephone service at his construction site office. Radio-telephone service is not acceptable as a substitute for telephone service.

4.0 SANITARY FACILITIES

The Contractor shall provide toilet and washup facilities for his work force at the site of work. The facilities shall comply with applicable laws, ordinances, and regulations pertaining to the public health and sanitation of dwellings and camps.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01560

ENVIRONMENTAL CONTROLS

1.0 SITE MAINTENANCE

The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

2.0 TEMPORARY DAMS

Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sand bags, asphaltic concrete, or other acceptable material will be permitted when necessary to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.

Measures to protect and maintain water quality shall be in accordance with Section 01561 STORM WATER POLLUTION PREVENTION PLAN (SWPPP).

3.0 AIR POLLUTION CONTROL

The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of any legally constituted authority. He shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water, in amounts which result in mud on public streets, is not acceptable as a substitute for sweeping or other methods.

4.0 NOISE CONTROL

Between 7:30 p.m. and 7:00 a.m., noise from Contractor's operations shall not exceed limits established by applicable laws or regulations and in no event shall exceed 86 dBA at a distance of 50 feet from the noise source.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01561

STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

PART 1--GENERAL

1.01 SCOPE

- A. The CONTRACTOR shall provide all labor, equipment, materials, and services to acquire, prepare, implement and maintain best management practices (BMP) under a Construction General Permit (CGP) and Stormwater Pollution Prevention Plan (SWPPP) for construction activities that may adversely impact water quality.
1. The U. S. Environmental Protection Agency (EPA), Pacific Southwest, Region 9 is the permitting authority for all regulated stormwater discharges on Indian Lands. More information on stormwater permitting on Indian Lands within Arizona is available online at U.S. EPA and U.S. EPA Region 9 NPDES Stormwater Program at:

<http://www.epa.gov/region09/water/npdes/stormwater.html>
 2. Definitions shall be in accordance with EPA
 3. For information about the storm water program in EPA's Pacific Southwest Region (AZ, CA, NV, Pacific Islands, and Tribal lands), contact: Eugene Bromley, bromley.eugene@epa.gov (415) 972-3510, or Andrew Sallach, sallach.andrew@epa.gov, (415) 972-3503.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit record copies of the following documents to the CONSTRUCTION MANAGER:
1. Approved Notice of Intent (NOI)
 2. Approved SWPPP and amendments
 3. Notice of Termination (NOT) following completion of construction and final /permanent stabilization
 4. Inspection and non-compliance reports that at a minimum include name of the inspector, time and date, reason for the inspection, and any findings on the conditions of the SWPPP controls and any location(s) of discharges of sediments or other pollutants from the site, BMP's that require maintenance,

additional BMPs required, corrective actions to be taken, and evidence of or potential for pollutant discharge from the site.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The CONTRACTOR shall complete a Storm Water Pollution Prevention Plan (SWPPP) that complies with all Federal, State and local requirements.
 - 1. The Storm Water Pollution Prevention Plan shall be developed in accordance with the permit requirements and EPA guidebook, "Storm Water Management for Construction Activities, Developing Pollution Plans and Best Management Practices" (EPA publication number 823-R-92-005). The guidebook is a reference for information relating to the different methods of stormwater pollution prevention presented in this SWPPP.
 - 2. The CONTRACTOR shall amend the SWPPP as necessary during completion of the Work if there are changes to the site that significantly affect the discharge of pollutants or if inspection or investigation determine the approved SWPPP is no longer effective at mitigating pollutants in stormwater discharges.
- B. The CONTRACTOR shall provide a "qualified person" to perform inspections according to the inspection schedule provided in the approved SWPP, before and/or during predicted rain events and "spot" inspections as requested by the CONSTRUCTION MANAGER to ensure Best Management Practices (BMPs) are in place and maintained.
 - 1. A "qualified person" is a person knowledgeable in the principles and practice of erosion and sediment controls and pollution prevention, who possesses the skills to assess conditions at the construction site that could impact stormwater quality, and the skills to assess the effectiveness of any stormwater controls selected and installed to meet the requirements of the SWPPP and CGP.
- C. The CONTRACTOR shall maintain a copy of the approved grading and drainage plan, NOI, up to date SWPP and inspection reports on site available for review at all times.
- D. Construction Wastes: The CONTRACTOR is responsible for proper disposal of all construction wastes in accordance with all applicable Federal, State, and local codes.

1. Unless otherwise required by code, construction wastes shall be disposed of in a proper manner via use of an on-site dumpster supplied by the CONTRACTOR. The CONTRACTOR shall provide removal services by a licensed solid waste management firm. The dumpster shall be emptied a minimum of once per week or more often if necessary. Burial of construction wastes on-site is not permitted. The CONTRACTOR shall ensure that the CONTRACTOR on-site work crews and subcontractors are trained in the proper manner of disposal for construction wastes.
- E. Sanitary Wastes: Disposal of sanitary waste from the construction site shall meet all applicable Federal, State, and local codes.
1. The CONTRACTOR shall hire a licensed sanitary waste management firm for the disposal of the sanitary waste from the construction site, including from the CONTRACTOR's trailers.
- F. Hazardous Wastes: All hazardous materials used for the construction shall be stored, handled, and applied per the manufacturer's printed instructions and per all applicable Federal, State, and local codes.
1. The CONTRACTOR shall ensure that the on-site work crews and subcontractors are trained in the proper manner of disposal for hazardous wastes. The disposal of hazardous wastes from the construction site shall be the responsibility of the CONTRACTOR and shall be performed by a licensed hazardous wastes management firm.
- G. Construction access shall be stabilized to prevent the removal of sediment from the construction site onto the adjacent property or paved road. The stabilized access roadway shall be wide enough to handle the anticipated truck traffic to and from the construction site.

PART 2--PRODUCTS

- A. NOT USED

PART 3--EXECUTION

3.01 MAINTENANCE AND INSPECTION

- A. Perform joint inspections with the CONSTRUCTION MANAGER per the approved SWPPP schedule and after any storm event unless otherwise specified.
- B. All erosion control structures and stabilization practices shall be maintained in good working condition throughout the duration of the construction project.

1. Remove accumulated sediment and debris from silt fences before it loses thirty percent (30%) or its storage capacity. Remove accumulated sediment and debris before other BMP lose fifty percent (50%) of storage capacity.
- C. Repair of the damage to any erosion control structure shall commence within 24 hours of discovery of the damage.

3.02 SPILL PREVENTION

- A. Only materials used for completion of Work performed as part of this construction project shall be stored on-site.
- B. The handling and storage of all materials shall follow the Manufacturer's written instructions, the site conditions, project Specifications, or applicable governmental codes; whichever is most stringent. Materials shall be stored in a neat and orderly fashion in their original containers.
- C. When transferring or unloading materials, the CONTRACTOR shall ensure that the area is protected from discharge into protected areas and that the materials transfer operation shall not cause contamination to stormwater due to runoff from the materials transfer location.
- D. During adverse weather, as described in the General Conditions of the Contract Documents, and against the possibility thereof, the CONTRACTOR shall take all necessary precautions to ensure the protection of the construction materials storage area.

3.03 HAZARDOUS MATERIALS SPILL PREVENTION AND PRACTICES

- A. The following precautions shall be followed for hazardous materials:
 1. The CONTRACTOR shall keep the Material Safety Data Sheets of all hazardous materials at the Site.
 2. Products shall remain in their original containers with the original legible product label attached to the container. All products shall be used before disposal of the container.
 3. Hazardous materials shall be stored separately from non-hazardous material on-site.
 4. Hazardous materials, including diesel fuel, must be stored in contained areas which are able to contain 150 percent of the volume of the largest container's contents. If the area is not exposed to stormwater, the volume

of the containment area shall be 110 percent of the volume of the largest container's contents. Each hazardous material shall be stored in its own containment area. Under no circumstances shall hazardous materials be used or stored within 100-feet of any water supply well, unless specifically permitted by the CONSTRUCTION MANGER and governing Federal, State, or local codes.

At a minimum, the containment area shall be constructed with dikes and lined with a material resistant to the properties of the hazardous material being contained. Before removal of any stormwater from the containment area, a representative sample of water shall be tested for contamination by the hazardous material stored in that containment area. If the stormwater is found to be contaminated, the CONTRACTOR shall follow the spill control measures for this hazardous material.

5. Hazardous materials shall be disposed of in accordance with proper disposal procedures and in accordance with all Federal, State, or local codes.

B. PRODUCT SPECIFIC PRACTICES

1. Petroleum-Based Products: All on-site vehicles shall be properly maintained and checked for any leaks of fluid or petroleum-based products. If a leak is found, the vehicle shall be repaired immediately or removed from the Site. Diesel fuel shall be considered a hazardous material and shall be stored in a containment area as indicated above.
2. Acid and Base Chemicals: All acid and base chemicals are considered hazardous materials and shall be stored in containment areas as described above. Disposal of acid or base chemicals shall, under no circumstances, occur via dumping or via the storm drain system.
3. Paints, Thinners and Solvents: Paints, thinners, and solvents shall be stored in their original containers. Unused paints, thinners, and solvents shall not be dumped on-site or disposed through the sanitary or storm sewer system. Disposal of unused paints, thinners, and solvents shall be through proper hazardous materials disposal procedures.
4. Fertilizers and Pesticides: Fertilizers and pesticides shall be applied at the minimum rate recommended by the manufacturer. Before spraying any pesticide, a certified pesticide applicator shall receive a permit for spraying of the pesticide in a well field. Storage of fertilizers shall be transferred to sealable containers to prevent spillage and exposure to

stormwater. Fertilizer shall be worked into the soil upon application in a landscaped area.

5. Concrete Trucks: The washdown of concrete trucks or the disposal of unused or unacceptable concrete from a concrete truck will be permitted on-site only if the CONTRACTOR has set aside a specific area, with dikes to prevent contact between excess concrete and washdown water or stormwater. After the solids in the area have hardened, the CONTRACTOR shall dispose of the solids in a proper manner as approved by the CONSTRUCTION MANGER.

3.04 SPILL CONTROL PRACTICES

- A. In addition to the precautionary practices described above, the following practices shall be followed for spill prevention, control, cleanup, and notification:
 1. Any spills shall be cleaned up immediately.
 2. The CONTRACTOR shall notify the CONSTRUCTION MANGER, OWNER, and all applicable agencies if a spill occurs.
 3. Manufacturer's printed instructions for the cleanup of a spill shall be kept on-site by the CONTRACTOR at all times. The CONTRACTOR's work crews and subcontractors shall be required to be familiar with the requirements and procedures for spill cleanup. Equipment necessary for spill cleanup, such as gloves, metal containers, mops, etc., shall be maintained on-site by the CONTRACTOR. The cleanup equipment shall be kept on-site by the CONTRACTOR during construction activities.
 4. Workers involved in the cleanup of a spill shall be properly protected by protective suits, ventilation masks, goggles, and other necessary equipment, prior to contact with the spilled material.
 5. The CONTRACTOR shall name an employee who will be on-site full-time throughout the duration of the project as the spill cleanup coordinator. The spill cleanup coordinator will be responsible for notifying the proper personnel and agencies of a spill and obtaining the proper equipment and personnel to clean up the spill. The name and phone number where the spill cleanup coordinator can be reached at all times shall be posted on the Site. The spill cleanup coordinator shall be properly trained in spill cleanup procedures.

6. After a spill is contained and cleaned up, a spill occurrence report shall be completed by the on-site inspector and the SWPPP shall be modified to prevent a reoccurrence of a spill.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01580

PROJECT IDENTIFICATION SIGNS

The Contractor shall provide one 4-foot by 8-foot multicolored signboard with a multi-colored "U.S. Department of Agriculture Rural Development" emblem. Signboard shall be provided with 1-1/4-inch by 4-inch edging, shall be constructed of exterior grade high density overlaid plywood, and shall be mounted and located in an acceptable manner which will permit public viewing. Sign shall list the following information:

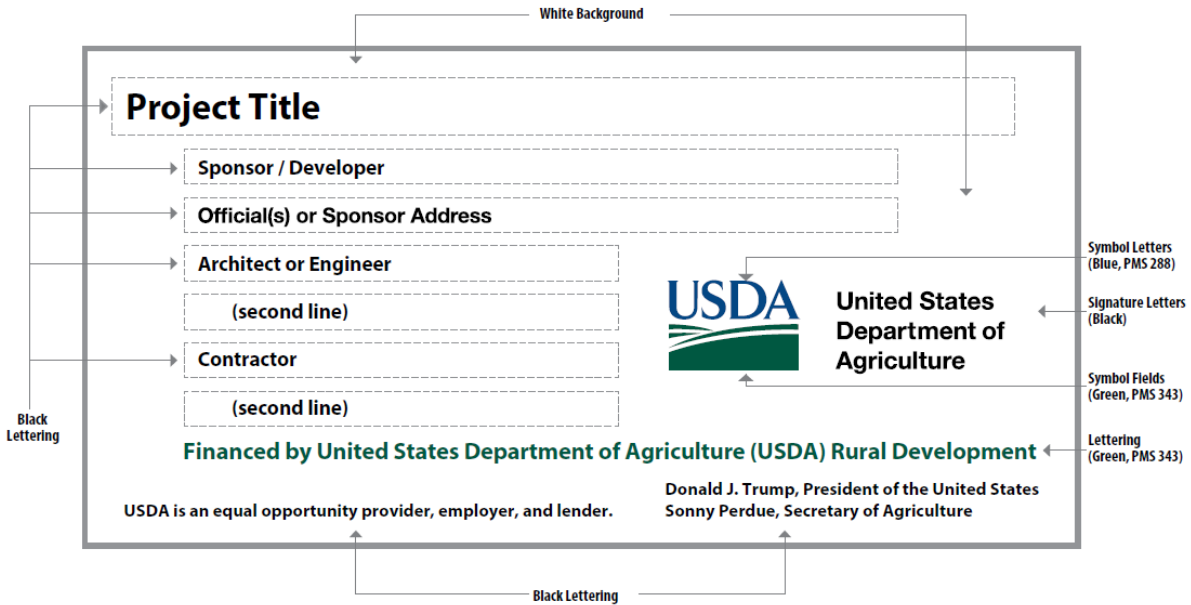
The final layout of the sign shall comply with the requirements of the U.S. Department of Agriculture and the sign details shown on Figure 01580-1.

The Contractor shall erect the sign in accordance with the details shown on Figure 01580-1 and the following specifications. The sign shall be maintained in good condition until completion of the contract, at which time the sign shall become the property of the Owner. The sign is to be painted white with lettering and emblem colors as shown. Sign support shall be 4-inch by 6-inch posts painted black, set a minimum 3 feet 6 inches in the ground. Paint shall be exterior type. The lettering shall be similar in style to that shown.

The Contractor and his subcontractors may erect signs for information and direction. No commercial or advertising signs will be allowed on the site of the work.

TEMPORARY CONSTRUCTION SIGN FOR RURAL DEVELOPMENT PROJECTS

Recommended Fonts: Helvetica, Arial, or Myriad Pro



SIGN DIMENSIONS : 1200 mm x 2400 mm x 19 mm (approx. 4' x 8' x ¾")
PLYWOOD PANEL (APA RATED A-B GRADE-EXTERIOR)

Figure 01580-1

****END OF SECTION****

SECTION 01605

SHIPMENT, PROTECTION AND STORAGE

1.0 GENERAL

Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Construction Manager.

2.0 PIPE

Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

3.0 EQUIPMENT

A. PACKAGE AND MARKING:

All equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.

Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or subassembled units where possible.

B. IDENTIFICATION:

Each item of equipment and valve shall have permanently affixed to it a label or tag with its equipment or valve number designated in this contract. Marker shall be of stainless steel. Location of label will be easily visible.

C. SHIPPING:

Bearing housings, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.

Damage shall be corrected to conform to the requirements of the contract before the assembly is incorporated into the work. The Contractor shall bear the costs arising out of dismantling, inspection, repair and reassembly.

D. FACTORY APPLIED COATINGS:

Unless otherwise specified, each item of equipment shall be shipped to the site of the work with the manufacturer's shop applied epoxy prime coating as specified in Section 09900. The prime coating shall be applied over clean dry surfaces in accordance with the coating manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats. Electrical equipment and materials shall be painted by manufacturer as specified in paragraph 09900-3.03 H.

E. STORAGE:

During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.

Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

F. PROTECTION OF EQUIPMENT AFTER INSTALLATION:

After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing piping and equipment. As a minimum, vacuum cleaning, blowers with filters, protective shieldings, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted and the ventilation systems installed.

****END OF SECTION****

SECTION 01660

EQUIPMENT AND SYSTEM PERFORMANCE AND OPERATIONAL TESTING

PART 1--GENERAL

1.01 DESCRIPTION

This section contains requirements for the Contractor's performance in documenting testing work required under this contract. In addition, this section contains requirements for the Contractor's performance during installed performance testing of all mechanical, electrical, instrumentation, and HVAC equipment and systems, including structures for watertight construction, provided under this contract. This section supplements but does not supersede specific testing requirements found elsewhere in this project manual.

1.02 QUALITY ASSURANCE

A. CONTRACTOR'S QUALITY ASSURANCE MANAGER:

The Contractor shall appoint an operations engineer or equally qualified operations specialist as Quality Assurance Manager to manage, coordinate, and supervise the Contractor's quality assurance program. The Quality Assurance Manager shall have at least 5 years of total experience, or experience on at least five separate projects, in managing the startup commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems. Operations engineers shall be graduates from a minimum 4-year course in mechanical or civil engineering. Operations specialists shall have equivalent experience in plant operation and maintenance. The quality assurance program shall include:

1. A testing plan setting forth the sequence in which all testing work required under this project manual will be implemented.
2. A documentation program to record the results of all equipment and system tests.
3. An installed performance testing program for all mechanical, electrical, instrumentation, and HVAC equipment and systems installed under this contract.
4. A calibration program for all instruments, meters, monitors, gages, and thermometers installed under this contract.

5. A calibration program for all instruments, gages, meters, and thermometers used for determining the performance of equipment and systems installed under this contract.
6. A testing schedule conforming to the requirements specified in paragraph 01660-2.02 C.

For the purposes of this section, a system shall include all items of equipment, devices and appurtenances connected in such a fashion as their operation or function complements, protects or controls the operation or function of the others. The Quality Assurance Manager shall coordinate the activities of all subcontractors and suppliers to implement the requirements of this section.

B. CALIBRATION:

All test equipment (gages, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under this contract shall be calibrated to within plus or minus 2 percent of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale. Pressure gages shall be calibrated in accordance with ANSI/ASME B40.1. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve.

Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than 2 inches shall be calibrated in situ using either the total count or dye dilution methods. Gas flow meters installed in piping systems with diameters greater than 6 inches shall be calibrated in situ using the pitot tube velocity averaging method. Flow meter calibration work shall be performed by individuals skilled in the techniques to be employed. Calibration tests for flow metering systems shall be performed over a range of not less than 10 percent to at least 75 percent of system full scale. At least five confirmed valid data points shall be obtained within this range. Confirmed data points shall be validated by not less than three test runs with results which agree within plus or minus 2 percent.

C. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the

last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/ASME B40.1	Gauges Pressure Indicating Dial Type—Elastic Element
ASTM E77	Method for Verification and Calibration of Liquid-in-Glass Thermometers
AWWA M6	Water Meters – Selection, Installation Testing and Maintenance

1.03 SUBMITTALS

Submittal material, to be submitted in accordance with Section 01300, shall consist of the following:

1. A complete description of the Contractor's plan for documenting the results from the test program in conformance with the requirements of paragraph 01660-2.02 A, including:
 - a. Proposed plan for documenting the calibration of all test instruments.
 - b. Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems.
 - c. Sample forms for documenting the results of field pressure and performance tests.
2. The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.
3. Preoperational check-out procedures, reviewed and approved by the respective equipment manufacturers.
4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract.
5. A schedule and subsequent updates, presenting the Contractor's plan for testing the equipment and systems installed under this contract.

6. A schedule establishing the expected time period (calendar dates) when the Contractor plans to commence operational testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.
7. A summary of the Quality Assurance Manager's qualifications, showing conformance to paragraph 01660-1.02 A requirements.

PART 2--PRODUCTS

2.01 GENERAL

The Contractor shall prepare test plans and documentation plans as specified in the following paragraphs. The Construction Manager/Resident Project Representative will not witness any test work for the purpose of acceptance until all test documentation and calibration plans and the specified system or equipment test plans have been submitted and accepted.

2.02 DOCUMENTATION

A. DOCUMENTATION PLANS:

The Contractor shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.

Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the Construction manager's/Resident Project Representative's witness and the Contractor's quality assurance manager. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:

1. Metallurgical tests
2. Factory performance tests
3. Accelerometer recordings made during shipment
4. Field calibration tests¹
5. Field pressure tests¹
6. Field performance tests¹
7. Field operational tests¹

Section 01999 contains samples showing the format and level of detail required for the documentation forms. The Contractor is advised that these are samples only and are not specific to

¹Each of these tests is required even though not specifically noted in detailed specification section.

this project nor to any item of equipment or system to be installed under this contract. The Contractor shall develop test documentation forms specific to each item of equipment and system installed under this contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the Construction Manager/Resident Project Representative as a condition precedent to the Contractor's receipt of progress payments in excess of 50 percent of the contract amount. Once the Construction Manager/Resident Project Representative has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this contract.

B. TEST PLANS:

The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:

1. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
2. Calibration of all analysis instruments and control sensors.
3. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the project manual.
4. System tests designed to duplicate, as closely as possible, operating conditions described in the project manual.

Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.

As a condition precedent to receiving progress payments in excess of 75 percent of the contract amount, or in any event, progress payments due to the Contractor eight weeks in advance of the date the Contractor wishes to begin any testing work (whichever occurs earliest in the project schedule), the Contractor shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this contract. Once the Construction Manager/Resident Project Representative has reviewed and taken no exception to the Contractor's test plans, the Contractor shall reproduce the plans in sufficient number for the Contractor's purposes and an additional ten copies for delivery to the Construction

Manager/Resident Project Representative. No test work shall begin until the Contractor has delivered the specified number of final test plans to the Construction Manager/Resident Project Representative.

C. TESTING SCHEDULE:

The Contractor shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the Contractor's construction schedule specified in Section 01310. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than 4 weeks in advance of the date testing is to begin. The Construction Manager/Resident Project Representative will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Construction Manager/Resident Project Representative takes no exception. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of this project manual.

2.03 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

Each item of mechanical, electrical, instrumentation, and HVAC equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this contract shall be tested in accordance with the requirements of this project manual.

2.04 OPERATIONAL TESTS

Once all equipment and systems have been tested individually, the Contractor shall fill all systems except wastewater, scum sludge and other wastewater derived systems with the intended process fluids. Wastewater-derived process systems shall be filled with water. After filling operations have been completed, the Contractor shall operate all systems for a continuous period of not less than 2 days, simulating actual operating conditions to the greatest extent possible. The Contractor shall install temporary connections, bulkheads and make other provisions to recirculate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, the Contractor's Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the Construction Manager/Resident Project Representative.

2.05 PRODUCT DATA

Product data, to be provided in accordance with Section 01300, shall be the original and three copies of all records produced during the testing program.

PART 3--EXECUTION

3.01 GENERAL

The Contractor's quality control manager shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, the Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this contract. The objective of the testing program shall be to demonstrate, to the Construction Manager's/Resident Project Representative's complete satisfaction, that the structures, systems, and equipment constructed and installed under this contract meet all performance requirements and the facility is ready for the commissioning process to commence. In addition, the testing program shall produce baseline operating conditions for the Owner to use in a preventive maintenance program.

3.02 CALIBRATION OF FIXED INSTRUMENTS

Calibration of analysis instruments, sensors, gages, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system performance acceptance tests shall be performed until instruments, gages, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the Construction Manager/Resident Project Representative.

All analysis instruments, sensors, gages, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gages, and meters installed under this contract shall be subject to recalibration as a condition precedent to commissioning under the provisions of Section 01662.

3.03 PERFORMANCE TESTS

A. GENERAL:

Performance tests shall consist of the following:

1. Pressure and/or leakage tests.
2. Electrical testing as specified in Section 16030.
3. Wiring, individual component, loop, and loop commissioning testing as described in Section 17030.
4. Preoperational checkout for all mechanical and HVAC equipment.
Preoperational check-out procedures shall be reviewed and approved by the respective equipment manufacturers.

5. Initial operation tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems to demonstrate compliance with the performance requirements of this project manual.

In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the Construction Manager/Resident Project Representative after receipt of a written request, complete with justification of the need for the change in sequence.

B. PRESSURE AND LEAKAGE TESTS:

Pressure and leakage tests shall be conducted in accordance with applicable portions of Divisions 3 and 15. All acceptance tests shall be witnessed by the Construction Manager/Resident Project Representative. Evidence of successful completion of the pressure and leakage tests shall be the Construction Manager's/Resident Project Representative's signature on the test forms prepared by the Contractor.

C. FUNCTIONAL CHECKOUT:

Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the procedures required in Section 16030.

D. COMPONENT CALIBRATION AND LOOP TESTING:

Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested in accordance with the procedures required in Section 17030.

E. ELECTRICAL RESISTANCE:

Electrical resistance testing shall be in accordance with Section 16030.

F. PREOPERATIONAL TESTS:

Preoperational tests shall include the following:

1. Alignment of equipment using reverse dial indicator method.
2. Preoperation lubrication.
3. Tests per the manufacturers' recommendations for prestart preparation and preoperational check-out procedures.

G. FUNCTIONAL TESTS:

Equipment and System Performance and Operational Testing
01660-8

1. GENERAL: Once all affected equipment has been subjected to the required preoperational check-out procedures and the Construction Manager/Resident Project Representative has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications. If available, plant effluent may be employed for the testing of all liquid systems except gaseous, oil, or chemical systems. If not available, potable water shall be employed as the test medium. Test media for these systems shall either be the intended fluid or a compatible substitute. The equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls. When testing requires the availability of auxiliary systems such as looped piping, electrical power, compressed air, control air, or instrumentation which have not yet been placed in service, the Contractor shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the Owner. Disposal methods for test media shall be subject to review by the Construction Manager/Resident Project Representative. During the functional test period, the Contractor shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the Owner to enter in a preventive maintenance system.

Test results shall be within the tolerances set forth in the detailed specification sections of this project manual. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the Construction Manager/Resident Project Representative and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the Construction Manager/Resident Project Representative may order the test to be repeated. If the repeat test, using such modified methods or equipment as the Construction Manager/Resident Project Representative may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner. Otherwise, the costs shall be borne by the Contractor. Where the results of any functional test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by the Contractor at his expense.

The Contractor shall provide, at no expense to the Owner, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.

2. RETESTING: If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the Construction Manager/Resident Project

Representative, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, including the costs of the Construction Manager/Resident Project Representative, as a result of repeating such tests.

3. POSTTEST INSPECTION: Once functional testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the Construction Manager/Resident Project Representative. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the Construction Manager/Resident Project Representative at no cost to the Owner.

3.04 OPERATIONAL TESTS

The Contractor shall provide system operation testing. After completion of all performance testing and certification by the Construction Manager/Resident Project Representative that all equipment complies with the requirements of the specifications, the Contractor shall fill all process units and process systems, except those employing domestic water, oil, air, or chemicals, with well water. All domestic water, oil, air, and chemical systems shall be filled with the specified fluid.

Upon completion of the filling operations, the Contractor shall circulate water through the completed facility for a period of not less than 48 hours, during which all parts of the system shall be operated as a complete facility at various loading conditions, as directed by the Construction Manager/Resident Project Representative. The operational testing period shall commence after this initial period of variable operation. The operational testing period shall be 5 days. Should the operational testing period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the operational testing program shall be repeated until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, and flow.

As-built documents specified in Section 01720 of facilities involved shall be accepted and ready for turnover to the Owner at the time of operational testing.

****END OF SECTION****

SECTION 01662

COMMISSIONING

PART 1--GENERAL

1.01 DESCRIPTION

This section contains requirements for the Contractor's performance during the commissioning of the structures, equipment and systems constructed and installed during the course of this contract. All commissioning work, as described in this section, shall be performed by the Contractor.

1.02 QUALITY ASSURANCE

A. CLEANUP:

Following completion of the operational testing period, the Contractor shall remove, clean, and replace all permanent and temporary filters and strainers in all pipeline systems; replace all HVAC filters; dewater and clean all sumps; and dewater all process units for final inspection as a condition precedent to commissioning.

B. COMMISSIONING TEAM:

The Contractor shall assemble a commissioning team under the direction of an individual duly authorized to commit the Contractor's personnel and resources to respond to requests for assistance on the part of the Construction Manager or, through the Construction Manager, the Owner. The commissioning team shall consist of representatives of the Contractor's mechanical, electrical, and instrumentation subcontractors, and others as appropriate. The commissioning team shall be available at the site of the work during normal working hours (8 hours a day, 5 days a week, Saturdays, Sundays, and legal holidays excepted) and shall be available within 2 hours' notice at all other times upon notice by telephone. The commissioning team shall at all times be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this contract.

1.03 SUBMITTALS

The following information shall be submitted to the Construction Manager in accordance with the provisions of Section 01300:

1. Detailed plans for commissioning each process unit and each system constructed or modified as a part of the work performed under this contract.
2. The Contractor's plan for providing a commissioning team conforming to the requirements of paragraph 01662-1.02 B during the commissioning period.

Commissioning
01662-1

Contract 2
Bid Issue

The plan shall be complete with a daytime staffing plan and names, qualifications, and telephone numbers of those assigned to off-hour standby duty.

PART 2--PRODUCTS

Working with representatives of the Owner and the Construction Manager, the Contractor shall develop and produce a detailed, written plan for the startup and initial operation, under actual operating conditions, of the equipment and systems installed and constructed under this contract. The document, after acceptance by the Construction Manager, shall serve as the guidance manual for the commissioning process.

PART 3--EXECUTION

After completion of the equipment and system performance and operational testing, where required, and agreement on the part of the Construction Manager that the systems did meet all test requirements, commissioning will begin. The commissioning period for each modified or new unit process system shall be 4 weeks. The Contractor shall remove all temporary piping, bulkheads, controls and other alterations to the permanent systems that may have been needed during the performance and operational testing and shall perform the tasks necessary to make the improvements constructed under this contract fully operational. The Construction Manager shall confirm in writing the date(s) that the system is ready for commissioning and on which actual commissioning activities commence. Activities conducted prior to such written confirmation shall not constitute commissioning.

The Owner's operation and maintenance personnel will be responsible for operation of the systems to be commissioned. The portion of the work to be commissioned shall be fully operational, performing all functions for which it was designed.

The Contractor shall be available at all times during commissioning periods to provide immediate assistance in case of failure of any portion of the system being constructed. At the end of the commissioning period and when all corrections required by the Construction Manager to assure a reliable and completely operational facility are complete, the Construction Manager shall issue a completion certificate. Each system shall have been issued a completion certificate as a condition precedent to the final acceptance of the work of this contract.

During the commissioning period, the Owner shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials, required to keep the portion of the plant being commissioned, operational.

****END OF SECTION****

Commissioning
01662-2

Contract 2
Bid Issue

SECTION 01664

TRAINING

PART 1--GENERAL

1.01 DESCRIPTION

This section contains requirements for training the Owner's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this contract.

1.02 QUALITY ASSURANCE

Where required by the detailed specifications, the Contractor shall provide on-the-job training of the Owner's personnel. The training sessions shall be conducted by qualified, experienced, factory-trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.03 SUBMITTALS

The following information shall be submitted to the Construction Manager in accordance with the provisions of Section 01300. The material shall be reviewed and accepted by the Construction Manager as a condition precedent to receiving progress payments in excess of 50 percent of the contract amount and not less than 3 weeks prior to the provision of training.

1. Lessons plans for each training session to be conducted by the manufacturer's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
2. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2--PRODUCTS

2.01 GENERAL

Where specified, the Contractor shall conduct training sessions for the Owner's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date scheduled for the individual training session.

2.02 LOCATION

Training sessions shall take place at the site of the work in Lower Greasewood at the new water treatment plant.

2.03 LESSON PLANS

Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject.

One complete set of originals of the lesson plans, training manuals, handouts, visual aids, and reference material shall be the property of the Owner and shall be suitably bound for proper organization and easy reproduction. The Contractor shall furnish ten copies of necessary training manuals, handouts, visual aids and reference materials at least 1 week prior to each training session.

2.04 FORMAT AND CONTENT

Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization
 - a. Review catalog, parts lists, drawings, etc., which have been previously provided for the plant files and operation and maintenance manuals.
 - b. Check out the installation of the specific equipment items.
 - c. Demonstrate the unit and indicate how all parts of the specifications are met.
 - d. Answer questions.
2. Safety
 - a. Using material previously provided, review safety references.
 - b. Discuss proper precautions around equipment.
3. Operation
 - a. Using material previously provided, review reference literature.

- b. Explain all modes of operation (including emergency).
 - c. Check out Owner's personnel on proper use of the equipment.
- 4. Preventive Maintenance
 - a. Using material previously provided, review preventive maintenance (PM) lists including:
 - 1) Reference material.
 - 2) Daily, weekly, monthly, quarterly, semiannual, and annual jobs.
 - b. Show how to perform PM jobs.
 - c. Show Owner's personnel what to look for as indicators of equipment problems.
- 5. Corrective Maintenance
 - a. List possible problems.
 - b. Discuss repairs--point out special problems.
 - c. Open up equipment and demonstrate procedures, where practical.
- 6. Parts
 - a. Show how to use previously provided parts list and order parts.
 - b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.
- 7. Local Representatives
 - a. Where to order parts: name, address, telephone.
 - b. Service problems:
 - 1) Who to call.
 - 2) How to get emergency help.

8. Operation and Maintenance Manuals

- a. Review any other material submitted.
- b. Update material, as required.

2.05 VIDEO RECORDING:

The Owner will retain the services of a commercial video taping service to record each training session. After taping, the material will be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers providing training sessions that the material will be video taped and shall make available to the Owner's video taping contractor such utility services and accommodation as may be required to facilitate the production of the video tape record.

PART 3--EXECUTION

Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of classes scheduled for any one day. Concurrent classes shall not be allowed. Training shall be certified on Form 11000-B specified in Section 01999.

Acceptable operation and maintenance manuals for the specific equipment shall be provided to the Owner prior to the start of any training. Video taping shall take place concurrently with all training sessions.

The following services shall be provided for each item of equipment or system as required in individual specification sections. Additional services shall be provided, where specifically required in individual specification sections.

1. As a minimum classroom equipment training for operations personnel will include:
 - a. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
 - b. Purpose and plant function of the equipment.
 - c. A working knowledge of the operating theory of the equipment.

- d. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
 - e. Identify and discuss safety items and procedures.
 - f. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
 - g. Operator detection, without test instruments, of specific equipment trouble symptoms.
 - h. Required equipment exercise procedures and intervals.
 - i. Routine disassembly and assembly of equipment if applicable (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.
2. As a minimum, hands-on equipment training for operations personnel will include:
- a. Identify location of equipment and review the purpose.
 - b. Identifying piping and flow options.
 - c. Identifying valves and their purpose.
 - d. Identifying instrumentation:
 - 1) Location of primary element.
 - 2) Location of instrument readout.
 - 3) Discuss purpose, basic operation, and information interpretation.
 - e. Discuss, demonstrate, and perform standard operating procedures and round checks.
 - f. Discuss and perform the preventative maintenance activities.
 - g. Discuss and perform start-up and shutdown procedures.
 - h. Perform the required equipment exercise procedures.

- i. Perform routine disassembly and assembly of equipment if applicable.
 - j. Identify and review safety items and perform safety procedures, if feasible.
- 3. Classroom equipment training for the maintenance and repair personnel will include:
 - a. Theory of operation.
 - b. Description and function of equipment.
 - c. Start-up and shutdown procedures.
 - d. Normal and major repair procedures.
 - e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.
 - f. Routine and long-term calibration procedures.
 - g. Safety procedures.
 - h. Preventative maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.
- 4. Hands-on equipment training for maintenance and repair personnel shall include:
 - a. Locate and identify equipment components.
 - b. Review the equipment function and theory of operation.
 - c. Review normal repair procedures.
 - d. Perform start-up and shutdown procedures.
 - e. Review and perform the safety procedures.

- f. Perform Owner approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01710

FINAL CLEANUP

1.0 GENERAL

At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the following provisions:

1. The Contractor shall thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the Construction Manager.
2. All subcontractors shall similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their Contracts.
3. The Contractor shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material.
4. Should the Contractor not remove rubbish or debris or not clean the buildings and site as specified, the Owner reserves the right to have the cleaning done at the expense of the Contractor.
5. Only experienced workers, or professional cleaners, shall be employed for final cleaning.
6. Only cleaning materials recommended by the manufacturer of surface to be cleaned shall be used.
7. Cleaning materials shall be used only on surfaces recommended by the cleaning material manufacturers.
8. In preparation for substantial completion or occupancy, a final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces, shall be conducted.
9. Grease, dust, dirt, stains, labels, fingerprints, and other foreign materials shall be removed from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.
10. Marred surfaces shall be repaired, patched, and touched up to specified finish, to match adjacent surfaces.

11. Air-handling filters shall be cleaned if units were operated during construction.
12. Ducts, blowers, and coils shall be cleaned, if air-handling units were operated without filters during construction.
13. All interior spaces shall be vacuum cleaned, including inside cabinets.
14. Materials shall be handled in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

2.0 OWNER OCCUPANCY

As a condition precedent to final acceptance or release of a structure, space or process unit for use by the Owner, the Contractor and all subcontractors shall thoroughly clean all floors, walls, woodwork, and windows to leave same in first-class condition.

All building roof gutters, downspouts, pits and sumps shall be cleared of silt, sand, debris, and construction materials. Ductwork air intakes and exhaust grilles shall be inspected and cleared of dust and extraneous material, and all grounds shall be cleared of all debris. Finished floors shall be thoroughly cleaned, sealed, and given a final coat of wax. The Contractor shall also remove all paint from and clean all window glass and all plumbing fixtures. Carpeted areas shall be thoroughly vacuumed and steam cleaned. Blinds, all furniture, and cabinets shall be dusted.

3.0 POST-CONSTRUCTION REPAIRS

The Contractor shall make such minor repairs and alterations as may be necessary to make any building or structure ready for occupancy including touch-up paint, refit windows, doors, and cabinets. The Contractor shall replace all broken and scratched glass with material which complies with the Contract Documents. This section shall not apply after or to the extent that the Owner has taken possession of a building on which the Contractor has performed work.

4.0 SITE CLEANUP

For all roadway work, the Contractor shall conform the work to acceptable line and grade, as determined by the Construction Manager. In addition, the Contractor shall have the sidewalks and streets affected by the work swept by a street or sidewalk cleaner as determined by the Construction Manager. Other surfaces of the grounds shall be rake cleaned. The Owner will not authorize final payment until the Contractor has removed all rubble and debris from the street and adjoining work areas, including all temporary storage and parking areas used by the Contractor.

For pipelines, storm sewers, catch basins, manholes, and all building floor drains, prior to their activation or at the conclusion of the project, the Contractor shall thoroughly clean all of the new pipes by flushing with water for fluid lines, or compressed air for gas lines. Debris cleaned from the lines shall be removed from the lowest access point.

All temporary utility drops, fencing, and water supply outlets shall be removed.

All plant gate identification signs, barricades, tools, rubbish collection receptacles and other such items shall be removed by the Contractor.

All remaining earthen stockpiles of excess excavated material shall be graded to provide gentle slopes to prevent erosion as directed by the Construction Manager.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01720

RECORD DRAWINGS

Record drawings refer to those documents maintained and annotated by the Contractor during construction and are defined as (1) a neatly and legibly marked set of contract drawings showing the final location of piping, equipment, electrical conduits, outlet boxes and cables; (2) additional documents such as schedules, lists, drawings, and electrical and instrumentation diagrams included in the specifications; and (3) Contractor layout and installation drawings.

Unless otherwise specified, record drawings shall be full size and maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes and shall be available for review by the Construction Manager during normal working hours at the Contractor's field office. At the completion of the work, prior to final payment, all record drawings shall be submitted to the Construction Manager.

Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed. Annotations to the record documents shall be made with an erasable colored pencil conforming to the following color code:

Additions - Red
Deletions - Green
Comments - Blue
Dimensions - Graphite*

*Legibly mark to record actual depths, horizontal and vertical location of underground raceways, cables, and appurtenances referenced to permanent surface improvements.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01730

OPERATING AND MAINTENANCE INFORMATION

1.0 SCOPE

Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.

O&M instructions must be submitted and accepted before on-site training may start.

2.0 TYPES OF INFORMATION REQUIRED

A. GENERAL:

O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.

B. OPERATING INSTRUCTIONS:

Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:

1. SAFETY PRECAUTIONS: List personnel hazards for equipment and list safety precautions for all operating conditions.
2. OPERATOR PRESTART: Provide requirements to set up and prepare each system for use.
3. START-UP, SHUTDOWN, AND POSTSHUTDOWN PROCEDURES: Provide a control sequence for each of these operations.
4. NORMAL OPERATIONS: Provide control diagrams with data to explain operation and control of systems and specific equipment.
5. EMERGENCY OPERATIONS: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency

operations of all utility systems including valve locations and portions of systems controlled.

6. **OPERATOR SERVICE REQUIREMENTS:** Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
7. **ENVIRONMENTAL CONDITIONS:** Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

C. PREVENTIVE MAINTENANCE:

The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:

1. **LUBRICATION DATA:** Provide lubrication data, other than instructions for lubrication in accordance with paragraph 2.0-B6.
 - a. A table showing recommended lubricants for specific temperature ranges and applications;
 - b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
 - c. A lubrication schedule showing service interval frequency.
2. **PREVENTIVE MAINTENANCE PLAN AND SCHEDULE:** Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. CORRECTIVE MAINTENANCE:

Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.

1. **TROUBLESHOOTING GUIDES AND DIAGNOSTIC TECHNIQUES:** Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment

required to determine whether parts and equipment may be reused or require replacement.

2. **WIRING DIAGRAMS AND CONTROL DIAGRAMS:** Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type identically to actual installation numbering.
3. **MAINTENANCE AND REPAIR PROCEDURES:** Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.
4. **REMOVAL AND REPLACEMENT INSTRUCTIONS:** Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.
5. **SPARE PARTS AND SUPPLY LISTS:** Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
6. **CORRECTIVE MAINTENANCE MANHOURS:** Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

E. **APPENDICES:**

The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.

1. **PARTS IDENTIFICATION:** Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate

listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

2. **WARRANTY INFORMATION:** List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
3. **PERSONNEL TRAINING REQUIREMENTS:** Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
4. **TESTING EQUIPMENT AND SPECIAL TOOL INFORMATION:** Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

3.0 TRANSMITTAL PROCEDURE

Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01300 accompanied by Transmittal Form 01730-A and Equipment Record Forms 01730-B and/or 01730-C, as appropriate, all as specified in Section 01999. The transmittal form shall be used as a checklist to ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.

Five (5) hard copies and five (5) electronic pdf (CD) copies of the specified O&M information shall be provided. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information. Binders shall be 3-ring, of uniform color (preferably white) with plastic view covers for cover page and spine inserts. The binders shall be sized adequately to accommodate the appropriate manual. The outside cover page insert and spine insert shall include the equipment location, project number, all applicable equipment ID numbers, description, supplier name and purchase agreement number. The inside cover page shall include all applicable equipment ID numbers, description, location, "Purchased From" (supplier name), "purchased by" (purchaser name), suppliers contact information, and purchase agreement number. All manuals shall also have a uniform tabbed Table of Contents.

If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

4.0 PAYMENT

Acceptable O&M information for the project must be delivered to the Construction Manager prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Construction Manager.

5.0 FIELD CHANGES

Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01800

ENVIRONMENTAL CONDITIONS

This section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

The Water Treatment Plant site is at an elevation of **5920** feet above mean sea level. The site of work is located at a lat/long of 35°32'19.33"N and 109°50'3.69"W. Climate conditions are described as follows:

Description	Range of Conditions
Winter	-20 to 40 (°F)
Summer	44 to 110 (°F)
Relative humidity, percent	
Indoors	40-60%
Average outdoors	40-60%
Air temperature, degrees F	
Outdoors	53.2 °F Annual Avg
Indoors	70 °F (Varies)
Barometric pressure, inches, mercury	30.01 Annual Avg

Additional conditions which may be applicable are specified in other sections.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01900

STRUCTURAL DESIGN AND ANCHORAGE REQUIREMENTS FOR NONSTRUCTURAL COMPONENTS AND NONBUILDING STRUCTURES

PART 1—GENERAL

1.01 SUMMARY

A. SCOPE

This section specifies the minimum structural requirements for the design, anchorage and bracing of architectural/mechanical/HVAC/electrical components, equipment, and systems, and nonbuilding structures. Design of supports, attachments and bracing for all parts or elements of the architectural, mechanical, HVAC and electrical systems shall be provided in accordance with this section. The requirements of this section shall apply to the design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or nonbuilding structures.

This section applies to nonstructural components that are permanently attached to structures, and nonbuilding structures as defined below in paragraph 1.01-B and ASCE 7-05. Note that equipment is defined as a non-structural component and tanks are defined as a nonbuilding structure.

Design shall be in accordance with the criteria listed within this section and shall conform to the provisions of the design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the drawings or where the size of attachments, anchorage, or bracing is defined in the technical specification sections.

The following nonstructural components are exempt from the seismic design loading requirements of this section.

1. Components in Seismic Design Category A.
2. Architectural components in Seismic Design Category B other than parapets supported by bearing walls or shear walls provided that the component importance factor, I_p , is equal to 1.0.
3. Mechanical and electrical components in Seismic Design Category B.
4. Mechanical and electrical components in Seismic Design Category C provided that the component importance factor, I_p , is equal to 1.0.

5. Mechanical and electrical components in Seismic Design Categories D, E or F where the component importance factor, I_p , is equal to 1.0 and both of the following conditions apply:
 - a. Flexible connections between the components and associated ductwork, piping and conduit are provided, and
 - b. Components are mounted at 4 ft or less above a floor level and weigh 400 lb or less (4 ft criteria applies to the mounting support elevation relative to the floor).
6. Mechanical and electrical components in Seismic Design Categories D, E or F where the component importance factor, I_p , is equal to 1.0 and both of the following conditions apply:
 - a. Flexible connections between the components and associated ductwork, piping and conduit are provided, and
 - b. The components weigh 20 lb or less or, for distribution systems, weighing 5 lb/ft or less.

B. DEFINITIONS:

1. **STRUCTURES:** The structural elements of a building that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.
2. **NONSTRUCTURAL COMPONENTS:** The nonstructural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature and seismic loads. Nonstructural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.
3. **NONBUILDING STRUCTURES:** All self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature and seismic loads. Nonbuilding structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels and structural towers that support tanks and vessels.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER:

Special Inspection of nonstructural components and nonbuilding structures, and their anchorages shall be performed by the Special Inspector under contract with the Owner and in conformance with IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

B. REFERENCES:

Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced. When conflicting requirements occur, the most stringent requirements will govern the design.

Reference	Title
AAMA	American Architectural Manufacturer's Association
ACI 318-05	Building Code Requirements for Structural Concrete
ACI 350-06	Code Requirements for Environmental Engineering Concrete Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360-05	Specification for Structural Steel Buildings
ASCE 7-05	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Standard Practice for Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel

Reference	Title
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.2	Structural Welding Code – Stainless Steel
IBC	International Building Code with local amendments
NFPA-13	Standard for the Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
ADOSH	Arizona Division of Occupational Safety and Health
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems

1.03 SUBMITTALS

For structural elements of nonstructural components and nonbuilding structures required to be designed per this specification section, drawings and design calculations shall be stamped by a Arizona licensed professional engineer qualified to perform structural engineering.

Submit drawings and calculations no less than four weeks in advance of the installation of any component to be anchored to the structure or installation of any structural member to which the component will be attached.

A. The following submittals shall be provided in accordance with Section 01300:

1. List of all nonstructural components and nonbuilding structures requiring wind and seismic design and anchorage.
2. Shop drawings showing details of complete wind and seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
3. Shop drawings showing plans, elevations, sections and details of equipment support structures and nonbuilding structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
4. Identify all interface points with supporting structures or foundations, as well as the size, location, and grip of all required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
5. Calculations for all supports, bracing, and attachments shall clearly indicate the design criteria applied in the design calculations. Concrete embedment calculations shall be coordinated with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level)

equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in the design calculations.

6. Product Data: Manufacturer's certificates of compliance with the seismic force requirements of this section.

7.

1.04 DESIGN CODES

The following standard codes have application at this site for:

Buildings/Structures:	International Building Code 2006 and ASCE 7-05
Reinforced concrete:	ACI 350-06 for Concrete Liquid Containing Tanks, ACI 318-05 for all other reinforced concrete
Structural steel:	AISC 360-05 and AISC 341-05
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA)

When conflicting requirements occur, the most stringent requirements will govern the design.

1.05 DESIGN LOADS

All nonstructural components and nonbuilding structures shall be designed for the following loads. Wind and snow loads shall not be applied to nonstructural components and nonbuilding structures that are located inside buildings.

A. DEAD LOADS:

An additional allowance will also be added for piping and conduit when supported and hung from the underside of equipment and platforms.

B. UNIFORM LIVE LOADS:

Elevated grating floors:	100 psf
Columns:	No column live load reduction allowed
Stairs, storage areas, and landings:	100 psf

Equipment platforms, walkways/catwalks (other than exitways):	100 psf
Utility bridges:	75 psf per level minimum

C. SNOW LOADS:

Code:	IBC 2006 & ASCE 7-05
Ground Snow Load (p_g)	25 psf (Navajo County Addenda and Additions to the IBC)
Exposure Factor (C_e)	1.0
Importance Factor (I):	1.1
Minimum Roof Snow Load:	22 psf

D. WIND LOADS:

Code:	IBC 2006 & ASCE 7-05
Basic Wind Speed (3-second gust):	90 mph
Exposure:	C
Topographic Factor (K_{zt})	1.0
Importance Factor (I):	1.15 (Wastewater Treatment facilities are Occupancy Category III)

All exterior nonstructural components and nonbuilding structures, unless located in a pit or basin, shall be designed to withstand the design wind loads without consideration of shielding effects by other structures.

E. SEISMIC LOADS:

Code:	IBC 2006 & ASCE 7-05
0.2 Sec. Mapped Spectral Response, S_s :	0.18 g
1.0 Sec. Mapped Spectral Response, S_1 :	0.049 g
Site Class:	D
0.2 Sec. Design Spectral Response, S_{Ds} :	0.194 g
1.0 Sec. Design Spectral Response, S_{D1} :	0.079 g

Importance Factor (I):	1.25 (Wastewater Treatment facilities are Occupancy Category III)
Component Importance Factor (I_p):	1.0, except $I_p=1.5$ for fire protection sprinkler systems or components containing hazardous materials
Seismic Design Category	B

Seismic loads shall be calculated on the basis of the governing building code. The structure dead load shall include equipment operating loads.

Individual members shall be checked for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Equipment operating loads shall be combined with seismic loads.

F. IMPACT LOADS:

Impact loads shall be considered in the design of support systems.

The following impact load factors shall be used unless recommendations of the equipment manufacturer will cause a more severe load case.

Rotating machinery:	20% of moving load
Reciprocating machinery:	50% of moving load
Monorail Hoists:	
Vertical	25% of lifted load
Longitudinal	10% of lifted load
Hangers supporting floors and platforms:	33% of live and dead load

G. TEMPERATURE:

The effects of temperature shall be included in design where nonstructural components and nonbuilding structures are exposed to differential climatic conditions. See Section 1.07 for temperature extremes.

1.06 LOAD COMBINATIONS

All nonstructural components and nonbuilding structures shall be designed to withstand the load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, then the load shall be ignored when evaluating that member.

1.07 DESIGN CONSIDERATIONS

All nonstructural components and nonbuilding structures shall be designed for the following conditions:

A. CLIMATIC CONDITIONS:

Maximum design temperature:	100	degrees Fahrenheit
Minimum design temperature:	10	degrees Fahrenheit

B. FOUNDATIONS:

Foundations supporting nonstructural components and nonbuilding structures shall extend below the frost line, or be supported on non-frost susceptible structural fill down to the frost line.

Frost line for foundations:	30 inches
-----------------------------	-----------

Consult project geotechnical report for allowable soil bearing recommendations at location of structure.

1.08 COLUMN BASE FIXITY

Column bases shall be designed as pinned connections. No moments shall be assumed to be transferred to the foundations.

Where significant shear loads (greater than 5,000 lb. per anchor bolt) are transferred at column base plates, the equipment vendor shall provide a shear key.

1.09 DEFLECTIONS

Maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load. Maximum total load deflection for equipment supports shall be L/450.

PART 2—PRODUCTS

2.01 GENERAL

Materials shall be in conformance with information shown on the drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

PART 3—EXECUTION

3.01 GENERAL

- A. Attachments and braces shall be made in such a manner that the component force is transferred to the lateral force-resisting system of the structure. Attachment requirements and size and number of braces shall be based on the calculations submitted by the Contractor.
- B. All anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the drawings or other specification Sections. Contractor shall be responsible for any remedial work or strengthening of concrete elements because of superimposed seismic loading if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to the Owner.
- C. Anchor bolts shall be provided and installed by the Contractor in accordance with Section 05502. Size of anchor bolts and embedment of anchor bolts shall be based on the calculations submitted by the Contractor.
- D. Details of and calculations for all anchorages shall be submitted and accepted in accordance with paragraph 1.03 prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. The Contractor shall be responsible for revisions to the anchorages and/or strengthening of the structural support so that there is no overstressed condition at no additional cost to the Owner.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 01999

REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01300-A	Submittal Transmittal Form
01660-A	Equipment Test Report Form
01730-A	Operation and Maintenance Transmittal Form
01730-B	Equipment Record Form
01730-C	Equipment Record Form
09900-A	Coating System Inspection Checklist
11000-A	Manufacturer's Installation Certification Form
11000-B	Manufacturer's Instruction Certification Form
11000-C	Unit Responsibility Certification Form
11002-A	Rigid Equipment Mount Installation Inspection Checklist
11060-A	Motor Data Form
16000-A	Wire and Cable Resistance Test Data Form
16000-B	Installed Motor Test Data Form
16000-C	Dry Transformer Test Data Form
16000-D	Motor Control Center Test Form
16000-M	Starter Panel Test Form
17000-A	Loop Wiring and Insulation Resistance Test Data Form
17000-B	Control Circuit Piping Leak Test Form
17000-G	Field Switch Calibration Test Data Form
17000-H	Transmitter Calibration Test Data Form
17000-I	Miscellaneous Instrument Calibration Test Data Form
17000-J	Individual Loop Test Data Form
17000-K	Loop Commissioning Test Data Form
17000-L	PLC Control Panel Test Data Form
17000-M	Radio Test Data Form

Submittal Description: _____ Submittal No:¹ _____

Spec Section: _____

	Routing	Sent	Received
OWNER: Navajo Tribal Utility Authority (NTUA)	Contractor/CM		
PROJECT: Navajo Nation Lower Greasewood Water System Improvements	CM/Engineer		
	Engineer/CM		
CONTRACTOR:	CM/Contractor		

We are sending you ☐ Attached ☐ Under separate cover via _____
☐ Submittals for review and comment ☐ Product data for information only

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected Attach additional sheets if necessary.**Contractor**

Certify either A or B:

- ☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- ☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

¹See paragraph 01300-4.0 A, Transmittal Procedure.

Certified by: _____ Contractor's Signature

01660-A. EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

CITY OF SAMPLE

**EXAMPLE WATER TREATMENT PLANT
STAGE IV EXPANSION PROJECT**

ABC Construction Company, Inc., General Contractor
XYZ Engineering, Inc., Construction Manager

EQUIPMENT TEST REPORT

Equipment Name: Sludge Pump 2
 Equipment Number: P25202
 Specification Ref: 11390
 Location: East Sedimentation Basin Gallery

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
PREOPERATIONAL CHECKLIST				
<u>Mechanical</u>				
Lubrication				
Alignment				
Anchor bolts				
Seal water system operational				
Equipment rotates freely				
Safety guards				
Valves operational				
Hopper purge systems operational				
Sedimentation tank/hopper clean				
O&M manual information complete				
Manufacturer's installation certificate complete				
<u>Electrical</u> (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC 5				
Control to HOA				

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
Indicators at MCC:				
Red (running)				
Green (power)				
Amber (auto)				
Indicators at local control panel				
Wiring labels complete				
Nameplates:				
MCC				
Control station				
Control panel				
Equipment bumped for rotation				
<u>Piping Systems</u>				
Cleaned and flushed:				
Suction				
Discharge				
Pressure tests				
Temporary piping screens in place				
<u>Instrumentation and Controls</u>				
Flowmeter FE2502F calibration				
Calibration Report No.				
Flow recorder FR2502G calibrated against transmitter				
VFD speed indicator calibrated against independent reference				
Discharge overpressure shutdown switch calibration				
Simulate discharge overpressure Shutdown				
FUNCTIONAL TESTS				
<u>Mechanical</u>				
Motor operation temperature satisfactory				
Pump operating temperature satisfactory				
Unusual noise, etc?				
Pump operation: 75 gpm/50 psig				
Measurement:				
Flow:				
Pressure:		Test gage number:		
Alignment hot				
Dowelled in				
Remarks:				

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
	Contractor		Construction Manager	
	Verified	Date	Verified	Date
<u>Electrical</u>				
Local switch function:				
Runs in <i>HAND</i>				
No control power in <i>OFF</i>				
Timer control in <i>AUTO</i>				
Overpressure protection switch PS2502C functional in both <i>HAND</i> and <i>AUTO</i>				
Overpressure protection switch PS2502C set at 75 psig				
PLC 2500 set at 24-hour cycle, 25 min <i>ON</i>				
OPERATIONAL TEST				
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional				

RECOMMENDED FOR BENEFICIAL OCCUPANCY

Construction Manager _____ Date _____

ACCEPTED FOR BENEFICIAL OCCUPANCY

Owner's Representative _____ Date _____

01730-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date: _____ Submittal No:² _____
 To: _____ Contract No: Contract 3
 _____ Spec. Section: _____
 _____ Submittal Description: _____
 _____ From: _____
 Attention: _____

Checklist	Contractor		Construction manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and postshutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: _____

Contractor's Signature _____

²See paragraph 01300-4.0 A, Transmittal Procedure.

01730-B. EQUIPMENT RECORD FORM

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	Hours
LUBRICANTS: RECOMMENDED:							
ALTERNATIVE:							
MISC. NOTES:							

RECOMMENDED SPARE PARTS			
PART NO	QUAN	PART NAME	COST

ELECTRICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	V	AMP	HZ
PH	RPM	SF	DUTY
CODE	INSL. CL	DES	TYPE
NEMA DES	C AMB	TEMP RISE	RATING
MISC.			
MECHANICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	RPM	CAP	SIZE
TDH	IMP SZ	BELT NO.	CFM
PSI	ASSY NO.	CASE NO.	
MISC			

EQUIP DESCRIP		EQUIP LOC	
EQUIP NO.	SHOP DWG NO.	DATE INST	COST
MFGR		MFGR CONTACT	
MFGR ADDRESS			PHONE
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS			PHONE

Contract 2
Bid Issue

09900-A COATING SYSTEM INSPECTION CHECKLIST

09900-A Coating System Inspection Checklist			
Project Name	Navajo Nation Lower Greasewood Water System Improvements		
Owner	Navajo Tribal Utility Authority (NTUA)	Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (eg E-1)		Coating Type (eg Epoxy, etc.)	

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			

Step	Description		Name	Signature	Date
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			

Step	Description		Name	Signature	Date
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

11000-A. MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

Date

Manufacturer

Signature of Authorized Representative

Date

Contractor

Signature of Authorized Representative

11000-B. MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: _____ Specification section: _____

Equipment name: _____

Contractor: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

<u>Operations Check List</u> (check appropriate spaces)	
Start-up procedure reviewed	
Shutdown procedure reviewed	
Normal operation procedure reviewed	
Others:	

<u>Maintenance Check List</u> (check appropriate spaces)	
Described normal oil changes (frequency)	
Described special tools required	
Described normal items to be reviewed for wear	
Described preventive maintenance instructions	
Described greasing frequency	
Others:	

Date

Manufacturer

Signature of Authorized Representative

Date

Signature of Owner's Representative

Date

Signature of Contractor's Representative

(Project Title)

CERTIFICATE OF UNIT RESPONSIBILITY

for Specification Section _____

(Section title)

In accordance with paragraph 11000-1.02 C of the contract documents, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section _____, and for related equipment manufactured under Sections _____, _____, and _____.

We have reviewed the requirements for Sections 11000 (and 11050 where applicable) and all sections referencing this (these) section(s), including but not limited to drivers, supports for driving and driven equipment and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section _____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section _____ due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the workmanship, quality, or performance of related equipment provided by others under specification Sections _____, _____, and _____. Our obligation to warranty all equipment provided by us shall remain unaffected.

Notary Public_____
Name of Corporation_____
Commission expiration date_____
Address

Seal:

By: _____
Duly Authorized Official_____
Legal Title of Official

Date: _____

11002-A. RIGID EQUIPMENT MOUNT INSTALLATION CHECKLIST

(CLIENT, PROJECT NAME)

Equipment Tag No.: _____ Date: _____

Grout Product Name and Type: _____

Grouting System Manufacturer: _____

Grouting Application Contractor: _____

General Contractor: _____

Step 1: Verify Equipment Anchor Installation Conformance to Equipment Pad Details

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Name: _____
Construction Manager Millwright

Step 2: Completion of Cleaning and Concrete Substrate Preparation Prior to Grouting

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Name: _____
Construction Manager Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 3: Equipment Leveling

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Name: _____
Construction Manager Millwright

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Date ____/____/____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Construction Manager

Step 7: Epoxy Grout Installation

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Name: _____
Construction Manager Grouting Contractor Rep.

Name: _____
Grout Manufacturer's Technical Rep.

Step 8: Completion of Full and Proper Cure of Epoxy Grout

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Date ____/____/____
Grouting Contractor Rep.

Name: _____ Date ____/____/____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Construction Manager

Step 9: Completion of Localized Repair of Grout Voids

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Date ____/____/____
Grouting Contractor Rep.

Name: _____ Date ____/____/____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Construction Manager

Step 10: Final Acceptance of Grouting System Installation Including Final Clean-Up of the Work Site Complying with All Specification Requirements and the GSM's Quality Requirements

Name: _____ Date ____/____/____
Contractor Rep.

Name: _____ Date ____/____/____
Grouting Contractor Rep.

Name: _____ Date ____/____/____
Grout Manufacturer's Technical Rep.

Name: _____ Date ____/____/____
Construction Manager

11060-A. MOTOR DATA FORM

Equipment Name: _____ Equipment No(s): _____

Project Site Location: _____

Nameplate Markings

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb Temp Rating:	°C
Time rating:				Design Letter:			
	(NEMA MG1-10.35)				(NEMA MG-1.16)		
KVA Code Letter:				Insulation Class:			

The following information is required for explosion-proof motors only:

- A. Approved by UL for installation in Class _____, Div _____, Group _____
- B. UL frame temperature code _____ (NEC Tables 500-8B)

The following information is required for all motors 1/2 horsepower and larger:

- A. Guaranteed minimum efficiency _____
(Paragraph 11060-2.04 G)
- B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of Enclosure:				Enclosure Material:			
Temp Rise:	°C (NEMA MG1-12.41,42)						
Space Heater included?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If Yes:	Watts	Volts		
Type of motor winding over-temperature protection, if specified:							

Provide information on other motor features specified:

16000-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.: _____ Temperature, °F: _____

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

16000-B. INSTALLED MOTOR TEST FORM

Motor Equipment Number: _____ Date of test: _____

Equipment Driven: _____

MCC Location: _____

				Ambient temp	°F
Resistance:					
Insulation resistance phase-to-ground megohms:					
Phase A		Phase B		Phase C	
Current at Full Load:					
Phase		Current, amps			
Phase		Current, amps			
Phase		Current, amps			
Thermal Overload Device:	Manufacturer/catalog #			Amperes	
Circuit breaker (MCP) setting:					

Motor Nameplate Markings:

Mfr		Mfr Model		Frame		HP	
Volts		Phase		RPM		Service factor**	
Amps		Freq		Ambient temp rating		°C	
Time rating				Design letter**			
	(NEMA 1-10.35)				(NEMA MG-1.16)		
Code letter				Insulation class			

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

16000-C. DRY TRANSFORMER TEST DATA FORM

(Note: Use Data Form for dry type transformers with voltage rating of 600 Vac or less and sizes to 167 kVA single phase and 500 kVA three phase. Use NETA Test Forms and Test Procedures for higher voltages and larger transformers.)

Equipment Tag No.: _____ Temperature Rating: _____

Description/Location: _____ Feeder size/Source: _____

Primary Voltage: _____ Secondary Voltage: _____ Winding Connection: _____

A. VISUAL INSPECTION

Transformer Inspection	Pass	Fail	Note
1. Nameplate data as specified			
2. Mechanical condition			
a. Free of dents and scratches			
b. Anchored properly			
c. Shipping brackets removed			
d. Spacing from wall per nameplate			
3. Grounding *			
a. Equipment grounding			
b. System grounding			

B. INSULATION-RESISTANCE TESTS:

Perform tests with calibrated megohmmeter. Apply 1000 Vdc test voltage for 60 seconds and record readings in megohms at 30-seconds and 60-seconds intervals.

Test Group	Resistance between		30-second reading	60-second reading	Absorption Ratio Index 60-sec. / 30-sec.
Primary Winding to ground	A	GRD			
	B	GRD			
	C	GRD			
Secondary Winding to ground with * N-G Bond removed	a	GRD			
	b	GRD			
	c	GRD			
Primary Winding to Secondary Winding	A	a			
	B	b			
	C	c			

Submit resistance readings to the Construction Manager immediately after the tests that are less than the manufacturer's recommended value or less than 10-megohms. Record the Absorption Ratio Index values for future reference. Ratio must be 1.0 or greater, with infinity (∞) equal to 1.0.

Contractor Representative Certified: _____ Date _____

Owner Representative Witnessed: _____ Date _____

16000-D. MOTOR CONTROL CENTER TEST FORM

Equipment No.: _____ Ambient room temperature: _____

Location: _____

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for 1 minute using a megohmmeter at 1000 volts.

Test results (megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.
3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

16000-M. STARTER PANEL TEST DATA FORM

Location: _____

A. PHYSICAL TEST:

List any discrepancies with respect to the panel specifications:

1. Dimensions, component layout and wiring specifications.
2. Panel and component hardware.
3. Quality of Workmanship (wiring and general panel assembly).
4. Inventory of all panel parts and documentation (operations and maintenance manual).

B. FUNCTIONAL TEST:

Components	
Disconnect Switch	
HOA Switch - Auto	
HOA Switch - Off	
HOA Switch - Hand	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance ^a		Insulation Resistance ^b			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

- Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ± 2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
- Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-J. INDIVIDUAL LOOP TEST DATA FORM

Loop No.: _____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

- a. Wiring tested:
 (Attach test form 17000-A)
- b. Not used.
- c. Instruments calibrated:
 (Attach test forms 17000-G through I)
- d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Construction Manager's approval.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-K. LOOP COMMISSIONING TEST DATA FORM

Loop No.: _____

- a. Loop tested:
(Attach test form 17000-J)
- b. Controlled or connected equipment tests confirmed:
- c. Give complete description of loop's interface with process.
- d. With associated equipment and process in operation, demonstrate automatic start/stop and control operation.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-L. PLC CONTROL PANEL TEST DATA FORM

Location: _____

A. PHYSICAL TEST:

List any discrepancies with respect to the panel specifications:

1. Dimensions, component layout and wiring specifications.
2. Panel and component hardware.
3. Quality of Workmanship (wiring and general panel assembly).
4. Inventory of all panel parts and documentation (operations and maintenance manual).

B. FUNCTIONAL TEST:

Discrete Inputs	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Discrete Outputs	
1	
2	
3	

Reference Forms
01999-32

Contract 2
Bid Issue

4	
5	
6	
7	
8	
9	
10	
11	
12	

Analog Inputs	
Loop Powered	
Loop Powered	
Self Powered	
Self Powered	

Analog Outputs	
Loop Powered	
Loop Powered	

Power	
24 VDC Power	
12 VDC Power	
PS Fail Relay	
GFI	
Radio Power	
Touchscreen	

Comments: _____

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-M. RADIO TEST DATA FORM

Location: _____

Radio Model Number: _____

A. PHYSICAL TEST:

1. Reflected Power: _____
2. Radio System Address: _____
3. RSSI reading (Remote): _____
4. Mode: _____
5. Long Polling (Master), Buff = OnData
6. Interface Parameters:
 - a. Baud Rate: _____
 - a. Data Bits: _____
 - a. Parity: _____
7. Quality of Workmanship – Antenna/Cable assmebly: _____

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

SECTION 02100
SITE PREPARATION

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies site preparation which consists of clearing, grubbing, demolition and salvage.

Removal and disposal of electrical Work is included in Division 16. Coordinate with the subcontractor and Owner for all materials required to be turned over to Owner.

B. EXISTING CONDITIONS:

The CONTRACTOR shall determine the actual condition of the site as it affects this portion of work.

C. PROTECTION:

Site preparation shall not damage existing utilities to remain in service, structures, landscaping or vegetation adjacent to the site. The CONTRACTOR shall repair, or replace any damaged property.

Demolition activities shall not damage utilities to remain in service, structures, landscaping or vegetation adjacent to the site. The Contractor shall repair, or replace any property damaged by demolition activities.

D. DEFINITIONS

1. REMOVAL: Facilities to be removed shall be completely removed from the site as shown and specified in the Contract Documents. Disposal shall conform to applicable codes and procedures when hazardous or contaminated materials are removed and disposed of.
2. ABANDON: Facilities to be abandoned shall remain in place and be abandoned in accordance with procedures as shown and specified in the Contract Documents.
3. SALVAGE: Equipment and appurtenances to be salvaged shall be removed without damage and delivered to Owner as shown and specified in the Contract Documents.

Site Preparation
02100-1

Contract 2
Bid Issue

PART 2--PRODUCTS

No products are included in this section.

PART 3--EXECUTION

3.01 CLEARING AND GRUBBING

Unless otherwise specified, the CONTRACTOR shall remove obstructions such as brush, trees, logs, stumps, roots, heavy sod, vegetation, rock, stones larger than 6 inches in any dimension, broken or old concrete and pavement, debris, and structures where the completion of the work require their removal.

Material that is removed and is not to be incorporated in the work shall be properly disposed of off the site in accordance with local, state and federal regulations.

3.02 DEMOLITION AND REMOVAL

A. STRUCTURES:

The existing altitude valve assembly and valve vault shall remain in service during construction of the replacement altitude valve assembly and valve vault. After construction, testing and start-up activities are complete, and before Final Completion, the Contractor shall demolish the existing assembly and vault.

Demolition and removal of the assembly and vault consists of cutting and capping existing inlet and outlet pipes downstream and upstream of existing gate valves respectively, closing existing gate valves, removal of the top of the existing structure, as well as removal of air valve assembly valves, fittings, and piping. Material that is removed shall be properly disposed of off site in accordance with local, state and federal regulations.

The existing valve vault shall be removed, to a point three feet below existing or proposed grade, whichever is lower. Contractor shall dispose of the existing manhole frame/cover and crack the vault base to permit drainage prior to backfill. Vaults and excavations shall be cleared of waste, debris and loose soil, and backfilled with clean, compacted Type C fill per Section 02200. Backfill shall match existing finished grades.

The existing Lower Greasewood chlorination building located at the Water Treatment Plant site shall be demolished after piping and valves have been installed to allow chlorinated water from Well 2 to be conveyed to the distribution system and prior the construction of the Lower Greasewood Water Treatment Plant.

Demolition and removal of the chlorination building consists of cutting and capping existing inlet and outlet pipes as shown on the drawings, closing existing gate valves that will remain except as necessary to supply Well 2 water to the system, removal of the existing structure, as well as enclosed valves, fittings, and piping, chlorine dosage equipment, foundation slab and drain lines and sumps. Contractor shall coordinate with Owner regarding salvage and disposal requirements. Material not salvaged by the Owner shall be disposed of off-site in accordance with local, state and federal regulations.

The existing well control equipment and supporting structures at the Lower Greasewood Well 1 site shall be demolished prior the construction of the Lower Greasewood Well 1 Pump House.

Demolition and removal of the Well 1 equipment and supporting structures consists of removal of all existing control equipment, supporting structures, fencing, as well as ancillary materials. Contractor shall coordinate with Owner regarding salvage and disposal requirements. Material not salvaged by the Owner shall be disposed of off-site in accordance with local, state and federal regulations.

Excavations shall be cleared of waste, debris and loose soil, and backfilled with clean, compacted Type C fill per Section 02200. Backfill shall match existing finished grades.

The Contractor shall protect all existing utilities and related structure along the interconnection pipeline alignment and in the area of Work. Contractor shall coordinate with utilities to determine utility locations and required removal or protection procedures.

B. PAVEMENT:

When portions of asphalt pavements and concrete pads are to be removed and later construction is to be connected, edges shall be saw cut, on a neat line at right angles to the curb face.

C. SALVAGE:

The Owner has the right to salvage any items scheduled for removal. The CONTRACTOR shall notify the CONSTRUCTION MANAGER 15 days prior to any salvage or demolition work to determine the disposition of items to be removed. The CONSTRUCTION MANAGER will mark items to be salvaged. Such items shall be properly disconnected, removed from their foundations, cleaned, and stored at a location on the plant site as directed by the CONSTRUCTION MANAGER.

3.03 UTILITY INTERFERENCE

Where existing utilities interfere with the prosecution of the work, the CONTRACTOR shall protect or relocate them in accordance with Division 0.

****END OF SECTION****

Site Preparation
02100-3

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 02160

HORIZONTAL DIRECTIONAL DRILLING

PART 1 – GENERAL

1.01 DESCRIPTION

A. SCOPE:

This Section specifies installation of product pipe by horizontal directional drilling (HDD) or directional boring.

The Contractor shall provide all services, equipment, material and labor necessary for the complete and proper installation and testing of the product pipeline by directional drilling methods.

The Contractor shall secure all necessary permits, except as noted below:

1. The Owner has prepared the 404 Army Corp of Engineers Permit,
2. The Owner has prepared the 401 Certification permit for work impacting the Pueblo Colorado Wash.
3. The Owner has prepared Road crossing permits for the following locations:
 - a. BIA 15, route between Ganado and Greasewood
 - b. BIA 28, access road to WTP

The Contractor shall be responsible for investigating existing soils and subsurface conditions to select appropriate equipment and methods. The Contractor shall include in the bid price the cost of any geotechnical borings along the pipe alignment which may be necessary to design and install the directionally drilled crossing. Geotechnical investigations have not been performed in the HDD alignment shown.

Work shall be completed in accordance with industry standards and in accordance with all local, state and federal regulations. All applicable permits and applications must be in place prior to start of work

B. REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. References shall be made to the latest edition of said standards unless otherwise called for.

Reference	Title
ASTM F1962	Standard Guide for Use of Maxi-Horizontal Directional Horizontal Directional Drilling 02160-1

	Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles
IHS	Standard Drawing No W-13
IHS	Standard Drawing No W-24
IHS	Standard Drawing No W-33

1.02 QUALITY ASSURANCE

A. QUALIFICATIONS

All directional drilling operations shall be performed by qualified directional drilling contractor who has at least five (5) years experience involving work of a similar nature. The contractor must have installed a minimum of 10,000 linear feet of pipe (6-inch diameter or greater) using directional drilling operations in the last five (5) years. And supply a list of project references, prior to job commencement

The HDD field supervisor and HDD equipment operator shall have a minimum of 2 years experience in the operation of the equipment being used. The field supervisor shall be on-site at all times during the preparation and execution of the horizontal directional drilling operation.

B. CONTROL OF LINE AND GRADE

The Contractor shall use electronic guidance instrumentation to monitor and adjust the drill head. The guidance system shall provide data establishing the horizontal and vertical location of the drill head throughout the bore and provide readings at sufficient intervals to allow for slope and steering adjustment to maintain line and grade.

The Contractor shall maintain a daily drilling operation log and guidance system log. An as-built sketch of the finished pilot hole shall be furnished as part of the record drawings.

C. HORIZONTAL CONTROL

Survey work including location of existing utilities and geotechnical investigations, and control points for bore path determination, product pipe locating and tracking shall be provided by a surveyor licensed in the State of Arizona

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300.

Submit the following prior to commencement of the Work:

Horizontal Directional Drilling
02160-2

Contract 2
Bid Issue

- A. Contractor's Experience Record: Furnish document(s) supporting the directional drilling Contractor's qualifications and experience. Information provided shall be sufficient to demonstrate compliance with Section 1.02. A and include all personnel including backup personnel in the event that an individual is unavailable.
- B. Material: Submit product data for HDD pipe, fittings, appurtenances and other materials provided under this section.
- C. Work Plan: Submit a work plan detailing the procedure and schedule for mobilization and setup, drilling, back reaming and pipe installation, demobilization and restoration. The plan shall include a description of all equipment and tools to be used, a list of all personnel, list of subcontractors, safety plan (including MSDS of any potentially hazardous substances to be used), an environmental protection plan, and contingency plan.

The Work plan should be comprehensive demonstrating the thoughtful planning required to successfully complete the project and based on actual site and working conditions for the project.

- D. Bore Plan: Submit a pilot bore plan showing grades, entry and exit angles, deflection and radiuses of the pilot bore, existing utilities with minimum vertical and horizontal clearances and cover over the installed pipe. Provide the location of the drill rig setups, the bore lengths, soil conditions along the path.
- E. Design Calculations: Submit calculations demonstrating the provided pipe is adequate for the service and installation conditions. Maximum allowable safe loads on the pipe and the anticipated loads during installation along the proposed bore path shall be provided.
- F. Drilling Equipment: Submit product data for directional drilling equipment to be used demonstrating the equipment is adequate to complete the project based on existing site conditions. Equipment list is to include but not be limited to: drilling rig, down-hole tools, guidance system, and rig safety systems. Include calibration records for guidance equipment.
- G. Drilling Fluid (Mud) System: Submit product data for drilling fluid system materials and equipment to be used demonstrating adequacy for the existing site conditions. Submittal shall include but not be limited to: mud system, mud motors, drilling fluid properties including any product data and MSDS sheets for bentonite and additives. Submittal shall also identify disposal sites for drilling fluid, cuttings disposal and provide procedures for handling and disposal of cuttings and drilling fluid.

Submit the following Record information:

- H. Submit utility pothole locations and results

- I. Submit geotechnical borings and soil analysis performed.
- J. Submit Logs of HDD operations including daily logs, thrust, torque, pull back load or push back load, and slurry flow rate recorded at a minimum of every 20 feet of pipe length installed.

1.04 DESIGN REQUIREMENTS

Contract Drawings includes an approximate drill path with entry and exit locations. The Contractor shall review and modify the drill path shown based on the selected means and methods for HDD installation and results of any site investigations performed by the Contractor.

The Contractor's bore path plan shall be in accordance with accepted industry standards for performance of the Work and meet the minimum requirements as specified including minimum cover and bending radius of the pipe. Contractor shall determine actual bore lengths and length of pipe needed for installation including any allowance for the pipe to recover and relax from installation loads and other conditions.

The Contractor shall determine the handling and installation loads for all phases of the work. Contractor shall include forces resulting from frictional resistance between the pipe and the borehole, frictional resistance from the pipe and the ground, forces from bends, hydrokinetic drag, resistance due to pipe stiffness, as well as other installation and handling loads as applicable. Contractor shall determine allowable loads for the pipe including the appropriate factor of safety for successful installation, however, the factor of safety shall not be less than 2.0 for the yield stress of the pipe material nor shall it exceed the recommended limits identified by the pipe manufacturer, whichever is more stringent.

Determine appropriate size of reamed borehole and drilling fluid required for the existing soils, ground water and site specific requirements, to reduce forces applied to the pipe during pull back and to prevent hydrofracturing of soil and loss of drilling fluid.

PART 2 – PRODUCTS

2.01.1 EQUIPMENT

The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system.

All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.02 PIPE

Product pipe shall be provided as shown on the contract drawings and suitable for installation by HDD.

- A. High Density Polyethylene Pipe: HDPE Pipe shall be in accordance with Section 15065 with an outside diameter conforming to ductile iron pipe sizes (DIPS). Minimum thickness shall be as determined by the Contractor's calculations but not less than DR 11.
- B. Steel Casing Pipe: Steel casing pipe installed by HDD shall be in accordance with Section 15125.

2.03 DRILLING FLUID

Drilling fluid shall be a mixture of bentonite and water. Water shall be from a clean source with a pH of 8.5 to 10 and/or per the mixing requirements of the manufacturer.

Admixtures to improve the physical qualities of the mixture may be provided subject to acceptance by the Engineer. Admixtures shall be inert and non-toxic.

Drilling fluid viscosities shall be sufficient to suspend cuttings and maintain the integrity of bore wall based on the project soil and groundwater conditions.

2.04 GUIDANCE SYSTEM

The Guidance System shall be of a proven type and shall be setup and operated by personnel trained and experienced in its proper use. The system shall provide a continuous and accurate determination of the location of the drill head during the drilling operation and capable of tracking at the maximum depth required in the existing soil conditions. It shall enable the driller to guide the drill head by providing immediate information to the tool face, azimuth (horizontal direction), and inclination (vertical direction).

If a magnetic system is provided, the Contractor shall be responsible to identify any conditions creating magnetic anomalies such as but not limited to over-head power lines. The

Contractor shall consider such influences in the selection and operation of the guidance system and shall use alternate methods to maintain the required slope and alignment as required.

2.05 PIPE ROLLERS

Pipe rollers shall be provided to fully support the weight of the pipe during hydrotesting and pull-back operations.

PART 3 – EXECUTION

3.01.1 GENERAL

The Contractor shall notify the Engineer 48 hours prior to commencing work.

Prior to the start of drilling, existing utilities in proximity to the bore path shall be identified and located horizontally and vertically. A minimum of 18-inches shall be maintained between outer edges of the water main and any other utility

Excavation, backfill, and compaction of entry, exit, recovery pits, slurry sump pits or other excavations shall be in accordance with Section 02200, Earthwork.

3.02 PILOT HOLE

Pilot holes shall be drilled on the accepted bore path with no deviations greater than 2.5% of line or grade over a length of 100 feet. Minimum cover shall not be less than specified and line shall maintain a separation of 18-inch minimum from existing utilities and ROW boundaries. If deviation outside the stated tolerance occurs, Contractors shall notify the Engineer and shall be required to pull-back and re-drill to correct the deviation at no additional cost to the Owner if so determined by the Engineer.

3.03 PREREAM AND PULLBACK

A swivel shall be installed between the molehead/reamer and pipe connection to minimize torsional stress imposed on the pipe and allow the reamer to turn without rotating the pipe.

Water shall be provided to ballast the pipe as it is pulled below grade. Water shall be metered into the front end of the pipe string and anchored in place as pipe is pulled.

The pullback shall be conducted in one continuous operation to limit the potential for binding of the pipe in the hole, unless layout room is not sufficient for pipe stringing. All pipe pulled through the pilot holes shall have two (2) continuous tracer wires securely fixed to the pipe. Wire shall be #12 copper.

The leading edge of the pipe shall be examined for significant external damage after pull-back. If the pipe is deemed by the Engineer to have suffered significant damage, the damaged pipe shall be cut off and additional pipe pulled through the hole prior to the relaxation period.

Due to the elastic properties of the pipe, the pipe shall be relaxed for one overnight period in order to return to its original pre-pull length. The pipe shall be installed past the tie-in point, according to manufacturers' recommendations, to accommodate thermal as well as tensile forces in the pipe.

3.04 HANDLING OF DRILLING FLUIDS AND CUTTINGS

Provide adequate measures for handling and disposal of drilling fluid and cuttings. Piping, pumps, storage containers shall be water-tight and the Contractor shall take measures to guard against leakage of drilling fluid including use of drilling tools and procedures which will minimize the unintentional discharge of any drill fluids. Drilling fluid and cuttings shall not be discharged into any waterway, storm drain, sanitary sewer or other such conveyance, nor shall it be disposed of at the work site.

Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape. The Contractor shall stockpile haybales at the drilling site to contain an inadvertent bentonite slurry return. Any haybales used for containment of slurry shall be removed from the site and properly disposed of at the completion of the work.

Regulate the pressure of drilling fluid and conduct drilling operations in such a manner that minimizes potential for drilling fluid to migrate to the surface or collapse the provided pipe.

3.05 PIPE TESTING

All water pipe shall meet the testing requirements as described in Section 15065.

3.06 SITE RESTORATION

Following successful testing of the pipe, Contractor shall demobilize equipment and restore the site to original condition. All excavations shall be backfilled and compacted to a minimum of 90% density.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 02200

EARTHWORK

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies earthwork which consists of excavation, filling, grading, and disposal of excess material.

B. DEFINITIONS:

1. **COMPACTION:** The degree of compaction is specified as percent compaction. Maximum or relative densities refer to dry soil densities obtainable at optimum moisture content.
2. **EXCAVATION SLOPE:** Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.
3. **EMBANKMENT SLOPE:** Embankment slope shall be defined as an inclined surface formed by placement of material above existing grade.
4. **EMBEDMENT ZONE:** Embedment zone shall be defined as the area from the trench bottom to a level at least 12-inches over the top of the pipe including bedding, haunching and initial backfill.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents

shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in. (457-mm) Drop
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3017	Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. TESTS:

The CONTRACTOR will take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance with these specifications. The CONTRACTOR shall remove surface material at locations designated by the CONSTRUCTION MANAGER and provide such assistance as necessary for sampling and testing. The CONSTRUCTION MANAGER may direct the CONTRACTOR to construct inspection trenches in compacted or consolidated backfill to determine that the CONTRACTOR has complied with these specifications.

Tests will be made by the CONTRACTOR in accordance with the following:

Test	Standard Procedure
Moisture content	ASTM D3017
Gradation	ASTM C136
Density in-place	ASTM D1556
Moisture-density relationships	ASTM D1557

The CONTRACTOR shall provide safe access to the trench or excavation for the inspection and compaction testing. This shall include providing all safety equipment and temporary shoring to enable inspection of the trench foundation and compaction testing at multiple levels in the trench.

1.03 SUBMITTALS

Samples of fill materials to be used shall be submitted 2 weeks in advance of use. Samples shall consist of 0.5 cubic feet of each type of material.

PART 2--MATERIALS

2.01 FILL MATERIALS

A. TYPE A:

Type A material shall be a clean gravel-sand mixture free from organic matter and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3/4 inch	100
3/8 inch	70-100
No. 4	40-99
No. 10	35-95
No. 20	20-80
No. 40	0-55
No. 100	0-2

B. TYPE B:

Type B material shall be a select granular material free from organic matter and of such size and gradation that the specified compaction can be readily attained. Material shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1-1/2 inch	100
No. 4	50-100
No. 200	15-60

The coefficient of uniformity shall be 3 or greater.

Earthwork
02200-3

Contract 2
Bid Issue

The plasticity index of the material, as determined in accordance with ASTM D4318, shall not exceed 10.

The material may be an imported quarry waste, clean natural sand or gravel, select trench excavation or a mixture thereof.

C. TYPE C:

Type C material shall be unclassified silty sand material which is free from peat, wood, roots, bark, debris, garbage, rubbish or other extraneous material. The maximum size of stone shall not exceed 6 inches. The material shall have a maximum of 65% passing #4 sieve and maximum of 20% passing #200 sieve. If the native material excavated from the site meets these requirements, it may be segregated from non-conforming material and classified as Type C.

D. TYPE D:

Type D material shall be granular base material and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1 inch	100
3/4 inch	85-100
No. 4	45-95
No. 200	0-8

The granular base shall have a plasticity index of no greater than 3 when tested in accordance with ASTM D4318.

The coarse aggregate shall have a percent of wear, when subjected to the Los Angeles abrasion test (ASTM C131) of no greater than 50.

E. TYPE E:

Type E material shall be crushed rock commonly known as drain rock and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1-1/2 inch	100
3/4 inch	30-75
1/2 inch	15-55

U.S. standard sieve size	Percent by weight passing
1/4 inch	0-5

Type E material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65

F. TYPE F:

Type F material shall be crushed rock and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
1-1/2 inch	87-100
3/4 inch	45-90
No. 4	20-50
No. 30	6-29
No. 200	0-12

Type F material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

G. TYPE G:

Type G material shall be Class I crushed stone (manufactured angular, crushed stone, crushed rock, or crushed slag), commonly known as chips and shall conform to the following gradation:

U.S. standard sieve size	Percent by weight passing
3/4 inch	100
No. 4	30-50
No. 200	0-5

The material shall have a minimum sand equivalent value of 75.

H. TYPE H:

Type H material shall be 6-inch crushed/angular riprap. Riprap shall be graded rock having a range of individual rock weights as follows:

Weight of stone	Percent smaller by weight
-----------------	---------------------------

Weight of stone	Percent smaller by weight
10 pounds	100
5 pounds	80-100
2 pounds	45-80
1 pound	15-45
1/2 pound	5-15
Below 1/2 pound	0-5

Specific gravity shall be between 2.5 and 2.82.

I. TYPE I:

Type I material shall be 12-inch riprap. Riprap shall be graded rock having a range of individual rock weights as follows:

Weight of stone	Percent smaller by weight
160 pounds	100
100 pounds	80-100
50 pounds	45-80
20 pounds	15-45
5 pounds	5-15
1 pound	0-5

Specific gravity shall be between 2.5 and 2.82.

J. TYPE J:

Type J material shall be unclassified material and may be obtained from excavation on site. The material may contain extraneous material such as demolition waste, unsuitable material excavated from beneath structures, and clearing and grubbing debris up to 50 percent by volume. Extraneous material shall be thoroughly mixed and the maximum size of organic particles shall be 6 inches.

K. TYPE K

Native material, segregated from non-conforming material, may be used for bedding and backfill outside roadway and public right of ways or easements. The material shall be granular, free from peat, wood, roots, bark, clay lumps, debris, garbage, rubbish or other material as defined by the Construction Manager. All materials used as final backfill shall

pass a 3-inch sieve. Materials used for select backfill or bedding shall meet the following gradation requirements:

U.S. standard sieve size	Percent by weight passing
3/4 inch	100
No. 4	40-90
No. 200	30 or less

The plasticity index of the material, as determined in accordance with ASTM D4318, shall not exceed 10. Native soils including high plasticity clay soils, sandy clay and clayey sand soils shall not be used as bedding or backfill.

The Contractor shall furnish sieve analyses per ASTM C 136, plasticity indexes PI - per ASTM D 4318 and baseline maximum density tests, Modified Proctor per ASTM D 1557, for conditioned native material. Acceptance by the Construction Manager of the tests shall be required prior to using these materials. All costs for testing shall be paid for by the Contractor. Native materials shall be tested once per 400 feet of trench or as directed by the Construction Manager. In all cases, soil samples for testing shall be taken in the presence of the Construction Manager.

The Contractor will be solely responsible to demonstrate compliance and where native materials do not meet the requirements, shall provide imported bedding and backfill at no additional cost to the Owner.

PART 3--EXECUTION

3.01 GENERAL

A. CONTROL OF WATER:

The CONTRACTOR shall keep excavations reasonably free from water during construction. The static water level shall be drawn down a minimum of 1 foot below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Disposal of water shall not damage property or create a public nuisance.

The CONTRACTOR shall have on hand pumping equipment and machinery in good working condition for emergencies and shall have workmen available for its operation. Dewatering systems shall operate continuously until backfill has been completed to 1 foot above the normal static groundwater level.

Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. The

CONTRACTOR shall control surface runoff to prevent entry or collection of water in excavations.

Release of groundwater to its static level shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines.

The CONTRACTOR shall incorporate the use of temporary detention ponds, rock checks or rock socks to allow settlement or filtering of silt carried by the water before entering storm drains or natural waterways. Straw bales are not acceptable for this purpose.

If a National Pollutant Discharge Elimination System (NPDES) permit is required for disposal of water from construction dewatering activities, it shall be obtained by the CONTRACTOR prior to any dewatering activities.

B. OVEREXCAVATION:

The CONTRACTOR shall take care to avoid excavation below the depths indicated. However, where the undisturbed condition of natural soils is inadequate for support of the planned construction, the CONSTRUCTION MANAGER may direct the CONTRACTOR to overexcavate and install additional bedding material.

The quantity of overexcavation and placement of additional bedding material will be paid for on a unit price basis per cubic yard of overexcavation and additional material installed. The unit price shall include all costs associated with the overexcavation and installation of the additional material including but not limited to: bedding material, geotextile material, installation, and all testing.

C. SURPLUS MATERIAL:

Unless otherwise specified, surplus excavated material shall be disposed of off site in accordance with applicable ordinances and environmental requirements.

If the quantity of surplus material is specified, the quantity specified is approximate. The CONTRACTOR shall satisfy himself that there is sufficient material available for the completion of the embankments before disposing of any material inside or outside the site. Shortage of material, caused by premature disposal of any material by the CONTRACTOR, shall be replaced by the CONTRACTOR.

Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure except for those areas designated to be preconsolidated. For these areas, the depth of stockpiled material shall be as specified. The CONTRACTOR shall maintain stability of the soil adjacent to any excavation.

D. BORROW MATERIAL:

If the quantity of acceptable material from excavation is not sufficient to construct the embankments required by the work, the quantity of material needed to complete the embankments shall consist of imported borrow conforming to specified requirements.

E. HAULING:

When hauling is done over highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.

F. HAUL ROADS:

The CONTRACTOR shall construct haul roads required to transport materials on site. Alignment of haul roads shall be selected to avoid interference with plant operations. Haul roads must stay within the designated limit of disturbance as shown in the drawings. Haul roads shall be removed after completion of construction.

G. FINISH GRADING:

Finished surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.

Finished grade shall be as specified plus or minus 0.10 foot except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage. Allowance for topsoil and grass cover, and subbase and pavement thickness shall be made so that the specified thickness of topsoil can be applied to attain the finished grade.

When the work is an intermediate stage of completion, the lines and grades shall be as specified plus or minus 0.5 foot to provide adequate drainage.

If the soil is to be cultivated or straw is to be incorporated into the surface, rocks larger than 2-1/2 inches in maximum dimension, roots and other debris on the surface of the slope shall be removed and disposed of prior to cultivation or placement of straw.

H. CONTROL OF EROSION:

The CONTRACTOR shall maintain earthwork surfaces true and smooth and protected from erosion. Where erosion occurs, the CONTRACTOR shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

The CONTRACTOR shall provide Water bars along the trench as specified. Water bars shall be constructed of a 1-foot nominal thickness of cement slurry with 50 to 100 psi compressive strength after 28 days or a 3-foot nominal thickness of clay compacted to a

minimum of 95-percent modified Proctor Density and having permeability when completed of not more than 0.00001 centimeters per second. Water bars shall extend the full width of the trench and keyed in to the undisturbed trench wall and shall extend from the undisturbed trench bottom to a height equal to top of established water table or 2-feet above top of pipe, whichever is greater.

I. STABILIZATION:

Instead of or in addition to overexcavation and additional material as described in 02200-3.01B, the CONSTRUCTION MANAGER may direct the CONTRACTOR to stabilize the subgrade by pressing large riprap into the soft unstable subgrade to support the compaction of bedding, initial backfill and subsequent backfill. The quantity and placement of stabilization material will be paid for on a unit price basis per cubic yard of stabilization material installed. The unit price shall include all costs associated with the installation of the stabilization material including but not limited to: stabilization material, installation, and all testing.

3.02 CLASSIFICATION OF FILL

Fill material shall be placed in horizontal layers and compacted with power-operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative compaction, and general application are specified in Table A. Unless otherwise specified, fill classes shall be used where specified in Table A under general application.

Table A, Fill Classifications

Fill class	Material type	Maximum uncompressed layer depth, inches	Minimum compaction, percent	General application
A1 ^a	A	6	95	Subsequent, near-surface pipeline backfill under paved roadways, roadway shoulders, roadway embankments and public right of ways or easements; pipeline bedding; initial utility pipeline backfill per Alternate Trench Bottom Preparation, IHS Standard Drawing No. W-27
NOT REQD	A	48	95	NOT REQUIRED
B1	B	8	95	Subsequent pipeline backfill; compaction as specified, Structural fill
B2	B	8	90	Site fill; maximum particle size may be increased from 1-1/2 inches to 3 inches for fill 3 feet (min) away from structures and pipelines
C1	C	8	90-95	Subsequent pipeline backfill; compaction as specified

Fill class	Material type	Maximum uncompressed layer depth, inches	Minimum compaction, percent	General application
C2	C	8	90	Site fill for embankments and dikes
D1	D	8	95	Concrete slab support fill only for PRV Vault and in areas where structural fill is not specified
E1 ^{b,c}	E	8	95 ^b	Bedding and initial pipeline backfill for RCP only, backfill for overexcavated zone; Requires layer of non-woven filter fabric between Type E and any other material containing fines (including native)
NOT REQD	F	12	95	NOT REQUIRED.
NOT REQD	G	8	95	NOT REQUIRED
H1 ^d	H	-	-	Floor drain discharge area, Embankment slope face, channel slope face, stream bed installation above pipeline
H2 ^e	H	-	-	Trench or Excavation bottom soil stabilization.
I1	I	-	-	Embankment slope face, channel slope face
J1 ^f	J	8	90	Excess fill
K1	K	6	90	Subsequent, near-surface pipeline backfill nonpaved areas outside roadway and public right of ways or easements; pipeline bedding; initial utility pipeline backfill per Typical Trench Detail, IHS Standard Drawing No. W-27

^aSee Navajo Area Standards and Construction Requirements, Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities for requirements for roadways, roadway shoulders, roadway embankments, public right of ways and public easements.

^bCompaction of layers shall be accomplished in two passes of equipment with complete coverage across the width of the fill. Dry density compaction shown is per ASTM D1557. Use 70% of ASTM D4253 maximum relative density, as applicable, based on the soil used for fill.

^cNOT USED.

^dNOT USED.

^eRiprap to be pressed into unstable trench bottom soil until trench bottom will support placement and compaction requirements for backfill.

^fAsphalt and concrete slabs from demolition may be placed at the bottom of the fill side by side to form a continuous pad. Clearing and grubbing is not required unless shrubs are taller than 3 feet. Mucking of the subgrade and keying or benching of adjoining embankments is not required.

3.03 EARTHWORK FOR STRUCTURES

A. STRUCTURE EXCAVATION:

Earthwork
02200-11

Contract 2
Bid Issue

The bottom shall not be more than 0.15 foot above or below the lines and grades specified. If the elevation of structure excavation is not specified, the excavation shall be not more than 0.15 foot above or below the elevation specified for fill material below the structure. Slopes shall vary no more than 0.5 foot from specified grade unless the excavation is in rock where the maximum variation shall be 2 feet.

Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the CONTRACTOR's operations and require overexcavation and backfill, the CONTRACTOR shall refill such excavated space to the proper elevation in accordance with the procedure specified for backfill. The cost of such work shall be borne by the CONTRACTOR.

Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

Upon completion of foundation excavations, the CONTRACTOR shall coordinate the inspection of the bottom of the excavation prior to the placement of structural fill or auger cast piles.

B. FOUNDATION TREATMENT:

Rock foundations for concrete or masonry footings shall be excavated to sound material. The rock shall be roughly leveled or cut to steps and shall be roughened. Seams in the rock shall be grouted under pressure as directed by the CONSTRUCTION MANAGER and paid for as extra work.

When footings are to be supported on piles, excavations shall be completed to the bottom of the footings before any piles are drilled or driven therein. When swell or subsidence results from driving piles, the CONTRACTOR shall excavate, or backfill the footing area to the grade of the bottom of the footing with suitable material as specified. If material under footings is such that it would mix into the concrete during footing placement or would not support the weight of the fluid concrete, the CONTRACTOR shall replace the material with suitable material, install soffit forms or otherwise provide a suitable platform on which to cast the footing as directed by the CONSTRUCTION MANAGER. This shall be paid for as extra work.

Where clay soils are encountered at the bottom of cut surfaces, the clay surface shall be scarified and mixed to a minimum depth of 12 inches and watered as necessary to bring the upper foot of soil to between 1 and 3 percent above the optimum moisture content, and compacted to between 95 and 98 percent of maximum dry density.

Whenever solid or loose rock, rocky soil with rocks larger than 3/4 inches in their largest dimension, or otherwise unsuitable soils which are incapable of properly supporting the pipe are encountered in the trench bottom, all unsuitable material shall be overexcavated to a minimum depth of 6 inches (or 24 inches for soft or unstable areas) below the pipe and replaced with suitable bedding material.

Whenever any structure excavation is substantially completed to grade, the CONTRACTOR shall notify the CONSTRUCTION MANAGER who will make an inspection of the foundation. No concrete or masonry shall be placed until the foundation has been inspected by the CONSTRUCTION MANAGER. The CONTRACTOR shall, if directed by the CONSTRUCTION MANAGER, dig test pits and make test borings and foundation bearing tests. If the material tested is undisturbed soil, the cost thereof will be paid for as extra work. If the material tested is backfill material, the cost thereof will be paid as specified in 00700-14.02.

C. STRUCTURE BACKFILL:

Unless otherwise specified, structure backfill shall be Class B1.

After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.

Structure backfill shall not be placed until the subgrade portions of the structure have been inspected by the CONSTRUCTION MANAGER. No backfill material shall be deposited against concrete structures until the concrete has developed the specified compressive design strength or until the concrete has been in place for 28 days, whichever occurs first.

Backfill material shall be placed in uniform layers and shall be brought up uniformly on all sides of the structure. When compaction is done by ponding and jetting, thickness of uncompacted layers shall not exceed 4 feet. Moisture content at the time of compaction of structural backfill shall be within 2 percent of optimum moisture content.

Compaction of structure backfill by ponding and jetting will not be allowed.

3.04 EARTHWORK FOR PIPELINES AND CONDUITS

A. GENERAL:

Earthwork for pipelines and conduits is specified in paragraph 02200-3.02, Table A; in the standard details; and in the following paragraphs.

B. PIPELINE EXCAVATION:

Unless otherwise specified or approved by the CONSTRUCTION MANAGER, pipelines shall have a minimum 42-inch depth of cover and maximum 72-inch depth of cover. Excavate

the trench to line and grade with allowance for pipe thickness, sheeting and shoring, pipe bedding and overexcavation.

The CONTRACTOR shall be responsible to deflect joints and/or provide shop-fabricated fittings as required to achieve the vertical and horizontal alignment. The provided alignment shall not include isolated high or low points without air release valves or flush valves as required for the proper operation and maintenance of the pressure pipeline as determined by the Construction Manager. Where the Construction Manager determines the Contractor's alignment has created a high or low point, the Contractor shall provide air release and flush valves in accordance with the Standard Details at no additional cost to the OWNER.

The allowable joint deflection shall not exceed 50% of the manufacturer's written maximum recommendation unless otherwise specified. When gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. CONTRACTOR shall provide a wider trench as required for this purpose at no additional cost to the OWNER. Longitudinal bending of the pipe shall not be allowed.

In the event obstructions are encountered which require exceptions to the allowable depth of cover, the CONSTRUCTION MANAGER shall have the authority to change the plans and order the necessary deviation from the line and grade.

Remove hard spots that would prevent a uniform thickness of bedding or result in concentrated loads on the pipe. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade with specified bedding materials or in accordance with overexcavation requirements where unsuitable material is encountered.

Prior to placement of bedding, the exposed subgrade at the base of the trench excavation shall be examined to detect soft, loose, or unstable areas. Loose materials in the trench bottoms resulting from excavation disturbance should be removed until firm material is encountered. If soft or unstable areas are encountered, these areas should be overexcavated to a minimum depth of 24 inches below the pipe or to firm material and replaced with suitable bedding material.

Where clay soils are encountered at the bottom of cut surfaces, the clay surface shall be scarified and mixed to a minimum depth of 12 inches and watered as necessary to bring the upper foot of soil to between 1 and 3 percent above the optimum moisture content, and compacted to between 95 and 98 percent of maximum dry density.

C. PIPELINE EMBEDDMENT ZONE:

Bedding and backfill material in the embedment zone shall be as specified.

1. BEDDING: The CONTRACTOR shall not proceed with bedding placement in excavated areas until the subgrade has been inspected by the CONSTRUCTION MANAGER.

All pipe shall have a minimum thickness of bedding material below the barrel of the pipe to provide uniform and adequate longitudinal support under the pipe as specified. Bedding material shall be placed in the bottom of the trench, leveled and compacted.

Bell holes shall be excavated to provide a minimum clearance of 2-inches below the coupling or bell at each pipe joint and to permit proper inspection of the joint. Imported Type A or conditioned Type K bedding material shall be placed at bell holes and beneath the pipe as required to provide uniform and adequate longitudinal support.

2. **HAUNCHING:** After pipe has been properly bedded and laid to alignment and grade, additional bedding material shall be placed in layers the full width of the trench and compacted. CONTRACTOR shall place and compact haunching, defined as the area between the top of bedding to the springline of the pipe, simultaneously on both sides of the pipe, keeping the level of material the same on each side.

Haunching shall be carefully placed in 6" lifts and hand compacted around the pipe to ensure that the pipe barrel is completely supported with no voids or uncompacted areas and adequate side support to the pipe is provided without either vertical or lateral displacement of the pipe from proper alignment.

3. **INITIAL BACKFILL:** After placement of haunching material, CONTRACTOR shall place and compact initial backfill from the springline to at least 12-inches above the top of the pipe.

Initial backfill shall be placed and compacted in lifts not to exceed 6-inches in loose measure. Placement and compaction shall be performed in such a manner as to avoid damage or disturbance of the haunching material or pipe.

Moisture content of trench backfill at the time of compaction shall be within 2 percent of optimum moisture content.

4. **FINAL OR SUBSEQUENT BACKFILL:**

Backfill material, placement and compaction above the pipe zone shall be as specified. Backfill above the pipe zone shall not commence until pipe zone backfill has been inspected and accepted by the CONSTRUCTION MANAGER.

- a. **IMPROVED AREAS:** Unless otherwise specified, select granular backfill (Class A) shall be used under all paved and unpaved roadways and paved and unpaved roadway shoulders, roadway

embankments, and in all public right-of-ways and easements. The trench shall be backfilled to an elevation which will permit the placement of the specified surface and paving as specified. Parking lot surface and paving shall be as specified in Section 02500. Roadway surface and paving shall be as specified in the Navajo Area Standards and Construction Requirements, Technical Specifications for Materials and Workmanship for Water and Wastewater Facilities. Other surfaces shall be restored, including compaction, to the condition existing prior to construction including restoration of yard areas.

- b. UNIMPROVED AREAS: Class C1 or Class K backfill shall be used for all trenches in pastureland, cultivated land, undeveloped land, and for other unimproved areas where specified. Class C1 backfill shall not be used in any public right-of-way or under roadways. Excavated trench material that meets the requirements of Type C material may be used. The CONTRACTOR shall maximize the use of fine-grained materials (e.g., sand, silty sand, sandy silt) as Class C1 backfill.

The trench above the pipe zone shall be backfilled to within 12 inches of original ground surface. Moisture content of trench backfill at the time of compaction shall be within 2 percent of optimum moisture content.

The top 12 inches of soil shall be removed and stored in such a manner that it will not become mixed with unsatisfactory soils. After the trench has been backfilled, the stored topsoil shall be replaced at a uniform depth in its original area compacted to its original condition. The CONTRACTOR shall leave the backfilled trench neatly mounded not more than 6 inches above existing grade for the full width of the backfill area.

3.05 EARTHWORK FOR EMBANKMENTS

A. FOUNDATION PREPARATION:

The surface of the foundation shall not contain standing water and shall be free of loose material, foreign objects and rocks greater than 6 inches in maximum dimension. Immediately prior to placement of embankment fill material, the foundation surface shall be thoroughly moistened, scarified to a depth of 6 inches, moisture conditioned again as necessary and recompact to 95 percent relative compaction. After the preparation has been completed, the CONTRACTOR shall promptly place and compact the first lift of embankment on the foundation to prevent damage to the surface. If the foundation surface is damaged, the CONTRACTOR shall repair the surface to the specified condition. In any areas where materials become soft or yielding, such materials shall be removed, disposed of, and replaced with specified material. The surface of the embankment shall be maintained to

permit travel of construction equipment. Ruts in the surface of any layer shall be filled and leveled before compacting.

B. EMBANKMENT FILL:

Rocks, broken concrete, or other solid materials, which are larger than 4 inches in greatest dimension, shall not be placed in embankment areas where piles are to be placed or driven.

Fill material having a sand equivalent value less than 10 shall be placed in the lower portions of embankments and shall not be placed within 2.5 feet of finished grade.

When the embankment material consists of large, rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the embankment. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact embankment.

Unless otherwise specified, the embankment shall be raised to form an approximately horizontal plane extending transversely to the final slopes. The embankment shall be crowned at all times during construction so that water will drain readily off the embankment.

The temporary differential elevation between any two adjoining zones of the embankment due to construction operations shall not exceed 24 inches.

If the compacted surface of any layer of material is too smooth to bond properly with the succeeding layer, the surface shall be scarified. If required, the surface shall be sprinkled or otherwise moisture conditioned before the succeeding lift is placed. Any surface crust formed on a layer of fill material that has been dumped and spread shall be broken up by harrowing and, if required, the full depth of the affected layer shall be moisture conditioned immediately prior to rolling.

C. KEY CONSTRUCTION:

Where specified, a key shall be excavated along the length of the toe of fill slopes. The exposed soils along the key and under fill areas shall be disced and/or scarified to a depth of at least 12 inches, moisture conditioned to within 3 percent of optimum moisture content, and compacted to at least 90 percent of maximum dry density.

D. EMBANKMENT TOLERANCES:

1. **GENERAL:** Embankment slopes within 4 feet of shoulder grade shall vary less than 0.5 foot from the designated slope. Slopes beyond 4 feet from shoulder grade shall vary less than 1 foot from the designated slope. Measurements for variance shall be made perpendicular to the slope. Slopes

which are 6 to 1 or flatter shall vary less than 0.2 foot from the designated slope.

If embankments are constructed of rock greater than 12 inches in diameter, the slopes more than 4 feet below shoulder grade may vary up to 2 feet from the designated slope.

2. **ROADWAY EMBANKMENT TOLERANCES:** The excavated surface shall be less than 0.08 foot above or below the grades specified after deducting for the roadway pavement thickness.

Vertical alignment tolerances permitted on the roadway surface shall not exceed plus or minus 0.30 feet from the vertical alignment specified, with the provision that within the tolerance range local surface irregularities shall not exceed 0.15 feet as measured by the gap between the roadway surface and a 10-foot straightedge placed on any flat graded surface. On vertical curves, the same standards will apply except that an additional gap allowance will be made for the road surface curvature over the 10-foot length of the straightedge.

Horizontal alignment tolerances permitted shall not exceed plus or minus 1 foot providing the departure is relatively uniform over any specific length of the roadway.

3.06 SUBGRADE FOR PAVEMENT

The prepared subgrade shall be scarified to a depth of at least 12 inches and recompact to at least 95 percent of the maximum density.

3.07 SITE FILL

Unless otherwise specified, site fill shall be Class C2 fill. If the existing slope in an area to be filled is greater than 5:1, the CONTRACTOR shall bench the area prior to filling.

****END OF SECTION****

SECTION 02270

EROSION CONTROL (VEGETATIVE)

PART 1- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall provide erosion protection including fertilizing, seeding, and mulching for all disturbed areas.
- B. The CONTRACTOR shall provide biodegradable erosion control blanket on all slopes greater the 4H:1V.

1.02 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 - Submittals.
- B. Product Data: Manufacturer's catalog sheets and sample of erosion control fabrics.

PART 2- PRODUCTS

2.01 MATERIALS

- A. Fertilizer: Fertilizer shall be a commercial, chemical type, uniform in composition, free- flowing, conforming to state and federal laws and suitable for application with equipment designed for that purpose. Fertilizer shall have a guaranteed analysis showing not less than 11 percent nitrogen, 8 percent available phosphoric acid, and 4 percent water soluble potash.
- B. Seed: Seed shall be delivered in original unopened packages bearing an analysis of the . contents. Seed shall be guaranteed 95 percent pure with a minimum germination rate of 80 percent. Seed mix shall be native vegetation consisting of 3 lb – Crested Wheatgrass, 1 lb – Pubescent Wheatgrass, 2 lb – Indian Ricegrass, 3 lb – Western Wheatgrass, and 2 lb – 4-wing Salt bush.
- C. Mulch: Mulch shall be a fibrous, wood cellulose product produced for this purpose. It shall be dyed green and shall contain no growth or germination inhibiting substances, and shall be manufactured so that when thoroughly mixed with seed, fertilizer, and water, in the proportions indicated it will form a homogenous slurry which is capable of being sprayed. The mulch shall be Sliva Fiber as manufactured by Weyerhaeuser Company; Conwood Fiber as manufactured by Consolidated Wood Conversion Corp.; or equal.

D. Erosion Control Fabric

1. Materials: North American Green, S75 Temporary Erosion Control Blanket, or equal.
2. Anchorage Devices: Six-inch, 11-gauge staples from the manufacturer or staples of the proper length as recommended by the manufacturer for specific soil condition.

E. Manufacturers, or Equal

1. North American Green
2. Mirafi (Ten Cate)
3. Maccaferri

PART 3- EXECUTION

3.01 GENERAL

- A. Weather Conditions: Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 15 miles per hour or when the ground is frozen, unduly wet, or otherwise not in a tillable condition.
- B. Soil Preparation: The ground to be seeded shall be graded in conformance with the Drawings and shall be loose and reasonably free of large rocks, roots, and other material which will interfere with the work.
- C. Method of Application: Fertilizer, seed, and mulch may be applied separately (Dry Method), or they may be mixed together with water and the homogeneous slurry applied by spraying (Hydraulic Method), except that all slopes steeper than 3H:1V shall be stabilized by the Hydraulic Method.

3.02 DRY METHOD

- A. Fertilizing: The fertilizer shall be spread uniformly at the rate of 800 lb per acre (approximately 1 lb per 55 square feet). The fertilizer shall be raked in and thoroughly mixed with the soil to a depth of approximately 2-inches prior to the application of seed or mulch.
- B. Seeding: The seed shall be broadcast uniformly at the rate of 16.5 lb per acre. After the seed has been distributed it shall be incorporated into the soil by raking or by other approved methods.

- C. Mulch Application: Mulch shall be applied at the rate of 1,500 lb (air dried weight) per acre.

3.03 HYDRAULIC METHOD

- A. The hydraulic method consists of the uniform application by spraying of a homogeneous mixture of water, seed, fertilizer, and mulch. The slurry shall be prepared by mixing the ingredients in the same proportions as indicated above. The slurry shall have the proper consistency to adhere to the earth slopes without lumping or running. Mixing time of materials shall not exceed 45 minutes from the time the seeds come into contact with the water in the mixer to the complete discharge of the slurry onto the slopes, otherwise the batch shall be recharged with seed. The mixture shall be applied using equipment containing a tank having a built-in, continuous agitation and recirculation system, and a discharge system which will allow application of the slurry to the slopes at a continuous and uniform rate. The application rates of the ingredients shall be the same as those specified for the Dry Method. The nozzle shall produce a spray that does not concentrate the slurry nor erode the soil.

3.04 EROSION CONTROL BLANKET

A. Placement

1. Biodegradable erosion control blanket shall be used on all slopes 4H:1V and steeper.
2. The erosion control shall be spread only on prepared, fertilized and seeded surfaces.
3. On all slopes, the erosion control blanket shall be laid up-and-down the slope in the direction of water flow.
4. Waste of erosion control material shall be minimized by limiting overlaps as specified and by utilizing the full length of the netting at roll ends.

B. Anchorage

1. Ends and sides of adjoining pieces of material shall be overlapped 6-inches and 4-inches respectively, and stapled. Six anchors shall be installed across ends. A common row of staples shall be used at side joints. Staple through both blankets, placing staples approximately 6-inches apart.

2. The top edge of the erosion control blanket shall be anchored in a 6-inch deep by 6-inch wide trench. Backfill and compact trench after stapling.
3. Anchorage shall be by means of 9-inch long, 2-legged staples driven vertically and full-length into the ground. The legs shall be spread 3-inches to 4-inches apart at the ground to improve resistance to pull-out. In loose soils the use of 18-inch metal washer pins may be required to properly anchor the blankets.
4. All slopes which are 3:1 or greater shall be stapled with 2 staples per square yard in a triangular pattern. Staples shall be installed per the manufacturer's recommended staple pattern guide.
5. The erosion control blanket shall not be stretched, but should be laid loosely over the ground to avoid pulling the blanket downslope.
6. The erosion control blanket shall not be rolled out onto ground containing frost within the 9-inch penetration zone of the anchorage staples. Further, no stapling shall be undertaken while any frost exists within the staple penetration zone.

3.05 WATERING

- A. Upon completion of the erosion control seeding, water shall be applied as specified by the seed manufacture to meet germination requirements

3.06 MAINTENANCE PRIOR TO FINAL ACCEPTANCE

- A. The CONTRACTOR shall maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary, and sufficient watering to maintain the plant materials in a healthy condition. The ENGINEER may require replanting of any areas in which the establishment of the vegetative ground cover does not appear to be developing satisfactorily.

****END OF SECTION****

SECTION 02743

ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for placement of asphalt concrete as a surface course upon a prepared base in accordance with the Specifications, or as shown on the Plans, or ordered in writing by the Resident Engineer.

B. Related Sections

1. Section 01330 – Submittal Procedures

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials [AASHTO]

1. AASHTO T 168 – Sampling Bituminous Paving Mixtures
2. AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

B. American Society for Testing and Materials [ASTM]

1. ASTM D 29 Test Methods for Sampling and Testing Lac Resins
2. ASTM D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
3. ASTM D 464 Test Methods for Saponification Number of Naval Store Products Including Tall Oil and Other Related Products
4. ASTM D 465 Test Methods for Acid Number of Naval Stores Products Including Tall Oil and Other Related Products
5. ASTM D 2041 Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

C. Asphalt Institute [AI]

1. SP-2 – Superpave Mix Design
2. MS-2 – Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

D. Maricopa Association of Governments [MAG]

1. Uniform Standard Specifications for Public Works Construction
 - a. Section 710 – Asphalt Concrete
 - b. Section 713 – Emulsified Asphalts
 - c. Section 321 – Asphalt Concrete Pavement
2. Uniform Standard Details for Public Works Construction
 - a. Standard Detail No. 201 – Pavement Section at Termination

1.03 DEFINITIONS

- A. Screed is defined as any strike off device that operates by cutting, crowding, or other practical action which is effective on mixtures at workable temperatures without tearing, shoving, or gouging, and which will produce a finished surface of the smoothness and texture required.
- B. A leveling course is defined as a layer of Material used to bring existing pavement to a uniform grade prior to placing an overlay or other course.
- C. Float rock is defined as aggregate that has segregated to the surface of an asphalt concrete pavement course.

1.04 QUALITY CONTROL

- A. Provide quality control in accordance with the requirements of Section 01440, Quality Assurance and Quality Control, except as modified herein.
- B. Independent Certified Testing Laboratory:
 1. Retain an independent certified testing laboratory experienced in performing all of the tests required by this Section to perform or witness testing and certify the results.
 - a. The independent certified testing laboratory must be qualified according to ASTM C1077 and ASTM E329.
 - b. The independent certified testing laboratory must perform and document testing in accordance with ASTM E548.
 - c. Submit the independent certified testing laboratory's qualifications, their personnel, and their testing program and procedures to the Resident Engineer for approval.

2. Take periodic control tests of Materials and resultant concrete as specified herein and as necessary to ensure that concrete produced meets Specification requirements.
- C. Submit Certificates of Compliance with the specification for all commercial products, including industry-standardized products.
- D. Provide batching and mixing plants meeting the requirements of ASTM D995 or certified by the Asphalt Institute.
- E. Asphalt Concrete Control Technician (CCT):
1. Provide an Asphalt Concrete Control Technician (CCT), certified by an accredited organization, authorized to control the production of asphalt concrete.
 - a. The Quality Control Technician may be an employee of the independent certified testing laboratory or the Contractor.
 - 1) If employed by the Contractor, the Quality Control Technician must only answer to the Contractor's Superintendent.
 - b. Submit the name and credentials of the Asphalt Concrete Control Technician (CCT) proposed for the Work.
 2. Certification of the Asphalt Concrete Control Technician CCT will be required before the CCT is allowed to commence Work on the Project.
 3. The Asphalt Concrete Control Technician's duties and responsibilities include the following:
 - a. Developing asphalt concrete mix designs.
 - b. Instructing the batch plant control personnel how to adjust the batch weights of the ingredients required to maintain the asphalt cement ratio, and aggregate proportions to produce the specified mix design.
 - c. Being present at the batch plant or at the Work Site, if radio contact is maintained with the plant, to supervise control or adjustment of the mix when asphalt concrete is being placed.
 4. Replace the Quality Control Technician if in the opinion of the Resident Engineer the Quality Control Technician is not performing the prescribed duties.

1.05 SUBMITTALS

- A. Submit the following information in accordance with the requirements of Section 01300, Submittals.
 - 1. Product Data.
 - 2. Shop Drawings.
 - 3. Working Drawings.
 - 4. Mix designs.
 - 5. Weighmaster's certificates.

1.06 WARRANTY

- A. Remove asphalt concrete pavement mix whose stability is affected by excess asphalt cement content to such an extent that the pavement is displaced under normal traffic loads within a period of 1 year after acceptance, and replace it with new Material at no additional cost to the AGENCY.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Use Material manufacturers providing the type of asphalt Materials specified and which conform to the requirements of MAG Section 710 for Suppliers.

2.02 MATERIALS

- A. Provide asphalt concrete Materials in accordance with MAG Section 710 for the type of asphalt paving specified.
- B. Tack Coat: Provide tack coat per Section 02786, Tack Coat, using emulsified asphalt grade SS-1 as specified in MAG Section 713.

2.03 EQUIPMENT

- A. Spreading and finishing equipment
 - 1. Self-propelled mechanical spreader(s) and finishing equipment:
 - a. Provide self-propelled mechanical spreader(s) and finishing equipment equipped with a vibrating screed or strike off assembly capable of distributing not less than the full width of a traffic lane.
 - 1) Provide a screed adjustable to the required template and elevation.

Asphalt Concrete Pavement
02743-4

Contract 2
Bid Issue

- 2) Provide self-propelled mechanical spreading and finishing equipment capable of having the forward speed of operation regulated so that no irregularities result in the surface texture or smoothness of the mat due to excessive forward speed of the spreading machine.
- b. Screed control system:
- 1) Equip self-propelled mechanical spreading and finishing equipment with a control system capable of automatically maintaining the specified screed elevation.
 - 2) Provide a control system that is actuated automatically from either a reference line or surface through a system of mechanical sensors or sensor directed mechanisms or devices that maintains the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface.
 - a) When approved or requested by the Resident Engineer, make the transverse slope control system inoperative and provide screed control by sensor directed automatic mechanisms that independently control the elevation of each end of the screed from the reference lines or surfaces.
 - b) If the Resident Engineer determines that the automatic screed control operation is not practical under a particular set of conditions, the use of manual control may be ordered in lieu thereof, but the machine must still be equipped with the automatic device.
 - 3) Furnish controls capable of working in conjunction with any of the following attachments:
 - a) Ski-type device not less than 30 feet in length.
 - b) Taut string line or wire set to grade.
 - c) Short ski or shoe.
 - 4) Furnish all necessary control equipment to perform the paving operation including a long ski or shoe and all required stakes and wire.
 - a) If the automatic control system becomes inoperative during the day's work, placing the remaining Material on site using manual controls may be permitted.

- i) Thereafter, do not deliver additional Material to the project site and do not resume work until the automatic control system has been made operative.
 - b) Use a ski type device or stringline as described in Subparagraph 2.03A.2.c.1 or 2.03A.2.c.2 above as directed by the Resident Engineer.
 - c) In conditions where a curb and/or gutter is not even and true to grade, the Resident Engineer may require the Contractor to use a ski-type device or stringline as described in Subparagraph 2.03A.2.c.3 above to establish the grade of the asphalt concrete surface adjacent to the curb or gutter.
- 2. Spreader boxes:
 - a. Equip the spreader box with a readily adjustable strike off blade.
- 3. Tired blade grader:
 - a. The use of a self-propelled pneumatic tired blade grader must have the approval, in writing, of the Resident Engineer.
 - b. Equip the tired blade grader with an automatic leveling device capable of accurately maintaining transverse slope of the blade at a preset angle.
 - c. Furnish a grader blade not less than 12 feet long.
 - d. Ensure that the blade control in motor graders is free from appreciable lost motion.

B. Compaction Equipment

- 1. All rollers used for compaction of asphalt concrete must be self-propelled and reversible with a minimum weight of 8 tons.
 - a. Maintain all rollers to ensure smooth operation with respect to steering, the ability to stop, start and reverse.
 - b. Equip all rollers with an automatic device or devices capable of properly dispensing an approved releasing agent on the wheels to prevent the wheels from picking up the asphalt concrete.
 - 1) Do not use diesel fuel as a releasing agent.
 - c. Equip all rollers with scrapers to keep the wheels clean from asphalt and other debris

2. Pneumatic-tired rollers

- a. Furnish 2-axle tandem type pneumatic rollers having a roller width of not less than 5 feet.
 - 1) Furnish rollers with tires not less than 20 inches in diameter, all of the same size, and with treads acceptable to the Resident Engineer.
 - 2) Furnish rollers having an operating weight per tire not less than 2,000 pounds, and with the tires spaced so that the entire gap between adjacent tires will be covered by the tread of the following tire.
 - a) Inflate each tire to 90 psi, except as otherwise specified.
 - b) The maximum allowable variance between tire air pressure and specified air pressure is 5 psi.
 - 3) Equip pneumatic tired rollers with skirt-type devices mounted around the tires to maintain the temperature of the tires during the rolling process.

3. Steel-wheeled tandem rollers and vibratory rollers:

- a. Furnish rollers having straight steel wheels free from grooves and/or pits.

C. Curb forming equipment:

- 1. Furnish an extrusion type machine for curb forming.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Ensure the base on which the asphalt concrete is to be placed is smooth, firm, and true to grade and cross-section as shown on the Plans.
- B. For base paving two inches thick or greater, verify that atmospheric temperature is 40 degrees Fahrenheit and rising before proceeding.
- C. For surface paving or pavement less than two inches thick, verify that the surface temperature is 50 degrees Fahrenheit or greater before proceeding.

3.02 PREPARATION

A. Base

- 1. If necessary to meet the conditions specified in Paragraph 3.01A and if ordered by the Resident Engineer, spread aggregate base or a leveling course of asphalt

Asphalt Concrete Pavement
02743-7

Contract 2
Bid Issue

concrete compacted in layers not exceeding 2-inches in thickness to level irregularities such as dips, depressions, and sags.

- a. Maintain the base throughout the period of placing asphalt concrete.
 - b. Remove all irregularities such as humps or high spots to provide a smooth uniform grade and cross-section, so that subsequent surfacing will be of uniform thickness.
2. Install pavement terminations per MAG Standard Detail 201, Type A or B, on all street edges where no other curb or retainment has been installed.
 - a. This applies to, but is not limited to, the centerline of half streets, diagonal or perpendicular end terminations, street edges without curb and gutter or single curb.

B. Tack Coat

1. Apply a tack coat to all existing and to each new course of bituminous surfaces prior to placing a succeeding layer of bituminous mixed Material.
 - a. Apply the tack coat in accordance with MAG, Tack Coat.
 - b. Surfaces to be covered may require repair or patching as directed by the Resident Engineer.
 - c. When approved by the Resident Engineer, the tack coat may be deleted when a succeeding layer of asphalt concrete is being applied over a freshly laid course that has been subjected to very little traffic.
2. Apply a tack coat to the vertical surfaces of existing pavements, curbs, and gutters against which asphalt concrete is to be placed.

C. Construction joints:

1. Trimming construction joints:
 - a. Before a base or surface course is placed adjacent to cold transverse construction joints, trim the joints to create a vertical face by saw cutting the joints to their full depth and removing cut off Material to expose a fresh surface.
 - b. Cut the joint on a 10 to 15-degree skew from a perpendicular to the centerline of the street or roadway.
2. Joint bulkheads:

- a. For short overnight intermissions in paving, a full depth bulkhead (i.e., wooden member) can be placed near the end of the day's pavement placement.
 - b. Remove the bulkheads and excess material just prior to the placement of the following day's pavement.
3. Joint Heaters:
- a. If conditions warrant and it is deemed necessary by the Resident Engineer, use an approved joint heater on cold transverse or longitudinal joints.
 - b. Ensure the joint heater is capable of heating the joint to a minimum temperature of 200 degrees Fahrenheit for a minimum depth of 1/4 inch at a speed commensurate with that of the laydown machine.

3.03 CONSTRUCTION

A. Handling asphalt concrete:

1. Make sure the asphalt concrete mix is at a temperature within the job mix formula limits specified in MAG Section 710.
 - a. Take asphalt concrete temperature at a point 6 inches below the exposed surface of the Material, in the truck, on the job site, and just prior to placement.
 - b. Furnish and use tarpaulins to cover all loads during transportation if the temperature of the mixture is below the job mix formula limits specified in MAG Section 710.
2. When releasing agents are placed in the truck bed, ensure that no free fluid is present in the truck bodies at the time the asphalt concrete is loaded.
 - a. Do not use diesel fuel as a releasing agent.
3. Ensure the handling of the completed mixture at all times prevents segregation.
 - a. Handle all Material within the self-propelled mechanical spreading and finishing equipment in a manner that prevents segregation of the aggregate.
 - 1) Include Material-handling devices such as augers, screws, or slat conveyors on the equipment to prevent segregation.
 - a) Extend these devices to the final or termination point where the Material is being transported within the equipment.

- 2) In the case of the screed, install auger extensions and vibrators wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension.
 - a) The Resident Engineer may waive the auger extensions and vibrators when Material is placed against an extremely uneven curb or edge over a short distance.
- 3) If any of the devices fail to function, terminate the paving operation immediately until repairs are completed.
- b. Insure that asphalt Material spread is free from areas of excess coarse or fine Material.
4. Back trucks carrying asphalt Material into self-propelled mechanical spreading and finishing equipment in a manner that will not jar the equipment excessively or move it out of line.
 - a. Securely attach the truck to the equipment during spreading and finishing.

B. Placing asphalt concrete:

1. Begin placement of pavement at points farthest from the source of supply, and progress continuously toward the source of supply, unless otherwise ordered by the Resident Engineer.
 - a. Do not place more than 1/2 day's delivery to the project in any one lane in advance of the other lanes.
 - b. Stagger the end of each lane in relation to the adjacent lane.
2. Use self-propelled mechanical spreading and finishing equipment for placing asphalt concrete, but do not allow the forward speed of operation of the equipment to exceed 55 feet per minute unless it can be demonstrated to the satisfaction of the Resident Engineer that higher speeds will not affect the smoothness of the mat.
 - a. For locations where the mixture is to be placed over areas inaccessible to the specified spreading or compacting equipment or over areas where the use of the specified spreading and compacting equipment would not be practicable, have spreading or compacting the asphalt mixture by other means approved by the Resident Engineer.
 - b. Spreader boxes will be permitted for alleys and on narrow paving projects where it is not practical to use self-propelled equipment.

- 1) The use of spreader boxes must have the approval, in writing, of the Resident Engineer.
- 2) Minimize manipulation of the spreader box in order to obtain a smooth surface.
- 3) Back trucks into the spreader box in a manner which will not jar the equipment excessively or move it out of line.
 - a) Securely attach the trucks to the equipment during spreading and finishing.
3. Place float rock developed during the raking process on an underlying course or otherwise dispose of it.
 - a. Never scatter float rock over the final course surface.

C. Compacting asphalt concrete:

1. Use steel-wheeled tandem rollers or vibratory rollers where applicable.
 - a. In all cases, operate the larger of the two roller wheels in the forward position.
 - b. Operate vibratory rollers in accordance with standard practices and manufacturer recommendations.

D. Leveling Course

1. Use a leveling course when specified or when directed in writing by the Resident Engineer to bring existing pavement to a uniform grade prior to placing an overlay or other course.
2. After the prime coat or tack coat has been applied, spread the leveling course mixture to the proper width and to such depth as will compact to the required thickness.
 - a. The Resident Engineer will determine actual quantities of the mixture required.
3. Spread a leveling course only to a distance in advance of the following course covering it as ordered by the Resident Engineer.
 - a. Do not place the leveling course less than one lane in width, but place the longest practical length for any one lay, preferably not less than 1200 feet.
 - b. Have the Resident Engineer approve the exact width and length.

4. Prior to finishing the leveling course by means of self-propelled spreading equipment, spreader box, or motor graders, place the Material in layers of 2 inches maximum compacted thickness.
5. The Resident Engineer may approve other means for placing the leveling course provided that the method provides a finish surface that does not vary from the design surface by more than the amount specified below.
 - a. Minimize manipulation of controls of the paver in order to obtain a smooth surface.
 - 1) Unless otherwise permitted by the resident Engineer, do not make adjustments on less than 50 foot intervals except where the machine is equipped with electronic grade controls, and any adjustments may not result in a change in pavement thickness in excess of 1/8 inch.
6. Thoroughly compact the leveling course, smooth and true to grade and cross-section, and free from ruts, humps, depressions, and irregularities.
 - a. Use a pneumatic tire or steel wheeled roller for leveling course compaction.
 - b. Roll the leveling course concurrently with the laydown of the leveling course.
 - c. During the rolling operation, do not allow the speed of the roller to exceed 3 miles per hour.
 - d. Additional rollers may be required depending on the placement rate of the asphalt concrete.
 - 1) If an ample number of rollers are not present, adjust the placement rate to accommodate the roller speed.

E. Asphalt Base and Surface Courses

1. Spread and finish asphalt base and surface courses by means of self-propelled mechanical spreading and finishing equipment, except as otherwise noted.
2. When more than one course is placed, stagger the longitudinal joints of each course not less than 6 inches with relation to the longitudinal joints of the underlying course.
3. Perform break down and compaction rolling with either steel-wheel or pneumatic-tire.

- a. The compacted thickness of layers placed may not exceed 150 percent of the Design Target Thickness of Table 710-1 in MAG Section 710 except as otherwise provided in the Plans and Specifications, or if approved in writing by the Resident Engineer.
- b. Operate all rollers continuously from breakdown through finish rolling.
- 4. Furnish sufficient rolling equipment to satisfactorily compact and finish the amount of mixture being placed.
 - a. Prior to placing any asphalt Material, verify that the required type and number of rollers are on the Project and in acceptable operating condition.
 - 1) Vibratory rollers may be used in lieu of the steel-wheeled rollers; however, when the thickness of the asphalt is one (1) inch or less all rolling must be done in the static mode.
 - 2) Furnish a minimum of two rollers with two (2) operators on the project at all times.
 - 3) Upon approval of the Resident Engineer, one of the rollers may be a pneumatic tire roller.
 - b. During the rolling operation, the speed of the roller may not exceed 3 miles per hour.
 - 1) If an ample number of rollers are not present, adjust the placement rate to accommodate the roller speed.
- 5. Begin breakdown rolling as soon as the mixture will bear the roller without undue displacement.
 - a. Roll longitudinally along the pavement, overlapping on successive trips by at least 1/2 but not more than 3/4 the width of the rear wheels.
 - b. On alternate trips of the roller vary the lengths slightly.
 - c. Ensure that the motion of the roller at all time is slow enough to avoid displacement of the mixture.
 - d. The Resident Engineer may require a pneumatic roller for one of the rolling operations.
- 6. When more than one width of asphalt concrete Material will be placed, do not roll a 6-inch strip adjacent to the area on which future Material is to be laid until such Material has been placed.

- a. Do not leave the 6-inch strip unrolled for more than 2 hours after it is placed unless it is first heated with a joint heater before being rolled.
 - b. After the first strip or width has been compacted; place, finish and compact the second width in a manner similar to the first width except that the 6-inch width not previously compacted must also be compacted.
7. If the mix was designed with the Marshall method in accordance with Asphalt Institute's MS-2, continue rolling until the specific gravity of the compacted mixture is not less than 95 percent of the specific gravity of specimens composed of the same Materials in similar proportions or composed of the same mixture compacted in the laboratory by the 75 blow method of AASHTO T 245.
8. If the mix was designed with the Asphalt Institute's Superpave gyratory method in accordance with Asphalt Institute's SP-2, continue rolling until the specific gravity of the compacted mixture is not less than 93 percent of the maximum theoretical specific gravity according to ASTM D 2041 of specimens composed of the same Materials in similar proportions or composed of the same mixture compacted in the laboratory.
9. At any place not accessible to roller compaction, thoroughly compact the mixture with tampers, and where necessary finish with a hot smoothing iron to provide a uniform and smooth layer over the entire area compacted in this manner.
10. Perform finish rolling using steel-wheeled rollers or vibratory steel-wheeled rollers operated in the static mode.
11. The completed surface must be thoroughly compacted, smooth, true to grade and cross-section, and free from ruts, humps, depressions, or irregularities.

F. Tolerances of leveling and surface courses:

1. An acceptable leveling course surface may not vary more than 1/2 inch from the lower edge of a 25-foot straightedge placed parallel to the centerline of the roadway.
2. An acceptable finish course surface may not vary more than 1/4 inch from the lower edge of a 25-foot straightedge placed parallel to the centerline of the roadway.

G. Construction joints:

1. Use a light coat of asphalt emulsion applied to the exposed edge before the joint is made, if it deemed necessary by the Resident Engineer.

2. Verify that construction joints formed when the fresh mixture is placed are dense and well sealed.
3. Test transverse construction joints with a 25-foot straightedge in accordance with Paragraph 3.06B.

H. Curbs:

1. Place curbs using an approved extrusion type machine.
 - a. Have curb extrusion templates varying from the cross-section shown on the Plans approved by the Resident Engineer
2. Use a 9.5mm asphalt mix in accordance with MAG Section 710.
 - a. Ensure one percent by weight of the total mixture consists of a granulated synthetic resin stiffener, Lexite or equal, in accordance with the following:
 - 1) Softening Point (Ring & Ball): 210 degrees Fahrenheit, minimum, in accordance with ASTM D 36.
 - 2) Acid Number: Less than 1.00 in accordance with ASTM D 465.
 - 3) Saponifiable matter: Less than 1 percent in accordance with ASTM D 464.
 - 4) Iodine Number: 175 - 185 in accordance with ASTM D 29.

3.04 REPAIR/RESTORATION

A. Asphalt cement content deficiencies:

1. When the asphalt cement content is in excess of the limits established in MAG Section 710, remove any areas of bleeding as directed by the Resident Engineer, but in no case less than the specified roller width.
 - a. Replace the affected Material with new Material meeting the specification requirements for the mix type involved.
 - b. At any time bleeding occurs within the period lasting from placement until 1 year after placement, remove and replace defective Material until the bleeding has been corrected.
2. When the deviation of the pavement asphalt cement content exceeds 0.2 percentage points by weight from limits established in MAG Section 710, which is a greater deviation than the permitted deviation for reduced payment as indicated in Table 02743-3, overlay the pavement on the area affected with a new mat of Material as specified by the Resident Engineer

Asphalt Concrete Pavement
02743-15

- a. Overlay not less than one city block or 660 feet, whichever is less in length, for the full width of the deficient area.
- 3. Repair asphalt cement content deficiencies at no additional cost to the AGENCY.
- B. Mineral aggregate gradation deficiencies:
 - 1. When the mineral aggregate gradation deviates from the requirements of this Section in an amount that, in the opinion of the Resident Engineer, will affect the stability or durability of the mix, do either of the following:
 - a. Remove and replace the asphalt concrete pavement with Material that meets the requirements of this Section.
 - b. Place an additional mat of such thickness and gradation as required by the Resident Engineer which will, in the opinion of the Resident Engineer, correct the deficiency.
 - 2. Repair mineral aggregate gradation deficiencies at no additional cost to the AGENCY.
- C. Pavement compaction deficiencies:
 - 1. When a deficiency of the pavement density discovered by using methods described in Paragraph 3.05C exceeds 5 percent, which is a greater deviation than the permitted deviation for reduced payment as indicated in Table 02743-2, overlay the pavement in the area affected with a new mat of Material as specified by the Resident Engineer.
 - a. Overlay not less than one city block or 660 feet, whichever is less in length, for the full width of the deficient area.
 - 2. Overlay pavement compaction deficiencies at no additional cost to the AGENCY.
- D. Pavement thickness deficiencies
 - 1. When a deficiency of pavement thickness discovered by using methods described in Paragraph 3.05B exceed 1/2 inch, overlay the pavement on the area affected as follows:
 - a. Overlay not less than one city block or 660 feet, whichever is less in length, for the full width of the deficient area.

- b. Overlay the area specified in Subparagraph 3.04E.1.a with a new mat of Material as specified by the Resident Engineer and equal in thickness to the deficiency but not less than 1 inch in any instance.
 - 2. Overlay deficiencies in thickness at no additional cost to the AGENCY.
 - E. Drainage deficiencies:
 - 1. Correct any areas not draining properly, as demonstrated by the water test described in Paragraph 3.05A, to the Resident Engineer's satisfaction.
 - 2. Correct drainage deficiencies at no additional cost to the AGENCY.
 - F. Leveling course deficiencies:
 - 1. Correct leveling course deviations that exceed the tolerances specified in Subparagraph 3.03F.1, such as humps, or depressions, to meet the specified tolerance.
 - 2. Adjustment in the cost for the Material may be requested by either the AGENCY or the Contractor depending on the type of deviation.
 - 3. Provide all labor and equipment necessary to correct such deviations at no additional cost to the AGENCY.
 - G. Asphalt base and surface course deficiencies:
 - 1. If asphalt base and surface course deviations that exceed the tolerances specified in Subparagraph 3.03F.2 such as humps and depressions are found, do either of the following:
 - a. Correct asphalt base and surface course deviations.
 - b. Cut out the deviating areas along neat straight lines and replace those areas with fresh hot mixture, and thoroughly compact them to conform and bond to the surrounding area.
 - 2. Repair asphalt base and surface course deficiencies at no additional cost to the AGENCY.
- 3.05 FIELD QUALITY CONTROL
- A. Pavement drainage:
 - 1. Before final acceptance and in the presence of the Resident Engineer, test all streets by using water to demonstrate that the pavement allows for proper drainage.

2. Provide the water for this test at no additional cost to the AGENCY.

B. Asphalt pavement thickness:

1. When in the opinion of the Resident Engineer there is reason to believe that the pavement thickness is deficient, the Contractor shall take cores to verify conditions at random locations as follows:
 - a. 1 core will be taken for each 8 feet or portion thereof of width and for every 500 feet of lineal distance.
 - b. 1 core will be taken for each 8 feet of width between intersecting streets or portion thereof.
 - c. If a deficiency of more than 1/4 inch from the required thickness is found, 2 additional cores will be taken not closer than 100 feet apart or closer than 100 feet to the original deficient core.
 - 1) The average of these 3 cores will be used to determine the amount of any deficiency.
 - d. Core thickness will be determined by average caliper measurement.
 - e. Coring to establish if the pavement is deficient will be at no additional cost to the AGENCY.
2. Further cores may be taken by the Contractor, if he so chooses to determine the limits of the deficiency, if at no additional cost to the AGENCY.
 - a. These cores will not be used to determine the average thickness of the pavement.

C. Asphalt density:

1. When in the opinion of the Resident Engineer there is reason to believe that the compaction of the mixture is deficient, the Contractor shall take cores to verify conditions at random locations as follows.
 - a. 1 core will be taken for each 8 feet or portion thereof of width and for every 500 feet of lineal distance.
 - b. 1 core will be taken for each 8 feet of width between intersecting streets or portion thereof.
 - c. If a deficiency of more than 1 percent from the required specific gravity defined in Subparagraph 3.03E.7 or Subparagraph 3.03E.8 is found, 2

additional cores will be taken not closer than 100 feet apart or closer than 100 feet to the original deficient core.

- 1) The average of these 3 cores will be used to determine the amount of any deficiency.
- d. Coring to establish if the pavement is deficient will be at no additional cost to the AGENCY.
2. Further cores may be taken by the Contractor, if he so chooses to determine the limits of the deficiency, if at no additional cost to the AGENCY.
 - a. These cores will not be used to determine the average specific gravity of the pavement.

D. Asphalt Cement content:

1. Secure Samples from the roadway in accordance with the provisions of MAG Section 710 and AASHTO T 168 for the purpose of determining asphalt cement content.
2. If the asphalt cement content determined by tests performed on the Samples exceeds the limits established in MAG Section 710, for each deficient test taken take 2 additional cores not closer than 100 feet apart or closer than 100 feet to the original core, and repeat the testing on these 2 additional cores.
3. The average of all 3 tests made will be used to determine the asphalt cement content.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Asphalt concrete pavement will not be measured.

4.02 PAYMENT

- A. Asphalt concrete pavement will be paid for as shown on the Bid Schedule.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 03100

CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 DESCRIPTION

This section specifies formwork requirements for concrete construction.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 303.1	Standard Specification for Cast-In-Place Architectural Concrete Practice
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 347R	Guide to Formwork for Concrete
National Institute of Standards - PS1	Construction and Industrial Plywood

B. DESIGN:

Formwork design requirements shall conform to the following:

1. Formwork, shoring and reshoring shall be designed by a Professional Engineer currently registered in the State of Arizona having a minimum of 3 years experience in this type of design work.
2. Design and engineering of formwork, shoring and reshoring, as well as its construction, is the sole responsibility of the CONTRACTOR.
3. A procedure and schedule shall be developed for removal of shores (and installation of reshores) and for calculating the loads transferred to the structure during this process.
4. Structural calculations shall be prepared as required to prove that all portions of the structure, in combination with the remaining forming and shoring system, have sufficient strength to safely support their own weight plus the loads placed thereon.
5. When developing procedure, schedule and structural calculations, consideration shall be made regarding the structural system that exists, effects of all imposed loads and the strength of concrete at each stage of construction.

C. DESIGN CRITERIA:

Design of formwork shall conform to the following criteria:

1. Formwork shall be designed for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code. Where conflicts occur between the above two standards, the more stringent requirements shall govern.
2. Formwork shall be designed to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following information:

1. Manufacturer's product data, installation instructions and acknowledgement that products submitted meet requirements of standards referenced for
 - a. Form materials
 - b. Form release compound.
 - c. Form ties.
2. Formwork designer qualifications.
3. Submit letter of certification stamped by the registered Engineer referenced in paragraph 1.02B.1 that formwork has been designed in accordance with the specifications.
4. If requested, structural analysis and concrete strength data used in planning and implementing form removal and shoring.

PART 2--PRODUCTS

2.01 FORMS

A. WOOD FORMS:

Wood forms shall be new and unused exterior grade plywood panels manufactured in accordance with APA (American Plywood Association) and bearing the trademark of that group. Forms for all concrete surfaces exposed to view shall be APA High Density Overlay (HDO) Plyform Class I Exterior 48" X 96" X 3/4" minimum thickness. Forms for other concrete surfaces shall be APA Douglas Fir B-B Plyform Class I Exterior 48" X 96" X 3/4-inch minimum thickness.

When approved by the CONSTRUCTION MANAGER, plywood may be reused.

B. METAL FORMS:

Metal forms excluding aluminum may be used. Forms shall be free of rust and straight without dents to provide members of uniform thickness.

C. ARCHITECTURAL CONCRETE FORMWORK

1. Form-Facing Panels for As Cast Architectural Concrete Finish:
Exterior-grade plywood panels, nonabsorptive, that will provide continuous,

true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better, complying with DOC PS 1.

2. Rustication Strips: Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths. Strips to be installed securely, plumb, straight, and true.
3. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths. Strips to be installed securely, plumb, straight, and true.

2.02 FORM TIES

Form ties shall be commercially fabricated for use in form construction and shall be constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete. Diameter on ends shall be 3/4 inch minimum to 1 inch maximum. Embedded portion of ties shall be not less than 1 1/2 inch from face of concrete after ends have been removed. Ties with integral waterstops shall be provided in all water-retaining structures and in below grade structures exposed to a ground water level above the base slab.

2.03 FORM RELEASE COMPOUND

Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste and odor. Form release agent shall not adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces.

PART 3--EXECUTION

3.01 PREPARATION

Preparation shall conform to the following:

1. Surfaces of forms shall be covered with an approved form release compound prior to form installation. Application shall be in accordance with manufacturer's recommendations.
2. Excess form coating material shall not be permitted to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
3. Surfaces of forms, reinforcing steel and other embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.02 CONSTRUCTION

Formwork construction shall conform to the following:

1. Forms shall be used for all cast-in-place concrete including sides of footings.
2. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings. Forms shall be braced or tied together to maintain their position and shape under a load of freshly-placed concrete.
2. Forms shall be sufficiently tight to prevent leakage.
4. Temporary openings shall be provided at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
5. Temporary openings, also called form “windows”, shall be used to limit height of free fall of concrete and to limit the lateral movement of concrete during placement. Openings are required in wall placements greater than 20 feet in height and shall be spaced so that no more than 8 feet of solid form exists between openings measured horizontally and vertically.
6. A 3/4-inch chamfer strip shall be placed in exposed to view corners of the forms to produce a 3/4-inch wide beveled edge.
7. At construction joints, contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement shall be overlapped by at least 1 inch. Forms against hardened concrete shall be held to prevent offsets or loss of mortar at construction joint and to maintain a true surface. Where possible, juncture of built-in-place wood or metal forms shall be located at architectural lines, control joints or at construction joints.
- .8. Where circular walls are formed and forms made up of straight sections are proposed for use, straight lengths not exceeding 2 feet wide shall be provided for curved surfaces with a radius of 25 feet to 100 feet. Straight form lengths not exceeding 3 feet wide may be used for curved surfaces with a radius of 100 feet and larger. Formwork shall be braced and tied to maintain correct position and shape of members.
9. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling. Formwork shall be anchored to

shores or other supporting surfaces of members so that movement of any part of formwork system is prevented during concrete placement.

10. Runways for moving equipment shall be provided with struts or legs, supported directly on formwork or structural members without resting on reinforcing steel.
11. A positive means of adjustment (wedges or jacks) of shores and struts to take up all settlement during concrete placing operation shall be provided. Forms shall be securely braced against lateral deflection. Wedges used for final adjustment of forms shall be fastened prior to concrete placement in position after final check.
12. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
13. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
14. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
15. Architectural concrete smooth as-cast Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Do not repair and patch tie holes and defects in as-cast concrete finish without approval of the ENGINEER and Architect. Remove and replace cast-in-place architectural concrete that cannot be repaired. Repair in a manner acceptable to the ENGINEER and Architect.
16. Do not fill rock pockets or honey combing in the exposed -to-public-view surfaces without approval of the ENGINEER and the Architect.

3.03 TOLERANCES

Formwork tolerances shall be in accordance with ACI 117 and the following. If a discrepancy is found between the requirements below and ACI 117, the more stringent requirement shall control:

1. Products shall be installed in accordance with manufacturer's written instructions.
2. Surfaces of columns, piers, walls, and risers shall vary from plumb a maximum of 1/2 inch for entire height and 1/4 inch in 10 feet of height. Exposed corner columns, control-joint grooves, and other exposed to view

lines shall vary from plumb a maximum of 1/2 inch for entire length and 1/4 inch in 20 feet of length.

3. Maximum variation from level or from grade shall be 3/4 inch for entire length, 3/8 inch for any bay or 20 foot length, and 1/4 inch in 10 feet of length for slab soffits, ceilings, and beam soffits, measured before removal of supporting shores and shall be 1/2 inch for entire length and 1/4 inch in 20 feet of length for exposed lintels, sills, parapets, horizontal grooves, and other exposed-to-view lines.
4. Maximum variation of linear structure lines from established position in plan and related position of columns, walls, and partitions shall be 3/4 inch for entire length and 3/8 inch for any bay or 20 foot length.
5. Maximum variation in size and location of sleeves, floor openings, and wall openings and variation in horizontal plan location of beam, column and wall centerlines shall be $\pm 1/2$ inch
6. Maximum variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls shall be $\pm 3/8$ inch and in concrete plan dimensions for footings and foundations shall be - 1/2 inch + 2 inches.
7. Maximum misplacement or eccentricity of footings and foundations shall be 2 percent of footing width in direction of misplacement, but not more than 2 inches.
8. Specified thickness of footings and foundations may be decreased by up to 5 percent with no maximum increase except that which may interfere with other construction.
9. Maximum step variance in the flight of stairs for Rise is $\pm 1/8$ inch and for Tread is $\pm 1/4$ inch and in consecutive steps for Rise is $\pm 1/16$ inch and for Tread is $\pm 1/8$ inch.
10. Sufficient control points and benchmarks to be used for reference purposes to check tolerances shall be established and maintained in an undisturbed condition until final completion and acceptance of the work.
11. Regardless of tolerances listed, no portion of a structure shall be allowed to extend beyond the legal boundary of work site.
12. To maintain specified tolerances, formwork shall be cambered to compensate for anticipated deflections in formwork prior to hardening of concrete.
13. For Architectural Concrete limit form work deflection of form-facing panels to not exceed ACI 303.1.

14. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces.
 - a. Seal form joints and penetrations at form ties with form joint sealant to prevent cement paste leakage.

3.04 REMOVAL OF FORMS

Removal of forms shall conform to the following:

1. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
2. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, forms shall be removed as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
3. Top forms on sloping surfaces of concrete shall be removed as soon as concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once, followed by curing specified in Section 03300.
4. Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to concrete.
5. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
6. Where no reshoring is planned, forms and shoring used to support weight of concrete shall be left in place until concrete has attained its specified 28-day compressive strength.
7. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.05 RESHORING

Reshoring shall conform to the following:

1. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
2. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.
3. During reshoring, concrete in structural members shall not be subjected to combined dead and construction loads in excess of loads that structural members can adequately support.
4. Reshores shall be placed as soon as practicable after stripping operations are complete, but in no case later than the end of working day on which stripping occurs.
5. Reshores shall be placed to carry their required loads without overstressing.
6. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength by the formwork ENGINEER's structural calculations.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 03200

CONCRETE REINFORCEMENT

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies reinforcing steel for use in reinforced concrete.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements For Structural Concrete and Commentary
ACI SP-66	ACI Detailing Manual
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Steel Welded Wire, Fabric, Plain for Concrete Reinforcement

Reference	Title
ASTM A615/A615M REV B	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A706/A706M REV B	Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A775/A775M REV B	Epoxy-Coated Reinforcing Steel Bars
ASTM A884/A884M	Epoxy-Coated Steel Wire and Welded Wire Reinforcement
AWS D1.4	Structural Welding Code--Reinforcing Steel
CRSI-PRB	Recommended Practice for Placing Reinforcing Bars
CRSI-MSP 1	Manual of Standard Practice
FEDSPEC QQ-W-461H	Wire, Steel, Carbon (Round, Bare, and Coated)

B. SHIPPING, HANDLING AND STORAGE:

Reinforcing steel shall be shipped to the jobsite with attached plastic or metal tags having permanent mark numbers which match the shop drawing mark numbers. All reinforcing shall be supported and stored above ground. Use only plastic tags secured to the reinforcing steel bars with nylon or plastic tags for epoxy coated reinforcing steel bars.

C. FABRICATION:

Reinforcing steel bars shall be fabricated in accordance with ACI 315 and the following tolerances:

1. Sheared lengths shall be within +/- 1 inch.
2. Overall dimensions of stirrups, ties, and spirals shall be within +/- 1/2 inch.
3. All other bends shall be within +0 inch, -1/2 inch
4. Minimum diameter of bends of reinforcing steel bars shall be as indicated in ACI-318 paragraph 7.2.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following:

1. Mill certificates for all reinforcing.

2. Manufacturer and type of proprietary reinforcing steel splices. A current ICC Report and manufacturer's literature that contains instructions and recommendations for each type of coupler used shall be submitted.
3. Manufacturer and type of proprietary reinforcing headed bar anchor. A current ICC Report and manufacturer's literature that contains instructions and recommendations for each type of anchor used shall be submitted.
4. Manufacturer and type of reinforcing steel adhesive anchor. A current ICC Report and manufacturer's literature that contains instruction and recommendations for each type of adhesive anchor to be used shall be submitted.
5. Qualifications of welding operators, welding processes and procedures.
6. Reinforcing steel shop drawings showing reinforcing steel bar quantities, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing steel supports. Reinforcing steel shop drawings shall be of sufficient detail to permit installation of reinforcing steel without reference to the contract drawings. Shop drawings shall not be prepared by reproducing the plans and details indicated on the contract drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of reinforcing steel, including large scale drawings at joints detailing bar placement in congested areas. Placement drawings shall be in accordance with ACI 315. Reinforcing details shall be in accordance with ACI SP-66.

PART 2--PRODUCTS

2.01 BAR REINFORCEMENT

Reinforcing steel bars shall be deformed billet steel in conformance with ASTM A615, Grade 60. Bars to be welded shall be deformed billet steel conforming to ASTM A706.

Reinforcing steel bars in structural elements designated on the design drawings as "special moment frames" and "special shear walls" shall be ASTM A706. ASTM A615 Grade 60 reinforcement may be used if the following requirements are met:

1. The actual yield strength based on mill tests does not exceed the specified yield strength by more than 18,000 psi.
2. The ratio of the actual tensile strength to the actual yield strength is not less than 1.25.

2.02 WIRE FABRIC

Wire fabric shall be welded steel mesh conforming to ASTM A185.

2.03 WIRE AND PLAIN BARS

Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A82.

2.04 SMOOTH DOWEL BARS

Smooth dowel bars shall conform to ASTM A615, Grade 60, with a metal end cap at the greased or sliding end to allow longitudinal movement.

2.05 REINFORCING STEEL MECHANICAL SPLICES

Reinforcing steel mechanical splices shall be a positive connecting threaded type mechanical splice system manufactured by Erico, Inc., Dayton Superior, Williams Form Engineering Company, or approved equal.

Type 1 mechanical splices shall develop in tension or compression a strength of not less than 125 percent of the ASTM specified minimum yield strength of the reinforcement and shall meet all other ACI 318 requirements. Type 1 mechanical splices are typical except for locations noted below where Type 2 mechanical splices are required.

Type 2 mechanical splices shall meet the requirements for a Type 1 mechanical splice, plus develop the ASTM specified tensile strength of the reinforcement. Type 2 mechanical splices shall be provided at locations specifically noted on the design drawings.

2.06 TIE WIRE

The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.07 BAR SUPPORTS

Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI MSP-1 and placed in accordance with CRSI PRB.

1. Manufactured concrete block supports with embedded tie wires (wire dobies) shall be provided for footing and slabs on grade. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
2. Stainless steel or plastic protected plain steel supports shall be provided for

other work.

2.08 REINFORCING STEEL HEADED BAR ANCHORS

Reinforcing steel headed bar anchors shall be a positive connecting taper threaded type bar anchor. The bar end must be taper threaded using the manufacturer's bar threading equipment to ensure proper taper and thread engagement. Bars shall be installed in accordance with manufacturer's recommendations and the associated ICC report. Reinforcing steel headed bar anchors shall be model D6 Lenton Terminator as manufactured by Erico, Inc., or approved equal.

Type 1 mechanical splices shall develop in tension or compression a strength of not less than 125 percent of the ASTM specified minimum yield strength of the reinforcement and shall meet all other ACI 318 requirements. Type 1 mechanical splices are typical except for locations noted below where Type 2 mechanical splices are required.

Type 2 mechanical splices shall meet the requirements for a Type 1 mechanical splice, plus develop the ASTM specified tensile strength of the reinforcement. Type 2 mechanical splices shall be provided at locations specifically noted on the design drawings

PART 3--EXECUTION

3.01 TOLERANCE

Reinforcing steel placement tolerance shall conform to the requirements of ACI 117, ACI 318, and the following:

1. Reinforcing steel bar clear distance to formed surfaces shall be within $\pm 1/4$ inch of specified clearance and minimum spacing between bars shall be a maximum of $1/4$ inch less than specified.
2. Reinforcing steel top bars in slabs and beams shall be placed $\pm 3/8$ inch of specified depth in members 8 inches deep or less and $\pm 1/2$ inch of specified depth in members greater than 8 inches deep.
3. Reinforcing steel spacing shall be placed within \pm one bar diameter or ± 1 inch, whichever is greater.
4. The minimum clear distance between reinforcing steel bars shall be equal to the greater of 1 inch or the reinforcing steel bar diameter for beams, walls and slabs, and the greater of $1 1/2$ inches or 1.5 times the reinforcing steel bar diameter for columns.
5. Beam and slab reinforcing steel bars shall be threaded through column

vertical reinforcing steel bars without displacing the column reinforcing steel bars and still maintain clear distances for beam and slab reinforcing steel bars.

3.02 CONCRETE COVER

Unless specified otherwise on the Drawings, reinforcing steel bar cover shall conform to the following:

1. Reinforcing steel bar cover shall be 3 inches for concrete cast against earth.
2. Reinforcing steel bar cover shall be 2 inches for reinforcing steel bars for formed concrete surfaces exposed to earth and weather.
3. Reinforcing steel bar cover shall be 2 inches for any formed surfaces exposed to or above any liquid.
4. Reinforcing steel bar cover shall be 1 ½ inches for reinforcing not in the above categories unless noted otherwise on the design drawings.

3.03 SPLICING

Reinforcing steel splicing shall conform to the following:

1. Class B splice lengths in accordance with ACI 318, Chapter 12, shall be used for all reinforcing steel bars unless shown otherwise on the drawings.
2. For welded wire fabric the splice lap length measured between the outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, nor less than 1.5 times the development length nor less than 6 inches.
3. Splices of reinforcement steel bars not specifically indicated or specified shall be subject to the approval of the ENGINEER. Mechanical proprietary splice connections may be used when approved by the ENGINEER or as indicated on the drawings.
4. Welding of reinforcing steel bars is not allowed unless approved by the ENGINEER.

3.04 HEADED BAR ANCHORS

Reinforcing steel headed bar anchors shall be used only at locations shown on the drawings. Installation shall be in strict conformance with manufacturer's recommendations and the associated ICC report.

3.05 CLEANING

Reinforcing steel bars at time of concrete placement shall be free of mud, oil, loose rust, or other materials that may affect or reduce bond. Reinforcing steel bars with rust, mill scale or a combination of both may be accepted without cleaning or brushing provided dimensions and weights including heights of deformation on a cleaned sample are not less than required by applicable ASTM standards.

3.06 PLACEMENT

Reinforcing steel bar placement shall conform to the following:

1. Uncoated reinforcing steel bars shall be supported and fastened together to prevent displacement by construction loads or concrete placement. For concrete placed on ground, furnish concrete block supports or metal bar supports with non-metallic bottom plates. For concrete placed against forms furnish plastic or plastic coated metal chairs, runners, bolsters, spacers and hangers for the reinforcing steel bar support. Only tips in contact with the forms require a plastic coating.
2. Coated reinforcing steel bars shall be fastened together to prevent displacement. Plastic or nylon ties shall be used to hold the coated reinforcing steel bars rigidly in place. The coated reinforcing steel bars shall be supported with plastic or plastic coated chairs, runners, bolsters, spacers and supports as required.
3. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, reinforcing steel bars in the upper layers shall be placed directly over the reinforcing steel bars in the bottom layer with the clear distance between each layer to be 2 inches unless otherwise noted on the Drawings. Spacer reinforcing steel bars shall be placed at a maximum of 3'-0" on center to maintain the minimum clear spacing between layers.
4. Reinforcement shall be extended to within 2 inches of formed edges and 3 inches of the concrete perimeter when concrete is placed against earth.
5. Reinforcing steel bars shall not be bent after embedding in hardened concrete unless approved by the ENGINEER.
6. Tack welding or bending reinforcing steel bars by means of heat is prohibited.
7. Where required by the contract documents, reinforcing steel bars shall be embedded into the hardened concrete utilizing an adhesive anchoring system

specifically manufactured for that application. Installation shall be per the manufacturer's written instructions.

8. Bars with kinks or with bends not shown shall not be used.
9. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the ENGINEER. Bars shall not be welded at the bend.

3.07 FIELD QUALITY CONTROL

Field quality control shall include the following:

1. The CONSTRUCTION MANAGER shall be notified whenever the specified clearances between the reinforcing steel bars can not be met. The concrete shall not be placed until the CONTRACTOR submits a solution to the congestion problem and it has been approved by the ENGINEER.
2. The reinforcing steel bars may be moved as necessary to avoid other reinforcing steel bars, conduits or other embedded items provided the tolerance does not exceed that specified in Section 3.01. The ENGINEER's approval of the modified reinforcing steel arrangement is required where the specified tolerance is exceeded. No cutting of the reinforcing steel bars shall be done without written approval of the ENGINEER.
3. An independent laboratory shall be employed to review and approve CONTRACTOR welding procedures and qualify welders in accordance with AWS D1.4. The laboratory shall visually inspect each weld for visible defects and conduct non-destructive field testing (radiographic or magnetic particle) on not less than one sample for each 10 welds. If a defective weld is found, the previous 5 welds by the same welder shall also be tested.

****END OF SECTION****

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies cast-in-place concrete which consists of furnishing all material, mixing and transporting equipment, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing, and curing of concrete in the structure.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER:

Special Inspection of concrete work shall be performed by the Special Inspector under contract with the CONTRACTOR and in conformance with the IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the OWNER in their sole discretion. Special Inspection of concrete is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

All structural concrete work shall receive Special Inspection in accordance with IBC Chapter 17. Structural concrete includes all elements which resist code-defined loads and whose failure would impact life safety. Non-structural site work concrete does not require Special Inspection. Anchor bolts and anchors installed in hardened concrete require Special Inspection.

OWNER approved testing shall be in accordance with Section 01400.

B. QUALITY CONTROL BY CONTRACTOR:

Where required to demonstrate conformance with the specified requirements for cast-in-place concrete, the CONTRACTOR shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test concrete materials as specified in paragraphs 03300-2.01, 2.02, and 3.15. Costs of testing laboratory services shall be borne by the CONTRACTOR.

C. BASIS FOR QUALITY:

Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

D. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ACI 117	Tolerances for Concrete Construction and Materials
ACI 211.1	Selecting Proportions for Normal, Heavy Weight and Mass Concrete
ACI 214R	Evaluation of Strength Test Results of Concrete
ACI 301	Structural Concrete for Buildings
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318-05	Building Code Requirements for Structural Concrete
ACI 350-06	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.1	Tightness Testing of Environmental Engineering Concrete Structures
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	Organic Impurities in Fine Aggregate for Concrete
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Ready-Mixed Concrete
ASTM C117	Materials Finer Than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

Reference	Title
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C142	Clay Lumps and Friable Particles in Aggregates
ASTM C143	Slump of Hydraulic Cement Concrete
ASTM C150	Portland Cement
ASTM C157	Length Change of Hardened Cement Mortar and Concrete
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C595	Blended Hydraulic Cements
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Slag Cement for use in Concrete and Mortars
ASTM C1059	Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Sampling Aggregates
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E329	Agencies Engaged in Construction Inspection and/or Testing
CRD-C572	U.S. Corps of Engineer's Specifications for Polyvinylchloride Waterstop
IBC 2006	International Building Code with local amendments

E. CONCRETE CONFERENCE

A meeting shall be held to review the main specification requirements and the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction. The meeting shall be held no later than 28 days after the Notice to Proceed.

All parties involved in the concrete work shall attend the conference, including the following: CONTRACTOR's representative, testing laboratory representative, concrete subcontractor, concrete supplier, CONSTRUCTION MANAGER, and the ENGINEER.

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Each proposed mix design showing (a) the expected strength at 28 days, (b) corresponding slump before and after the introduction of high-range water-reducing admixtures, (c) water/cement ratios, (d) weights and test results of the ingredients, (e) aggregate gradation, (f) test results of mix design prepared by an independent testing laboratory, and (g) other physical properties necessary to review each mix design for conformance with these specifications. Mix design proposed shall be sealed by a Professional Engineer registered in the state where the project is located.
2. Product literature and technical data for aggregates, cement, and pozzolan.
3. Product literature, technical data and dosage of all proposed admixtures including, but not limited to, air entraining, water reducing and/or retarding admixtures and shrinkage reducing admixtures at liquid containing concrete.
4. Anticipated average delivery time from batch plant to site. If this time exceeds the limit specified in paragraph 3.02, include proposed method to extend set time without deleterious effects on final product. The ENGINEER reserves the right, in their sole discretion, to accept or reject such proposed methods.
5. Curing program description in sufficient detail to demonstrate acceptable strength, finish and crack control as specified.
6. Product literature and technical data for waterstops, curing and sealing compounds, bonding compounds, , epoxy and chemical grout for crack injection, retardant, and trench drains.
7. Samples of concrete floor and slab finishes are specified in paragraph 3.12 E.
8. Concrete delivery truck tickets showing the information listed in ASTM C94, section 14.
9. The CONTRACTOR shall prepare concrete placement drawings. The placement drawings shall include the intended placement sequencing, location of each placement, the size of the concrete placements, joint locations, embedded

items, slab high points and low points, and waterstop locations. Each placement shall also be label with a mix design and the type of finish the concrete surface is to receive.

PART 2--PRODUCTS

2.01 MATERIALS

A. CEMENT:

Portland cement shall be ASTM C150, Type II, low alkali, containing less than 0.60 percent alkalis. In addition to standard requirements, cement shall satisfy optional chemical and physical requirements of ASTM C150, Tables 2 and 4, respectively.

If low alkali cement is not available, aggregates shall show an expansion of less than 0.1% when tested in accordance with ASTM C1260 or ASTM C1567 concrete mix test results shall be submitted verifying that the aggregates are not reactive per the criteria in this standard. ASTM C1260 and ASTM C1567 results shall be no older than 1 year.

Portland-pozzolan cement shall be ASTM C595, Type IP (MS), interground, low alkali.

Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures. See Section 2.01G.

B. GROUND GRANULATED BLAST-FURNACE SLAG:

Ground granulated blast-furnace slag (GGBFS), if used in conjunction with portland cement, shall be per ASTM C989.

C. AGGREGATES:

1. GENERAL: Except as modified herein, fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates shall be regarded as separate ingredients. Aggregates shall be non-reactive and shall be washed before use.

Aggregates shall be checked for alkali-silica reactive constituents per ASTM C1260. Aggregate shall have less than 0.1% expansion when tested in accordance with ASTM C1260. Aggregates having 0.1% or greater expansion when tested in accordance with ASTM C1260 may still be satisfactory provided ASTM C1567 concrete mix test results are submitted and show an expansion of less than 0.1% at 16 days. ASTM C1260 and ASTM C1567 test results shall be no older than 1 year.

Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to

produce a concrete that has optimum workability and consolidation characteristics. The final combined aggregate gradation shall be established during the design mix.

Aggregates used in the concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by the submitted historical data or trial mixtures. See Section 2.01G.

2. FINE AGGREGATE: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33. For classes of concrete which will be used in liquid retaining structures, fine aggregate shall not exceed 40 percent by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.

Variations from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard sieve size	Permissible variation in individual tests, percent
30 and coarser	2
50 and finer	0.5

Other tests shall be in accordance with the following specifications:

Test	Test method	Requirements
Amount of material	ASTM C117	3 percent passing No. 200 sieve maximum by weight
Sand equivalent	ASTM D2419	Minimum 70

3. COARSE AGGREGATE: Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 3 for Class Designation 5S. Gradation of each coarse aggregate size specified in paragraph 03300-2.02 A shall conform to ASTM C33, Table 2.

Variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.

D. POZZOLAN:

Pozzolan shall be Class F fly ash conforming to ASTM C618. Class C fly ash is not allowed. Pozzolan supplied during the life of the project shall have been formed at the same single source. See Section 2.01G.

The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.

Use pozzolan materials that are of the same brand and type and from the same plant of manufacture as the materials used in the concrete represented by the submitted field test records or used in the trial mixtures.

E. ADMIXTURES:

1. GENERAL: Admixtures shall be compatible with the concrete and with each other. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix. The water reducing retarders and admixtures shall reduce the water required by at least 11 percent for a given concrete consistency and shall comply with the water/cement ratio standards of ACI 211.1. Retarder dosage shall result in set time consistent with paragraph 3.02.

2. WATER REDUCING ADMIXTURES: Water reducing admixtures shall conform to ASTM C494, Type A. Acceptable products include: BASF "Pozzolith 322N"; Sika Chemical Corp. "Plastocrete 161"; Euclid Chemical Co. "Eucon WR91"; or equal.

3. WATER REDUCING AND RETARDING ADMIXTURES: Water reducing and retarding admixtures shall conform to ASTM C494, Type D. Acceptable products include: BASF "Pozzolith 300R"; Sika Chemical Corp. "Plastiment"; Euclid Chemical Co. "Eucon Retarder 75"; or equal.

4. HIGH RANGE WATER REDUCING ADMIXTURES: High range water reducing (superplasticizing) admixtures shall conform to ASTM C494, Type F. Acceptable products include: BASF "Glenium 3000NS"; Sika Chemical Corp. "Sikament FF or 686"; Euclid Chemical Co. "Eucon 37"; W.R. Grace "ADVA 195"; or equal.

5. HIGH RANGE WATER REDUCING AND RETARDING ADMIXTURES: High range water reducing and retarding admixtures shall conform to ASTM C494, Type G. Acceptable products include: W.R. Grace "Daracem 100"; Euclid Chemical Co. "Eucon 537"; or equal.

6. AIR ENTRAINING AGENT: Air entraining agent shall conform to ASTM C260. Acceptable products include: BASF "MB-AE 90"; Sika Chemical Corp. "AEA-15"; Euclid Chemical Co. "AEA-92"; or equal. The air entraining agent added shall produce, in

accordance with ASTM C260, an entrained air content specified in paragraph 03300-2.02 A for each class of concrete.

7. SHRINKAGE REDUCING ADMIXTURE: Select shrinkage reducing admixture for compatibility with air entrainment admixture and other ingredients of the concrete mix. Acceptable products include: BASF “Tetraguard AS20” and Grace “Eclipse 4500”.

F. WATER:

Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalis, and organic materials; and shall comply with the requirements of ASTM C1602. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.

G. CHANGE OF MATERIALS:

After each concrete mix design is approved by the ENGINEER, no changes of any sort or source will be allowed without prior written approval from the ENGINEER. When brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed, new field data, data from new trial mixtures, or evidence that indicates that the change will not affect adversely the relevant properties of the concrete shall be submitted for approval by the ENGINEER before use in concrete.

2.02 CONCRETE CHARACTERISTICS

A. MIX PROPORTIONING:

Concrete shall be normal weight concrete composed of specified cement, pozzolan, admixtures, aggregates and water proportioned and mixed to produce a workable, strong, dense, and impermeable concrete. The CONTRACTOR may substitute interground Portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of Portland cement and pozzolan. Water-cementitious material (w/cm) ratio is based on the combined contents of cement and pozzolan in a given mix proportion.

Concrete shall be provided in accordance with the following:

Concrete class	ASTM coarse aggregate size	Maximum water-cementitious materials (w/cm) ratio	Minimum Cementitious Materials Content (pounds/CY)	Pozzolan, percent by weight of cementitious materials	Air content (percent)	Minimum ^a 28-day compressive strength, psi	Slump Range ^e (inches)
A	467	0.42	515	20-35	4-6	4000 ^b	3-5

Concrete class	ASTM coarse aggregate size	Maximum water-cementitious materials (w/cm) ratio	Minimum Cementitious Materials Content (pounds/CY)	Pozzolan, percent by weight of cementitious materials	Air content (percent)	Minimum ^a 28-day compressive strength, psi	Slump Range ^e (inches)
B	57 or 67	0.45	560	15-20 ^d	4-6	3000	3-5
C	57 or 67	0.40	560	15-20	4-6	4500	3-5
E ^c	57	--	-	15-20 ^d	Not Required	2000	4-8

^a Compressive strength shall be determined at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39.

^b Compressive strength of Class A concrete may be determined at 56 days.

^c Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.

^d Pozzolan use optional for this class of concrete.

^e Slump before addition of high range water reducing admixture (superplasticizer). Maximum slump after addition of high range water reducing admixture shall be 8".

B. USE:

Concrete shall be provided by class for the corresponding use listed as follows:

Type of use	Class of concrete
Concrete greater than 36 inches thick	A
Non-structural concrete (sidewalks, curbs, pavers, etc.)	B
Typical cast-in-place structural concrete, concrete fill, and Architectural Concrete	C
Pipe bedding and encasement, electrical conduit encasement (duct banks)	E

C. CONTROL TESTS:

1. **GENERAL:** Before beginning concrete work, the CONTRACTOR shall determine the proper proportions of materials for each class of concrete. The mix shall consist of specified cement, pozzolan, admixtures, aggregate and water. Methods for selecting and adjusting proportions of the ingredients shall be in accordance with ACI 211.1. Verification of mix characteristics for submittal may be achieved using either the Trial Mix Design method or Field Experience method. Concrete shall not be placed in the field prior to review and acceptance of mix proposed.

2. TRIAL MIX DESIGN: Each class of concrete and/or mix verified by this method shall be manufactured at the batch plant which will supply concrete to the project using materials proposed for the Work and material combinations listed in paragraphs 2.01 and 2.02. Testing, data and reporting shall conform to ACI 318 Section 5.3 and the following:

- (a) Required compressive strength used as the basis for selecting concrete proportions (f'_{cr}) shall be the specified concrete strength (f'_c) + 1000 psi for specified concrete strengths less than 3,000 psi and $f'_c + 1200$ psi for specified concrete strengths between 3000 psi and 5000 psi.
- (b) Make at least three trial different mixtures for each class of concrete qualified by the Trial Mix Design. Each trial mixture shall have a different w/cm ratio or different cementitious materials content that will produce a range of compressive strengths encompassing f'_{cr} .
- (c) Trial mixtures shall be designed to produce a slump within $\frac{3}{4}$ in. of the maximum specified and for air-entrained concrete, an air content within 0.5% of the maximum allowable air content.
- (d) For each w/cm ratio or cementitious materials content, at least twelve standard test cylinders shall be cast and cured in accordance with ASTM C192. Four cylinders from each batch shall be tested at age 7 days, 14 days, and 28 days or as required to comply with ACI 318 Section 5.3.
- (e) From results of the cylinder tests, plot a curve showing the relationship between w/cm ratio and compressive strength.
- (f) From the curve of w/cm ratio versus compressive strength, select the w/cm ratio that will produce f'_{cr} . This is the maximum w/cm ratio that shall be used unless a lower w/cm ratio is specified in paragraph 2.02A.

3. FIELD EXPERIENCE DATA: When sufficient test data for a particular mix design is available which is identical or substantially similar to that proposed for use, CONTRACTOR may substitute use of this data in lieu of a trial mix design. Field data, reports, and analysis shall conform to ACI 318 Section 5.3, except as modified herein. Historical mix design proportions for which data are submitted may vary from the specified mix within the following limits: (a) f'_c as specified or up to 500 psi above; (b) w/cm ratio as specified or lower; (c) pozzolan content within 5 percent of that specified; (d) maximum coarse aggregate size may not vary smaller, but gradation of coarse aggregate may vary; (e) fine aggregate fraction within ± 5 percent of that specified; and (f) slump after introduction of admixtures ± 1 inch. Use of historical mix design data does not allow modification of the project mix specifications herein without the express review and acceptance of the ENGINEER.

4. SHRINKAGE: Liquid containing structures using Class C-1 concrete are intended to be watertight. When used for liquid containing structures, the CONTRACTOR shall

provide test results for the Class C-1 concrete mix meeting the following requirement: drying shrinkage limit of 0.042 percent in the laboratory at 35 days (7 days moist cure and 28 days drying) as tested by ASTM C157 with the following modifications.

- (a) Wet cure specimens for a period of 7 days (including the period of time the specimens are in the mold). Wet cure may be achieved either through storage in a moist cabinet or room in accordance with ASTM C 511, or through storage in lime saturated water.
- (b) Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in ASTM C 157 section 8.4.
- (c) Report results in accordance with ASTM C 157 at 0, 7, 14 & 28 days of drying.

Concrete shall not be placed in the field prior to acceptance of the concrete mix. It is recommended that a shrinkage reducing admixture (see 03300-2.01 E.7) be considered for use in concrete for liquid containing structures using the Class C-1 concrete mix to meet the drying shrinkage limit.

2.03 WATERSTOPS

A. POLYVINYL CHLORIDE (PVC):

PVC waterstops shall be manufactured from virgin polyvinyl chloride conforming to the Corps of Engineers Specification No. CRD-C572. Unless otherwise specified or noted on the drawings, waterstops in construction joints shall be 6-inch flat center/ribbed sides/0.375 inch thick. Acceptable products include: Greenstreak Group, Inc. "Model 679"; Vinylex Waterstops and Accessories "Model R638"; or equal. Waterstops in expansion joints shall be 9 inch center-bulb/ribbed sides/0.375 inch thick. Acceptable products include: Greenstreak Group, Inc. "Model 696"; Vinylex Waterstops and Accessories Model "RLB938"; or equal.

Crosses, tees, and other shapes used for changes of direction, intersections, and transitions shall be molded pieces as recommended by the manufacturer.

B. EXPANDING (HYDROPHILIC) WATERSTOPS:

Expanding waterstops shall be bentonite-free and made from unvulcanized rubber. Acceptable products include: SIKA "SikaSwell P-2010"; Adeka Corporation "Ultra Seal MC-2010MN"; Greenstreak Group, Inc. "Hydrotite CJ-1020-2K"; or equal. These are allowable for use only where indicated on the drawings or accepted in writing by the ENGINEER. Provide adhesive approved by the waterstop manufacturer where required due to geometry, irregular surface conditions, or as recommended by the manufacturer. The waterstop MUST be placed between two mats or curtains of steel reinforcement. For limited cover applications or where only one mat or curtain of reinforcement is present, use Adeka Corporation "Ultra Seal KBA-1510FP".

C. INJECTED TUBE WATERSTOPS:

Chemical grout injection tube system, if shown on the Drawings, shall be "Injecto System" by De Neef Construction Chemicals or equal. Equivalent systems shall be submitted to the ENGINEER for review.

2.04 SEALANTS AND JOINT FILLERS

Sealants and preformed joint fillers shall be as specified in Sections 07900 and 07905.

2.05 BONDING COMPOUNDS

Epoxy resin bonding compounds to be used for wet areas shall conform to ASTM C881 Types IV or V, Class A, B, or C depending on temperature at use, and Grade to suit geometry and installation circumstances. Acceptable products include: BASF "Concresive Paste SPL" or "Concresive 1490", as applicable; Sika Chemical Corporation "Sikadur 35" or Sikadur 32", as applicable; or equal.

Non-epoxy bonding compounds may be used in dry areas for non-structural bonding or as specifically noted on the drawings only and shall conform to ASTM C1059 Type II. Acceptable products include: Edoco "Burke Acrylic Bondcrete"; ChemMasters "Cretelox"; or equal.

Bonding compounds shall be applied in accordance with the manufacturer's instructions.

2.06 EPOXY FOR CRACK INJECTION

Epoxy for crack injection shall be a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, blend of epoxy-resin compounds. The consistency shall be as required to achieve complete penetration in hairline cracks and larger. Material shall conform to ASTM C881 Type 1 Grade 1. Acceptable products include Sika Corporation "Sikadur 52"; Adhesives Technology Corporation "Crackbond SLV302"; or equal. Epoxy grout shall be used for all crack repairs except as noted below for non-structural cracks in liquid-containing concrete. The ENGINEER shall determine whether a crack is classified as structural or non-structural. Structural cracks must be repaired with epoxy.

2.07 CHEMICAL GROUT FOR CRACK INJECTION

Chemical (hydrophobic polyurethane) grout shall be used at the ENGINEER's discretion as an alternative to the injection of the epoxy grout for sealing non-structural cracks in structures intended to be watertight. Acceptable products include "Hydro Active Cut" by De Neef Construction Chemicals or SikaFix HH by Sika Corporation, or equal approved by the ENGINEER.

2.08 RETARDANT

Retardant for exposing aggregates for unformed surfaces in construction joints shall be Sika "Rugasol-S"; W.R. Grace "Top-Cast"; or equal. Retardant shall be applied in accordance with manufacturer's instructions sufficient to assure a minimum penetration of 1/4 inch.

2.10 CURING AND SEALING COMPOUNDS

Curing and sealing compound shall be BASF Sonneborn "Kure-N-Seal 25LV"; Edoco, "Spartan-Cote VOC"; or equal, conforming to ASTM C309.

Curing compound shall be clear and shall be applied in accordance with the manufacturer's instructions, except as otherwise specified. Curing and sealing compound shall be certified compliant with final finish systems.

PART 3--EXECUTION

3.01 GENERAL

This section covers the production of cast-in-place concrete. Included are methods and procedures for obtaining quality concrete through proper handling, placing, finishing, curing, and repair of surface defects.

3.02 CONCRETE

Concrete shall be truck-mixed, ready-mixed concrete conforming to the applicable portions of ASTM C94. Materials shall be proportioned by weighing. Pozzolan shall be introduced into the mixer with cement and other components of the concrete mix; pozzolan shall not be introduced into a wet mixer ahead of other materials or with mixing water. Water shall be introduced at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified slump is not exceeded and the maximum total water per the approved mix design is not exceeded. CONTRACTOR shall arrange with the testing laboratory for inspection as required to comply with these specifications.

Concrete shall be delivered to the site and discharge shall be completed within 90 minutes after introduction of water to the mixture. Extension of allowable time beyond this limit requires a CONTRACTOR proposed remedial action plan to be reviewed and accepted by the ENGINEER.

3.03 CONVEYING AND PLACING CONCRETE

A. CONVEYING CONCRETE:

Concrete shall be conveyed from the mixer to the forms in accordance with ACI 301. Concrete which has segregated in conveying shall be removed from the site of the work.

B. PLACING CONCRETE:

1. GENERAL: Concrete shall be placed in accordance with ACI 301. Do not permit concrete to drop freely more than 4-ft.

2. PLACING CONCRETE BY PUMPING: Concrete may be placed by pumping at CONTRACTOR's discretion. Use of pumping shall not, however, be cause to change or relax specified mix design characteristics. Concrete shall possess the specified characteristics at the point of placement.

Slump shall be measured at the hose discharge, except as follows. Initial slump testing in each pour shall occur at both the pumping unit inlet hopper and hose discharge. Slump loss in pumping, measured between the inlet hopper and the hose discharge, shall not exceed 1 inch. After these criteria have been satisfied, slump may be measured at the inlet hopper with allowable slump increased by the earlier measured difference, not to exceed 1 inch.

Air content shall be measured at the hose discharge, except as follows. Initial air content testing shall occur at both the pumping unit inlet hopper and the hose discharge. Loss of air content shall be measured between the inlet hopper and the hose discharge. The air content of the delivered concrete at the inlet hopper shall be increased to provide the specified air content at the hose discharge. After these criteria have been satisfied, air content may be measured at the inlet hopper.

Before starting each pumping operation, the pump and line shall be primed with a cement slurry to lubricate the system. Cement slurry shall be wasted outside the forms. Hose tip shall be equipped with a safety chain for recovery in case of hose blowout during pumping, and in no case shall hose or accessories remain in the freshly placed concrete.

Proper tremie placing techniques and equipment shall be used for all pump placed concrete. Pump discharge system shall remain full of concrete from pump to discharge point at all times. Concrete pumping shall not occur until CONSTRUCTION MANAGER has verified that the proper equipment is available, in particular, the tremie plug. Should the discharge line become open, with significant zones empty of concrete, then the pumping shall cease and the line re-primed with tremie plug installed before continuing the pour.

3. PLACING CONCRETE IN HOT WEATHER: In hot weather (above 80 degrees F), concrete shall be placed in accordance with ACI 305.1.

4. PLACING CONCRETE IN COLD WEATHER: In cold weather (below 45 degrees F), concrete shall be placed in accordance with ACI 306.1.

C. CONSOLIDATING CONCRETE:

Concrete shall be consolidated in accordance with ACI 301. If proper consolidation is not occurring, then concrete placing shall be suspended until proper consolidation can be achieved.

3.04 CURING AND SEALING

A. GENERAL:

Concrete curing shall be completed by water curing or by using a clear membrane curing compound or by a combination of both methods. Repairs or treatment of concrete surfaces shall be coordinated so that interruption of the curing will not be necessary.

Concrete surface temperature shall be maintained between 50 degrees F and 80 degrees F for at least 5 days. Curing concrete in hot weather (above 80 degrees F) shall be in accordance with ACI 305.1. Curing concrete in cold weather (below 45 degrees F) shall be in accordance with ACI 306.1.

B. WATER CURING:

When water curing is used, concrete shall be kept wet continuously for a minimum of 10 days after placement. Absorptive mats or fabric may be used to retain moisture during the curing period.

Unless otherwise specified, water curing shall be used in hot weather for water containment structures. Forms shall be covered and kept moist. The forms shall be loosened as soon as possible without damage to the concrete, and provisions made for curing water to run down inside them. During form removal, care shall be taken to provide wet cover to newly exposed surfaces.

C. CURING COMPOUND:

When curing compound is used, it shall be applied as soon as the concrete has set sufficiently so as not to be marred by the application or immediately following form removal for vertical and other formed surfaces. Preparation of surfaces, application procedures, and installation precautions shall be followed in strict compliance with the manufacturer's instructions. Curing compound shall be applied at twice the manufacturer's recommended dosage rate in two coats applied perpendicular to each other. Use of curing compound for other than liquid containing structures shall be in accordance with the manufacturer's recommendations.

Curing compound shall not be used on concrete surfaces to be coated, waterproofed, moisture-proofed, tiled, roofed, or where other coverings are to be bonded, unless the curing compound is compatible with the final finish covering or it is removed prior to covering.

3.05 PROTECTION

Concrete shall be protected from injurious action by sun, rain, flowing water, frost and mechanical injury.

Loading green concrete will not be permitted. Green concrete is defined as concrete with less than 100 percent of the specified strength.

Unless otherwise shown on the Drawings, no backfill shall be placed against concrete walls until the concrete has reached the specified strength and the connecting slabs and beams have been cast and have reached the specified strength.

Arrangements for covering, insulating, and protecting concrete in cold weather shall be in accordance with ACI 306.1.

3.06 CONSTRUCTION JOINTS

A. GENERAL:

Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Watertight joints shall be provided as specified in paragraph 03300-3.09.

B. CONSTRUCTION:

Construction joints shall be formed as specified. A rough surface of exposed concrete aggregates shall be produced using a surface retardant at construction joints, including joints between the slab and topping concrete. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, retarded surface mortar shall be removed either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregates. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/4 inch of laitance film and shall expose coarse aggregate to ensure adequate bond and watertightness at the construction joints.

Reinforcing steel and welded wire fabric shall be continued across construction joints. Waterstops shall be provided in construction joints at locations as specified in paragraph 03300-3.09.

3.07 INSERTS AND EMBEDMENTS

A. INSERTS:

Where pipes, castings or conduits are to pass through structures, the CONTRACTOR shall place such pipes or castings in the forms before placing the concrete, or he may provide openings in the concrete for subsequent insertion of such pipes, castings or conduits. Such openings shall be provided with waterstops and V-shaped construction joint as shown and shall have a slight flare to facilitate grouting and permit the escape of entrained air during grouting.

Additional reinforcement shall be provided around openings as shown. Grout fill around inserts shall be non-shrink grout as specified in Section 03600.

Horizontal conduits and pipes, where shown in structural slabs and beams, shall be placed between the top and bottom layers of reinforcement. Spacing and size limitations shall conform to ACI 318 Section 6.3 unless specifically approved otherwise by the ENGINEER. Such conduits and pipes shall not run directly beneath a column or, if used, its steel base plate. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. The outside diameter of such conduits should not exceed one-fourth the slab or beam thickness. Securing such items in position by welding them to the reinforcement will not be permitted.

B. EMBEDMENTS:

Gate frames, gate thimbles, special castings, channels or other miscellaneous metal parts that are to be embedded in the concrete shall be set and secured in the forms prior to concrete placement. Unless otherwise specified, anchor bolts and inserts shall be embedded in concrete as shown. The CONTRACTOR shall provide inserts, anchors or other bolts necessary for the attachment of piping, valves, metal parts and equipment. Nailing blocks, plugs, strips, and the like necessary for the attachment of trim, finish, and similar work shall be provided. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Operators or sleeves for gate or valve stems shall be positioned to clear reinforcing steel, conduit and other embedments, and to align accurately with equipment.

3.08 EXPANSION JOINTS

Expansion joints shall be as shown. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints. Waterstops shall be provided in expansion joints as specified in paragraph 03300-3.09.

3.09 WATERSTOPS

Waterstops shall conform to ACI 301. Waterstops shall be securely held in position during placing of concrete. If, after placing concrete, waterstops are materially out of position or shape, the

Cast-In-Place Concrete
03300-17

surrounding concrete shall be removed, the waterstop reset, and concrete replaced in accordance with paragraph 03300-3.10.

Waterstops shall be provided at the following joints:

1. Expansion joints in structures.
2. Joints in parts of structures exposed to ground or water on one side and occupied by non-submerged equipment or by personnel on the other.
3. Wall and slab joints of tanks and channels subject to water pressure. Waterstops shall be provided for the full height of the wall, or as otherwise noted on the drawings.

Field splices shall be heat fused welded butt splices only and shall be acceptable only in straight sections. Lapping of splices or joining by any means other than heat fused welding shall not be allowed.

Hydrophilic waterstops shall be installed according to manufacturer's recommendations. Surfaces of concrete shall be prepared to required level/plumb and smoothness as required by manufacturer. Form and finish concrete placed first with contact surface requirements in mind, or grind surface if necessary. Provide bonding adhesive if required for the particular product, or if surface conditions warrant. Note restrictions on use described in paragraph 03300-2.03 B.

3.10 FORMED SURFACE FINISHES

A. REPAIR OF SURFACE DEFECTS:

Surface defects, including tie holes, minor honeycombing or otherwise defective concrete shall be repaired in accordance with ACI 301. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1 inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Patches shall be cured as specified for the concrete. Finished surfaces shall be protected from stains and abrasions. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects which affect structural strength shall be corrected.

B. FORMED SURFACE FINISHING:

Formed surfaces shall be finished as soon as practicable after form removal and repair of surface defects. Finishes shall be as follows.

1. FINISH A: Finish A shall be a grout-cleaned rubbed finish in accordance with ACI 301 except that ALL FORM FINS AND OTHER PROTRUSIONS SHALL BE COMPLETELY REMOVED TO THE FINAL SURFACE. Surfaces shall be lightly sandblasted prior to sacking. Sandblasting shall occur after the specified curing period. For interior areas not exposed to moisture or weather, water used in the sacking mortar shall be mixed with a PVA bonding compound as recommended by the manufacturer. Finish A shall be provided for uncoated surfaces at surfaces of stair wells; interior surfaces of equipment rooms, galleries and tunnels; operations areas; exposed channels and tanks from 1 foot below minimum water surfaces and up; and permanently exposed vertical and sloped surfaces, such as pipe chases. Finish A shall not be provided at concrete surfaces receiving a coating.

2. FINISH B: Finish B shall be a smooth surface with all form fins and other protrusions completely removed to the final surface. Finish B shall be provided for coated surfaces. See specification 09900 for concrete surface coatings and surface preparation, including filling bug holes before coating.

3. FINISH C: Finish C shall be a finish which has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas shall be neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

4. FINISH D: Finish D shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired.

C. SAMPLES OF FORMED SURFACE FINISH:

A sample concrete panel, 2 feet by 2 feet, representative of formed surface Finish A shall be provided to the CONSTRUCTION MANAGER. The panel shall be representative of the workmanship and finish required, including filling of tie holes. The sample shall be deemed acceptable by the CONSTRUCTION MANAGER prior to the start of such work. The sample shall be on display at the job site, and finished surfaces shall match sample.

3.11 SLAB FINISHES

A. GENERAL:

The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Dry cement shall not be used on new concrete surfaces to absorb excess moisture. Edges shall be rounded to a radius of 1/2 inch. Joints shall be grooved to a radius and depth of 1/4 inch each. Finishes shall match the sample panels provided under paragraph 03300-3.12E.

Floors shall be sloped to drain uniformly within a room or space. Unless otherwise specified, slope shall be a minimum of 1/8 inch per foot toward nearest drain. Where finish is not specified, floor slabs shall receive steel troweling. Use of floor drains with only locally depressed slabs shall be coordinated with CONSTRUCTION MANAGER if detailed on the drawings, and restricted to locations specifically noted.

B. FLOAT FINISH:

Floating shall be performed with a hand or power-driven float in accordance with ACI 301. Begin floating when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit operation of the specific float apparatus. Floating of any one area shall be the minimum necessary to produce a finish that will meet tolerance requirements of ACI 117 for a conventional surface. Refloat the slab immediately to a uniform texture. Floating shall compact and smooth the surface and close any cracks and checking of surfaces. Float finish shall be applied to surfaces of channel, tank bottom slabs, tops of footings, and steps and surfaces to receive roofing and insulation.

C. STEEL TROWEL FINISH:

Float the concrete surface and then trowel in accordance with ACI 301. Immediately after final troweling, the surface shall be cured and protected as specified in paragraphs 03300-3.04 and 03300-3.05. Steel trowel finish shall be provided on floors unless specified otherwise.

D. BROOMED FINISH:

Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface in accordance with ACI 301. Broomed finish shall be provided for walks, tops of tanks, slabs-on-grade exposed to atmosphere, and where otherwise indicated or specified.

E. SAMPLES OF CONCRETE FLOOR FINISHES:

A sample concrete panel, 2 feet by 2 feet, representative of each specified finish, shall be provided to the CONSTRUCTION MANAGER. The panels shall be representative of the workmanship and finishes required. Samples shall be approved in field prior to the start of such work.

3.12 RELATED SURFACES

A. STAIR TREAD:

Stair tread shall be constructed with nonskid nosing as specified in Section 05530. Tread shall have a steel trowel finish and shall have a slope of 1/8 inch per foot toward the front. Ends of treads shall have a 1/16 to 1/8 inch cut between concrete and metal tread to allow for expansion.

B. FINISHING OF UNFORMED SURFACES:

1. RELATED UNFORMED SURFACES: Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the adjacent formed surfaces. Final treatment of formed surfaces shall continue uniformly across the unformed surfaces.

2. PAVEMENTS AND SIDEWALKS: The surfaces of the concrete shall be screeded to grade and sloped to drain. After screeding, the surface shall receive a broomed finish as specified in paragraph 03300-3.12 D. Edges and expansion joints shall be rounded to a radius of ½ inch. Joints shall be grooved to a radius and depth of 1/4 inch each.

3.13 FIELD SAMPLING AND TESTS

A. GENERAL:

Field sampling and testing shall be performed by the independent testing laboratory. Samples of aggregates and concrete shall be taken at such times to represent the quality of the materials and work throughout the project. The laboratory shall provide the necessary labor, materials and facilities for sampling the aggregate and for casting, handling and initially storing the concrete samples at the site of work. Aggregates shall be sampled in accordance with paragraph 03300-3.14 B not less than 30 days prior to the use of such aggregates in the work. The minimum number of samples and tests are specified in paragraph 03300-3.14 C.

B. SAMPLING:

1. AGGREGATES:

a. GENERAL: Fine and coarse aggregates shall be sampled in accordance with ASTM D75. Samples shall be taken at the discharge gates of the bins feeding the weigh hopper. The CONTRACTOR shall provide safe and suitable facilities for obtaining samples. Samples shall be obtained at the concrete batch plant at the frequency specified in paragraph 03300-3.14 C. Sampling shall be repeated when the source of material is changed or when unacceptable deficiencies or variations from the specified requirements of materials are found in testing. Aggregate samples shall be tagged and their sources identified.

b. COARSE AGGREGATE: A sample weighing between 50 and 60 pounds shall be taken after the batch plant is brought up to full operation. The samples shall be taken so that a uniform cross section, accurately representing the materials on the belt or in the bins, is obtained.

c. FINE AGGREGATE: Samples shall be taken as specified for coarse aggregate. The samples shall be taken for sieve analysis of fine aggregate and specific gravity tests. Samples of sand shall be taken when the sand is moist.

2. CONCRETE: Samples of plastic concrete shall be obtained in accordance with ASTM C172. Samples shall be taken at the hopper of concreting equipment or transit mix truck, except as noted in 03300-3.03B.2

C. TESTING:

1. AGGREGATE: A minimum of one test of coarse aggregate per 400 cubic yards of concrete and a minimum of one test of fine aggregate per 200 cubic yards of concrete used shall be made to confirm continuing conformance with specifications for gradation, cleanliness and sand equivalent. A maximum of one test per day of each aggregate is required. The full test program is required before source changes will be accepted.

2. CONCRETE:

a. STRENGTH TESTS: The strengths specified for the design mix shall be verified by the independent testing laboratory during placement of the concrete. Verification shall be accomplished by testing standard cylinders of concrete samples taken at the job site. Cylinders shall be 4 by 8 inch or 6 x 12 inch.

Standard cylinders shall represent the concrete placed in the forms. One set of six standard 6 x 12 inch (or nine 4 x 8 inch) cylinders shall be cast of each class of concrete for each 100 cubic yards or less or for each 5,000 square feet of surface area placed per day. Casting, handling and curing of cylinders shall be in accordance with ASTM C31. Additional cylinders shall be provided when an error in batching is suspected. For the first 24 hours after casting, the cylinders shall be kept moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the cylinders shall be transported to the testing laboratory.

Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. Two 6 x 12 inch (or three 4 x 8 inch) test cylinders from each group of six (or nine) shall be tested at the end of 7 days and two 6 x 12 inch (or three 4 x 8 inch) shall be tested at the end of 28 days. The two remaining 6 x 12 inch (or three 4 x 8 inch) cylinders shall be tested at the end of 56 days if the 28-day strength reports below specification. A strength test shall consist of the average strength of two 6 x 12 inch (or three 4 x 8) cylinders cast from material taken from a single load of concrete. If one cylinder shows evidence of low strength due to improper sampling, casting, handling or curing, the result of the remaining cylinders may be used if approved by the CONSTRUCTION MANAGER.

The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure shall be equal to or greater than the specified strength and not more than 10 percent of the strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test result shall be less than the specified strength by more than 500 pounds per square inch.

Certified reports of the test results shall be provided directly to the CONSTRUCTION MANAGER. Test reports shall include sufficient information to identify the mix used, the

Cast-In-Place Concrete

03300-22

stationing or location of the concrete placement, and the quantity placed. Slump, air content, temperature of concrete, and ambient temperature shall be noted. The 28-day strength test results shall be evaluated in accordance with ACI 214R. Quality control charts showing field test results shall be included with the test results for each class of concrete in each major structure. Charts shall be prepared in accordance with ACI 214R. Quality control charts shall be maintained throughout the entire job and shall be available for the CONSTRUCTION MANAGER's inspection at any time.

If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the CONTRACTOR's expense. Changes and adjustments shall be reported in writing to the CONSTRUCTION MANAGER.

If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the CONSTRUCTION MANAGER. Costs of such tests shall be borne by the CONTRACTOR.

b. TESTS FOR CONSISTENCY OF CONCRETE. The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placement. Tests shall be made at the beginning of concrete placement operation and at subsequent intervals to ensure that the specification requirements are met. Slump tests shall also be performed whenever standard cylinders are cast. For pumped concrete, slump shall be measured in accordance with paragraph 3.03B.2.

When high range water reducers are added at the site, slump tests shall be taken before and after addition of high range water reducing admixtures.

c. TESTS FOR TEMPERATURE AND AIR CONTENT: Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, temperature tests shall be performed.

Air content shall be as specified when measured in accordance with ASTM C231. Air content shall be measured whenever standard cylinders are cast. For pumped concrete, air content shall be measured in accordance with paragraph 3.03B.2.

D. FINAL LABORATORY REPORT:

A final report, prepared by the testing laboratory, shall be provided at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure. Final quality control charts for compressive strength tests for classes of concrete specified in each major structure shall be included. The report

shall also include the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete.

3.14 REPAIR OF DAMAGED CONCRETE, CRACKING:

A. ACCEPTANCE OF CONCRETE:

Completed cast-in-place concrete work shall conform to the applicable requirements of ACI 301 and the Contract Documents. Concrete work that fails to meet the requirements of ACI 301 or the Contract Documents shall be repaired as approved by the ENGINEER to bring the concrete into compliance. Concrete that cannot be brought into compliance by approved repair methods will be rejected. Rejected concrete work shall be removed and replaced. Repair methods shall be in accordance with ACI standards and are subject to the approval of the ENGINEER. The cost of repairs and replacement of defective concrete shall be borne by the CONTRACTOR.

B. REPAIR METHODS:

Damaged or excessively cracked concrete, as determined by the ENGINEER in their sole discretion, shall be repaired by one of the following methods as approved by the ENGINEER:

1. Repair Method 1: Fill the joint or crack by drilling holes to the affected area, install injection ports and force epoxy or chemical grout (expanding urethane) into the joint under pressure. The material type, whether epoxy or chemical grout shall be approved by the ENGINEER. After injection and curing, ports, sealing mix and surface generally shall be cleaned and worked to match the specified finish.
2. Repair Method 2: Fill cracks with low viscosity epoxy, applied by pouring/flooding crack zone until cracks are filled. Prepare surface, install, and cure according to manufacturer's recommendations. At a minimum, prepare surface to result in a clean, dry surface and with no visible detrimental material in cracks to be filled. Conform to temperature limitations for epoxy to be used. Finish to match adjacent areas.
3. Repair Method 3: Cut a bevel groove 3/8 to 1/2 inch in width and depth, and caulk with sealant in accordance with manufacturer's instructions. This repair method is only to be used where expressly allowed by the ENGINEER. Groove and caulk shall be applied on wet or hydrostatic pressure side of surface where occurs.

C. REPAIR METHOD USE:

1. Repair Method 1 shall be used for all cracks in walls, surfaces sloped 1:1 or greater, beams, columns, slabs, overhead surfaces and generally for liquid retaining surfaces. Need for repair depends upon crack width, location, and

surface conditions under service conditions. Epoxy grout shall be used for repair of structural cracks and chemical grout (expanding urethane) shall be used for repair of non-structural cracks at liquid-containing structures. The ENGINEER shall determine whether a crack is classified as structural or non-structural.

2. Repair Method 2 may be utilized in lieu of Method 1 for slabs which receive a raked finish. Method 2 may also be used with CONSTRUCTION MANAGER's approval for exposed troweled and broomed finishes after review of conditions, degree of exposure to public, and proposed repair product and installation. Finish shall substantially match adjacent surfaces.
3. Repair Method 3 shall be limited to dry-surface slabs, walls subject to less than three feet of liquid pressure, or as specifically directed by the ENGINEER. Method 3 is not an equivalent repair method to Methods 1 or 2, which shall be considered the standards.

3.15 CLEANUP

Upon completion of the work and prior to final inspection, the CONTRACTOR shall clean all concrete surfaces. The cleaning procedures shall be as follows: After sweeping with an ordinary broom to remove the loose dirt, the surface shall be flushed with clean water. Final scrubbing by hand or machine shall follow.

Floors that have curing and sealing compound shall be cleaned of loose dirt and debris by sweeping with ordinary brooms. They shall then be washed and mopped with clean water. Finally, one additional coat of the same clear curing and sealing compound shall be applied in the same manner as specified.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 03600

GROUT

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies grout for columns and other structural support bases, equipment bases, crack repair, surface repair and uses other than masonry. Grout for masonry is specified in Section 04200.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER:

The CONTRACTOR will pay and provide special inspection and testing in accordance with Section 01400.

B. QUALITY CONTROL BY CONTRACTOR:

If a product other than those listed below is proposed and test data is not available from the supplier to demonstrate equivalence to the specified grout, then to demonstrate equivalence with the grout properties of the specified product, the CONTRACTOR shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test the proposed grout materials. Costs of testing laboratory services shall be borne by the CONTRACTOR.

C. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM C230	Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
ASTM C942	Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
COE CRD-C611	Flow of Grout for Preplaced Aggregate Concrete
COE CRD-C621	Specification for Nonshrink Grout
IBC	International Building Code, 2012 edition

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Complete product literature and installation instructions for epoxy grout (all uses) and cementitious non-shrink grout.
2. Current ICC Evaluation Report for adhesives used for dowel and anchor setting.
3. Installer certification in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2--PRODUCTS

Grout
03600-2

Contract 2
Bid Issue

2.01 CEMENTITIOUS NONSHRINK GROUT

Cementitious nonshrink nonmetallic aggregate grout shall be Five Star Products, Inc. Five Star Grout, Master Builders Masterflow 928, Burke Company Non-Ferrous, Non-Shrink Grout, Hi-Flow Grout by Euclid Chemical Company, or equal.

2.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Epoxy grout for equipment mounting shall be a non-cementitious, resin based, multi-component formulation. Epoxy grout shall be flowable, with shrinkage minimized to achieve minimum 98% effective bearing area. Epoxy grout shall be Masterflow 648 CP Plus by Masterbuilders; Sikadur 42 by Sika Corporation; E3-G by Euclid Chemical Company; or equal.

2.03 ADHESIVE FOR DOWEL AND ANCHOR SETTING

Adhesive for setting dowels and anchoring connection/base plate bolts shall be an injectable two-component epoxy adhesive. Adhesive shall be approved for the intended use per the product ICC Report.

Adhesive shall be HIT-RE 500-SD by Hilti or approved equal (equivalent product must have ICC approval for use in cracked concrete in areas with high seismic risk).

2.04 CONCRETE REPAIR MORTAR

Horizontal Applications: Horizontal repair mortars shall be Emaco S66 CI by BASF, SikaTop 111 Plus by Sika Corp, or approved equal.

Vertical and Overhead Applications: Vertical and overhead repair mortars shall be SikaTop 123 Plus or approved equal.

PART 3--EXECUTION

3.01 CEMENTITIOUS NONSHRINK GROUT

Nonshrink, cementitious, nonmetallic aggregate grout shall be used for column base plates, structural bearing plates, and all locations where the general term "non-shrink grout" is indicated on the drawings. Use of this grout to support the bearing surfaces of machinery shall be as specified in Section 11002 or as detailed on the Drawings for specific locations or pieces of equipment. If guidance is not provided in locations noted above, use of non-shrink grout for equipment mounting shall be limited to equipment less than 25 horsepower or 750 pounds. Grout shall be placed and cured in accordance with manufacturer's instructions.

Nonshrink cementitious grout shall not be used as a surface patch or topping. Nonshrink cementitious grout must be used in confined applications only.

3.02 EPOXY GROUT FOR EQUIPMENT MOUNTING

Prepare concrete surfaces of equipment pads as indicated in details on the Drawings and as required by the epoxy grout manufacturer. Epoxy grout for equipment mounting shall be placed and cured in accordance with the requirements of Section 11002, details on the Drawings, and in strict conformance with manufacturer's recommendations.

3.03 CONCRETE REPAIR MORTAR

Concrete repair materials and procedures shall be submitted for review to the ENGINEER and shall be accepted prior to commencement of the repair work.

Follow all manufacturer's instructions, including those for minimum and maximum application thickness, surface preparation and curing. Add aggregate as required per manufacturer's recommendations. Any deviations from the manufacturer's instructions shall be submitted for review to the ENGINEER and shall be accepted prior to commencement of the work.

****END OF SECTION****

SECTION 04200

UNIT MASONRY

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies masonry work consisting of reinforced concrete masonry construction. Masonry work shall be constructed from concrete masonry units in combination with reinforcement, mortar, and grout as specified.

B. TYPE:

Masonry work shall be constructed from units of concrete in combination with reinforcing, mortar, and grout as specified.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ACI 530-05	Building Code Requirement for Masonry Structures
ACI 530.1-05	Specification for Masonry Structures
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement

Reference	Title
ASTM A90	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM C27	Classification of Fireclay and High-Alumina Refractory Brick
ASTM C55	Concrete Building Brick
ASTM C62	Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C67	Sampling and Testing Brick and Structural Clay Tile
ASTM C90	Loadbearing Concrete Masonry Units
ASTM C91	Masonry Cement
ASTM C129	Non-Load-Bearing Concrete Masonry Units
ASTM C144	Aggregate for Masonry Mortar
ASTM C150	Portland Cement
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C216	Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C270	Mortar for Unit Masonry
ASTM C404	Aggregates for Masonry Grout
ASTM C476	Grout for Masonry
ASTM C666	Resistance of Concrete to Rapid Freezing and Thawing
ASTM E514	Water Penetration and Leakage Through Masonry
IBC 2006	International Building Code

B. QUALITY ASSURANCE BY OWNER:

Special inspection of masonry work shall be performed by the Special Inspector under contract with the CONTRACTOR and in accordance with IBC Chapter 17.

C. SAMPLE PANEL:

A sample masonry panel for each type of masonry, approximately 6 feet long by 4 feet high shall be constructed on site for approval by the Construction Manager. Each panel shall show the workmanship, coursing, bond, anchors, joint reinforcing wall ties, tooling of joints, range of color, texture of masonry, and mortar color. Finished work shall match the approved sample panel.

D. APPEARANCE:

Source or supply of materials shall not be changed after the work has started if the appearance of the finished work would be affected.

E. EFFLORESCENCE TESTING:

Certified efflorescence test reports shall be provided on masonry units that are to be exposed to weathering. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Test three pairs of specimens of each type of masonry unit for efflorescence in accordance with ASTM C67. If any pair is rated "effloresced," the units represented by the samples will be rejected.

F. PRISM TESTS:

Compressive strength of masonry, f'_m , shall be 2000 psi. The compression strength shall be based on the Prism Test Method in accordance with the 2006 IBC and ACI 530.1. Tests for material compression strength shall be as follows:

1. Prior to construction, perform the following tests using samples of materials which will be incorporated into the work.
 - a. One prism test consisting of three test specimens constructed and tested in accordance with ASTM C1314.
 - b. One mortar test consisting of one set of three specimens constructed and tested in accordance with ASTM C780.
 - c. One grout test consisting of one set of three specimens constructed and tested in accordance with ASTM C1019.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following information:

- A. Masonry unit certificates showing compliance to the specifications shall be submitted for each type of masonry unit.
- B. Reinforcing certificates showing compliance to the specifications shall be submitted for reinforcing steel, including reinforcing steel wire and joint reinforcing, as specified herein and in Section 03200.
- C. Certified efflorescence test reports specified in paragraph 04200-1.02 D.

- D. Provide scaled fabrication and field layout drawings for all required masonry. Drawings to include reinforcing, anchors, adjustable wall ties, positioning devices, and other accessories.
- E. Mix designs for each type of mortar and grout. Include description of type and proportions of ingredients.
 - a. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - b. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.04 DELIVERY, STORAGE, AND HANDLING:

Cementitious materials shall be delivered to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands, stored in dry, weathertight enclosures to prevent entry of foreign materials and damage by water or dampness. Masonry units shall be stored off the ground and handled with care to avoid chipping and breakage. Materials shall be protected from damage and, except for sand, kept dry until used. Sand shall be covered to prevent intrusion of water and foreign materials and to prevent drying. Materials containing frost or ice shall not be used. Store masonry accessories, including metal items, in such a manner to prevent corrosion and accumulation of dirt and oil.

PART 2--PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.

Unit Masonry
04200-4

B. CMUs: ASTM C 90.

1. Density Classification: Normal weight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Texture:
 - a. Where exposed to view: Provide with a fine-textured surface.

C. CMU Types Schedule

1. CMU Type #1
 - a. Standard smooth faced texture.
 - b. Provide special shape as indicated on the drawings.
 - c. Nominal width: 8 inches; Height: 8 inches; Length: 16 inches.
 - d. Color, texture, and pattern to match Architect's sample equal to AMCOR Masonry Products: Tumbleweed

2. CMU Type #2

- a. Standard split face texture.
- b. Nominal width: 8 inches; Height: 8 inches; Length: 16 inches.

Color, texture, and pattern to match architect's sample. Color to be equal to AMCOR Masonry Products: Java

D. MASONRY LINTELS

Masonry lintels shall be made from special CMUs shapes with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.02 MORTAR

A. MORTAR TYPE:

Mortar shall be ASTM C270, Type S. The mortar shall be proportioned to achieve a minimum 28-day compressive strength of 2,800 psi. Where colored mortar is specified to match the masonry units, add colorant to obtain the color indicated. Colorant shall be alkali-resistant iron

oxide based and shall be Sonneborn "Sonobrite," Solomon Grind-Chem Service, Inc., "Concentrated Cement Color," or equal.

B. CEMENT:

Cement shall be Portland cement conforming to ASTM C150, Type II, low alkali containing less than 0.60 percent alkalis.

C. HYDRATED LIME:

Hydrated lime shall conform to ASTM C207, Type S.

D. MASONRY CEMENT:

Masonry cement shall not be used.

E. SAND:

Aggregate for mortar shall be sand conforming to ASTM C144. Sand must be clean and washed.

F. WATER:

Water shall be clean, potable, and free from substances which could adversely affect the mortar.

G. PREMIXED MORTAR:

Premixed mortar shall be ASTM C270, Type S for use as specified in paragraph 04200-2.02 G.

H. ADMIXTURES:

Admixtures may be used in mortar to retard curing and provide up to 36 hours of workability, provided that the admixture does not adversely affect bonding or compressive strength.

2.03 ACCESSORIES

A. HORIZONTAL JOINT REINFORCEMENT:

Horizontal joint reinforcement shall be fabricated from cold drawn steel wire, ASTM A82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A153. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Reinforcement shall be provided in flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2-inches less than nominal thickness of wall.

Unit Masonry
04200-6

For single-wythe walls and partitions, two 9-gage longitudinal wires and 9-gage cross wires shall be provided.

B. REINFORCING BARS:

Reinforcing steel shall be as specified in Section 03200.

C. ANCHORS AND TIES:

1. **GENERAL:** Anchors and ties shall be approved designs of stainless steel, zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc-coated steel shall be coated by the hot-dip process after fabrication to a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A90.

2. **CORRUGATED METAL TIES:** Metal ties shall be not less than 7/8-inch wide by approximately 7 inches long and not lighter than 22 gage.

3. **RIGID STEEL ANCHORS:** Rigid steel anchors shall be not less than 1 inch wide, 1/4 inch thick, and 24 inches long with each end bent not less than 2 inches.

4. **DOVETAIL FLAT BAR OR WIRE ANCHORS:** Flat bar anchors shall be sheet steel, not lighter than 16 gage, and 7/8-inch wide, with end turned up 1/4 inch. Wire anchors shall be not lighter than 6 gage, 7/8-inch wide with wire looped and closed.

5. **DOVETAIL ANCHOR SLOTS:** Unless otherwise specified, Dovetail slots shall be made of galvanized steel with minimum dimensions of 1 inch wide back by 1 inch deep by 5/8-inch throat.

D. THROUGH-WALL FLASHING:

Flashing, where specified, shall be 5-ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory applied coating shall weigh not less than 6 ounces per square foot (approximately 3 ounces per square foot on each side).

E. REINFORCING BAR POSITIONERS

Rebar positioners shall be of 9-gauge wire with a mill galvanized finish as manufactured by Hohmann & Barnard, Inc. or equal. Rebar positioners are to sized to fit masonry unit.

F. PREFORMED CONTROL JOINT

Preformed control joint shall be the RS Standard 2 5/8" Rubber Control Joint as manufactured by Hohmann & Barnard, Inc. or equal.

2.04 GROUT

A. GENERAL:

Grout shall comply with ASTM C476, shall use Type II cement, and shall be proportioned by volume to achieve a minimum 28-day compressive strength of 2,000 psi. Grout shall have sufficient water added to produce a consistency for pouring without segregation.

B. AGGREGATE:

Aggregate shall comply with ASTM C404.

C. FINE GROUT:

Fine grout shall be composed of one part cement, not more than 1/10 part lime, and 2 1/4 to 3 parts fine aggregate.

D. COARSE GROUT:

Coarse grout shall be composed of one part cement, not more than 1/10 part lime, 2 to 3 parts fine aggregate, and not more than 2 parts coarse aggregate.

2.05 EMBEDDED FLASHING MATERIALS, WEEPS, AND CAVITY DRAINAGE

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings and Waterproofing; CCW-705-TWF Thru-Wall Flashing
 - 2) Grace Construction Products, W.R. Grace & Co. – Conn.; Perm-A-Barrier Wall Flashing
 - 3) Henry Company; Blueskin TWF.
 - b. Accessories: Provide preformed corner, end dams, other special shapes, and seaming material produced by flashing manufacturer.
 - c. Application: Unless otherwise indicated, use the following:
 - 1) Where flashing is fully concealed, use flexible flashing.

Unit Masonry
04200-8

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

D. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and top flap to keep mortar out of the head joint; in color approved by Architect to match that of mortar.

1. Available Products:

- a. Hohmann & Barnard, Inc.; #341 Weep Hole
- b. Williams Products, Inc.; Williams-Goodco Brick Vent.
- c. Wire-Bond; Louvered Weepholes

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations

- a. Strip, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.

2. Available Products:

- a. Advanced Building Products, Inc.; Mortar Break II..
- b. Mortar Net USA, Ltd.; Mortar Net.
- c. Hohmann & Barnard, Inc.; Mortar Trap.

PART 3--EXECUTION

3.01 PREPARATION

A. GENERAL:

Foundations for masonry work shall be straight, on-line, and level. All surfaces to be bonded with masonry shall be clean and free from laitance or foreign materials. Reinforcing dowels shall be in the correct location as specified. The placement and location of anchor ties, inserts, and other embedded items in concrete or other adjoining work shall be coordinated by the Contractor to suit the masonry work.

B. PROTECTION:

1. Exposed surfaces shall be protected from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Base of walls shall be protected from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.
2. Uniform loads shall not be applied for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.
3. Temporary bracing shall be provided as required to prevent damage during construction.
4. Protective boards for polyester film shall be provided during job installation to ensure no damage from building debris.

3.02 WORKMANSHIP

Masonry shall be level and plumb. Story poles or gage rods shall be used throughout the work. Changes in coursing or bonding after the work is started will not be permitted; neither will carrying one section of the walls up in advance of the others be permitted. Unfinished work shall be stepped back for joining with new work; toothing will not be permitted. Heights of masonry at each floor and at sills and heads of openings shall be checked with an instrument to maintain the level of the walls. Door and window frames, louvered openings, anchors, pipes, ducts, and conduits shall be built in as the masonry work progresses. Spaces around metal door frames shall be filled solidly with mortar. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Masonry shall be cut with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork shall be placed in position as the work progresses. Chases of approved dimensions for pipes and other purposes shall be provided where specified and necessary. Tops of exposed walls and partitions not being worked on shall be covered with a waterproof membrane secured in place and extended down at least 2 feet on both sides.

3.03 MORTAR MIXING

Mortar materials shall be measured in 1 cubic foot containers to maintain control and accuracy of proportions; measuring materials with shovels is not permitted. Mortar shall be mixed in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Water shall be added gradually as required to produce a workable consistency. Mortar not formulated to include retarding admixtures, which has not been placed in final position within 2-1/2 hours after the initial mixing, shall not be retempered and used. Use of antifreeze compounds, salts, or other substances to lower the freezing point of mortar is prohibited.

Mortar shall be mixed in accordance with ASTM C270 to obtain type mortar required. Where colored mortars are required, pigments may be added at the site or provided as part of

prepackaged mortar mix. When masonry cement is used, mixing shall conform to printed instructions of the masonry cement manufacturer.

3.04 MORTAR JOINTS

Mortar joints shall be a uniform thickness of 3/8-inch unless otherwise specified. Exposed joints shall be tooled slightly concave with a round or other suitable jointer when the mortar is thumbprint hard except where otherwise required to match existing construction. For horizontal joints, jointers shall be at least 12 inches long for brickwork and 16 inches long for concrete masonry. Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Joints that will not be exposed shall be struck flush. Vertical joints shall be tooled first. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

Weep holes shall be placed at a maximum spacing of 48 inches at the base of cavity walls or veneer walls and in the course bearing on through-wall flashing.

3.05 TOLERANCES

Masonry work shall be within the following limits:

1. Pilasters and Columns: 1/4 inch from true line.
2. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.
3. Variation from True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.
4. Variation from Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.
5. Variation from Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.
6. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.06 CONCRETE MASONRY UNIT WORK

A. GENERAL:

The first course shall be laid in a full bed of mortar for the full width of the unit. Succeeding courses shall be laid in running bond unless otherwise specified. Bed-joints shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells and to head joints by applying the mortar for a width of about 1 inch to the ends of the adjoining units. The mortar shall

be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, metal lath shall be placed in the joint at the bottom of such cells and the cells filled with mortar or grout as the work progresses. Except at grouted or reinforced masonry, concrete brick shall be used for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Concrete masonry units shall not be dampened before or during laying.

B. SPECIAL CONCRETE MASONRY UNIT WORK:

Where exposed concrete masonry unit walls and partitions are specified, special concrete masonry unit work shall be provided. Units shall be selected for uniformity of size, texture, true plane, and undamaged edges and ends of exposed surfaces. Units shall be placed plumb, parallel, and with properly tooled joints of maximum 3/8-inch thickness, and exposed surfaces kept clean and free from blemishes or defects.

C. REINFORCED CONCRETE MASONRY UNIT WALLS:

Where vertical reinforcement occurs, cores shall be filled solid with grout, and units laid in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Adjacent webs shall be embedded in mortar to prevent leakage of grout, and mortar fins protruding from joints removed before grout is placed. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Reinforcing shall be positioned and held accurately before placing grout by using bar positioners at maximum 8-foot intervals. Vibrator shall be used to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be 1/2 inch. Unless otherwise specified, splices shall be formed by lapping bars not less than 40 bar diameters.

3.07 BONDING AND ANCHORING

Unless otherwise specified, partitions shall extend from the floor to the bottom of the construction above. Walls and partitions shall be structurally bonded and anchored to each other and to concrete walls and beams. Unless otherwise specified, non-load-bearing partitions and interior walls shall be securely anchored to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Anchors shall be completely embedded in mortar joints.

In addition, bonding and anchoring shall comply with the following procedures unless otherwise specified.

1. At corners of load-bearing walls, provide a true masonry bond in each course.
2. At intersections of load-bearing walls, provide a true masonry bond in each course, or anchor with rigid steel anchors not more than 2 feet apart vertically.

3. At intersections of non-load-bearing partitions with other walls or partitions, tie with wire mesh ties at vertical intervals of not more than 2 feet or with masonry bonding in alternate courses.
4. At masonry walls facing or abutting new concrete members, anchor masonry to the concrete with dovetail or wire-type anchors inserted in slots or inserts built into the concrete. To anchor masonry walls to existing concrete members, use corrugated metal ties anchored by drive pins to the concrete. Locate anchors not more than 18 inches o.c. vertically and not more than 24 inches o.c. horizontally.

3.08 HORIZONTAL JOINT REINFORCEMENT

Unless otherwise specified, reinforcement shall be provided at 16-inch spacing in all masonry walls. Reinforcement shall be continuous except at control joints and expansion joints. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Reinforcement shall be provided in the longest available lengths, utilizing the minimum number of splices. Welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement shall be provided at corners and intersections of walls and partitions.

3.09 CONCRETE MASONRY UNIT LINTELS AND BOND BEAMS

Special units, lintels, and bond beams shall have cells filled solidly with grout or concrete, and provided with not less than two No. 5 reinforcing bars, unless otherwise specified on the drawings. Reinforcing shall overlap a minimum of 40 bar diameters at splices, unless otherwise specified on the drawings. Bond beams and reinforcing shall terminate on each side of expansion joints. Concrete masonry units used for lintels and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Bond beam units shall be produced from standard vertically-voided units with precut knock-out cross walls. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end. Lintels shall set at least 6 days before shoring is removed.

3.11 GROUT

A. GENERAL:

Fine grout shall be provided in grout spaces which are less than 2 inches in any horizontal dimension after deducting the thickness of horizontal reinforcing or in which clearance between reinforcing and masonry is less than 3/4 inch. Coarse grout shall be provided in grout spaces which are 2 inches or greater in all horizontal dimensions after deducting the thickness of horizontal reinforcing provided the clearance between reinforcing and masonry is not less than 3/4 inch. For a coarse grout pour over 6 feet high, increase grout space minimum horizontal dimension to 3 inches.

B. PLACEMENT:

Grout shall be placed from the interior side of walls, except as approved otherwise. Sills, ledges, offsets, and other surfaces shall be protected from grout droppings. Prior to grouting, the grout space shall be clean so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings, or other foreign material. Grout shall be well mixed to prevent segregation, shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids, and shall be placed by pumping or pouring from buckets equipped with spouts. Grout shall be placed in a continuous pour in grout lifts not exceeding 6 feet. At grout pours exceeding 6 feet, cleanouts shall be provided in the bottom course at every vertical bar but shall not be spaced more than 32 inches on center for solidly grouted masonry. Pours shall be 1-1/2 inches below the top of masonry units in top course, except at the finish course. Grout shall be agitated thoroughly to eliminate voids. Masonry displaced by grouting operation shall be removed and relaid in alignment with fresh mortar.

3.12 FLASHING, WEEPS, AND CAVITY DRAINAGE MATERIAL

- A. General: Install embedded flashing, weeps, and cavity drainage in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install above door and window openings as well as at base of Veneer CMU walls.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into a masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions with weep spouts aligned with face of wall.
- E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specifies weep/vent product to form weep holes.
2. Space weep holes 32 inches o.c. unless otherwise indicated.

Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material. Install as per manufacturer's recommendation for conditions encountered on this project.

3.13 FORMS AND SHORING

Contractor shall construct forms to the shape, lines, and dimensions of members indicated and make sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Forms shall not be removed until members have cured.

3.14 CLEANING

Contractor shall protect work which may be damaged, stained, or discolored during cleaning operations.

Exposed masonry surfaces shall be cleaned with clear water and stiff fiber brushes and rinsed with clear water. Where stains, mortar, or other soil remain, scrubbing shall continue with warm water and detergent. Immediately after cleaning, each area shall be rinsed thoroughly with clear water. Damaged, stained, and discolored work shall be restored to original condition or replaced with new work.

3.15 COLD WEATHER CONDITIONS

A. CONSTRUCTION:

During cold weather, that is, when the air temperature is below 40 degrees F and falling, or when it appears that the air temperature will drop to 40 degrees F or below within 24 hours, Contractor shall not lay masonry unless the work is protected from freezing as specified below. Surfaces receiving mortar shall be free of ice and frost. The following requirements shall be adhered to:

1. Air Temperature 40 to 32 Degrees F: Heat sand or mixing water to produce mortar temperature between 40 and 120 degrees F.
2. Air Temperature 32 to 25 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F.
3. Air Temperature 25 to 20 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Use other heat sources on both sides of walls under construction. Use windbreaks when wind is in excess of 15 mph.

4. Air Temperature 20 Degrees F and Below: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F on both sides of walls under construction. Ascertain that temperatures of masonry units are not less than 20 degrees F when units are laid.

B. PROTECTION:

Newly laid masonry shall be protected as specified below for the respective mean daily air temperature (MDAT), that is, the average of the daytime high temperature and the forecasted nighttime low temperature.

1. MDAT 40 to 32 degrees F: Protect masonry from rain and snow by covering the top 4 feet with weather-resistive membrane for 24 hours after laying.
2. MDAT 32 to 25 degrees F: Completely cover newly-laid masonry with weather-resistive membrane for 24 hours.
3. MDAT 25 to 20 degrees F: Completely cover newly-laid masonry with insulating blankets and weather-resistive membrane for 24 hours.
4. MDAT 20 degrees F and Below: Maintain temperature of masonry above 32 degrees F for 24 hours by providing enclosures and supplementary heat or other approved means.

****END OF SECTION****

SECTION 05100

STRUCTURAL METALS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies structural metals consisting of standard shapes, fasteners, rods and plates that are used in structural supports and connections.

1.02 QUALITY ASSURANCE

A. GENERAL:

Structural assemblies and shop and field welding shall meet the requirements of the AISC Manual of Steel Construction.

The use of salvaged, reprocessed or scrap materials shall not be permitted.

B. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

References to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISC Steel Construction Manual	American Institute of Steel Construction, Steel Construction Manual, 13th Edition

Reference	Title
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures, 2005
AISC 341-10	Seismic Provisions for Structural Steel Buildings Including Supplement #1
ASTM A36	Carbon Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service
ASTM A307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A320/A320M	Alloy-Steel Bolting Materials for Low-Temperature Service
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A992	Steel for Structural Shapes for Use in Buildings
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-D1.1	Structural Welding Code--Steel

1.03 SUBMITTALS

- A. Shop drawings, including erection plans, member and connection details, steel materials, coatings, etc as required to fully delineate this portion of the work.

- B. Certification that steel fabricator is approved to perform steel fabrication without special inspection.
- C. Evidence that steel fabricator has AISC Certification for Steel Building Fabrication.
- D. Welder Qualifications
- E. Certified mill test reports for structural steel and high-strength bolts and nuts.

PART 2--PRODUCTS

2.01 MATERIALS

A. STEEL:

Table A, Steel Materials

Material	Specification
Standard rolled steel wide flange sections (and WTs)	ASTM A992
Structural steel S-shapes, channels, angles and plates	ASTM A36
Pipe sections for posts, guardrails and handrails	ASTM A53, Type E or S, Grade B
Structural steel tubing	ASTM A500, Grade B (Fy = 46 ksi)
Stainless steel bolts (used at stainless steel and aluminum framing unless noted otherwise)	ASTM A193, Grade B8M Class 1, AISI 316 or ASTM A320, Grade B8M Class 1, AISI 316
Stainless steel nuts and washers (used at stainless steel and aluminum framing unless noted otherwise)	ASTM A194 Grade 8M, SS316
Steel bolts (used at galvanized and painted steel framing)	Galvanized ASTM A325 (Type 1), bearing type bolts fully tensioned

B. ALUMINUM:

Table B, Aluminum Materials

Material	Specification
Aluminum structural shapes	Alloy 6061-T6 per ASTM B308

Material	Specification
Bolts	Use stainless steel bolts for aluminum framing (see Table A above)
Aluminum guardrail and handrail pipe	Alloy 6061-T6 per ASTM B241
Aluminum plates	Alloy 6061-T6 per ASTM B209

2.02 FABRICATION

Steel fabrication shall be in accordance with the AISC Manual of Steel Construction. Aluminum fabrication shall be in accordance with the Aluminum Association Specifications and Guidelines for Aluminum Structures.

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL:

Measurements shall be verified at the job.

Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or drilled. No drifting of bolts nor enlargement of holes will be allowed to correct misalignment. Mismatched holes shall be corrected with new material.

Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.

Metalwork to be embedded in concrete shall be as specified in Section 03300. Metalwork shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete after design strength is attained, and the metalwork shall be grouted in place in accordance with Section 03300. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned.

Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete. Metalwork which is bent, broken or otherwise damaged shall be repaired or replaced by the CONTRACTOR.

B. WELDING:

Welding shall be performed by operators who have been qualified by tests as prescribed by AWS to perform the type of work required. The quality of welding shall conform to AWS Code for Arc Welding in Building Construction.

Unless otherwise specified, continuous welds shall be provided on all structural members that are exposed to weather or submerged in water or wastewater, and continuous seal welds shall be provided on both sides of all plates or structural shapes that are in contact with or submerged in water or wastewater.

C. BOLTED CONNECTIONS:

Bolted connections shall conform to AISC Framed Beam Connections and shall be bearing type connections, with bolts fully tensioned unless connecting HSS shapes.

3.02 CORROSION PROTECTION

Unless otherwise specified, all structural metal, including that used in the fabrication of process equipment, shall be coated in accordance with Section 09900. Structural steel and member connection bolts shall be hot-dip galvanized per Section 05910 except where specified to be painted per the schedule in Section 09900. Paint coatings over the hot-dip galvanized coating at structural steel are not required. Surface preparation shall include the following operations:

1. Grind the exterior and interior edges of all flame-cut plates or members to a smooth surface.
2. Grind all sharp edges off of the sheared plates and punched holes.
3. Grind uneven or rough welds with high beads to a smooth finish.

3.03 CLEANING

After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat. Damaged surfaces of galvanized metals shall be repaired as specified in Section 05910.

****END OF SECTION****

SECTION 05210

STEEL JOIST FRAMING

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies steel joist framing which consists of furnishing all necessary labor, materials, tools, equipment, and incidentals to provide all design, fabrication, and erection of steel joist framing.

This includes the following:

- A. K-series steel joists.
- B. Steel joist bridging.
- C. Steel joist substitutes. Joist substitutes are 2.5 inch deep sections intended for use in very short spans (less than 10 feet) where open web steel joists are impractical. Joist substitutes are solid members that can be manufactured from material conforming to the Steel Joist Institute Standard Specifications and can be made of hot rolled or cold-formed channels or HSS.
- D. Steel joist accessories.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
AISC Steel Construction Manual	American Institute of Steel Construction, Steel Construction Manual, 13th Edition
ASTM A36	Standard Specification for Carbon Structural Steel.
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
ASTM A490	ASTM A490, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts.
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
AWS- D1.1	Structural Welding Code-Steel.
RCSC	Specification for Structural Joints Using ASTM A325 or A490 Bolts".
SJI	Standard Specifications and Load Tables for Steel Joists and Joist Girders.
SJI	Recommended Code of Standard Practice for Steel Joists and Joist Girders.
IBC	International Building Code 2006

B. DESIGN AND FABRICATION:

1. The joist fabricator shall be certified by SJI to manufacture steel joists framing complying with SJI's Standard Specifications and Load Tables.
2. Steel joist and steel joist bridging and all accessories shall be designed and fabricated in accordance with SJI's Standard Specifications and Load Tables.
3. Structural calculations shall be prepared as required to prove that all portions of the steel joists framing, have sufficient strength to safely support their own weight plus the loads placed thereon. The structural calculations shall be prepared by a Professional Engineer currently registered in the State of Arizona having a minimum of 3 years experience in this type of design work.

4. All welding, both shop and field, shall use qualified procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
5. Provide type of joist, chord configuration, and depth as indicated on Drawings.
6. Chord Members: Rolled double angle sections only.
7. The joist fabricator shall provide installation instructions and tolerances to be used by the joist erector. The tolerances shall include a sweep tolerance, a twist tolerance, and an out of plumb (between the top and bottom cord) tolerance.

C. DESIGN CRITERIA:

1. LOADS	
Roof dead load, (roofing materials+ incidentals)	20
Self weight of the joist framing system is not included in the number above, add in actual weights during design.	
Concentrated loads from Pipe Supports, lbs.	1130
See drawings for locations	
Roof live load, psf	20
Ground Snow load, psf	25
Importance factor	1.1
Basic wind speed, mph	90
Consider wind pressure acting upward and downward	
Exposure category	C
Importance factor	1.15
Seismic Design Category	B
Structural Occupancy Factor	III
Seismic Importance Factor, IE =	1.50
Site Class	D
SDS =	0.194g
SD1 =	0.079g

- D. DEFLECTIONS
- Design joists to withstand design loads with vertical deflections not to exceed 1/240 of the span.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following information:

- A. Product Data: For each type of joist, accessory, and product indicated.

- B. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction. Include special joist reinforcing and connections for supported items. Include structural steel members spanning between joists required to provide transfer pipe support loads to the joist.
- C. Complete design: Include stress and deflection calculations, for joists, joist members, and connections for design load and equipment weight as indicated, plus any construction loads applied by Subcontractor's operations. Calculations shall include check of joist chord bending stresses for concentrated loads applied between panel points.
- D. Welding certificates.
- E. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.
- F. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.
- G. Field quality-control test and inspection reports.
- H. Joist manufacturer's installation requirements including the tolerances mentioned in 1.02 B.7.

1.04 PRODUCT HANDLING

- A. PROTECTION:
 - i. Use all means necessary to protect materials of this section before, during, and after installation, and to protect work and materials of all other trades.
 - ii. Deliver, store, and handle joists as recommended in SJI's "Specifications."
 - iii. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. REPLACEMENT:

In the event of damage, immediately inform the Engineer. Make no repairs without the approval of the Engineer and the steel joist manufacturer. Replacements, if necessary, shall be timely and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

Steel Joist Framing
05210-4

Contract 2
Bid Issue

A. K-SERIES STEEL JOISTS

1. Manufacture steel joists in accordance with "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
2. Joist Type: K-series steel joists and KCS-type K-series steel joists.
3. Depth as indicated on the drawings.
4. Steel Joist Substitutes: Manufacture in accordance with "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or channel members. Chord Members: Rolled double angle sections only.
5. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
6. Provide holes in chord members for connecting and securing other construction to joists.
7. Top-Chord Extensions: Extend top chords of joists with SJI's Type S or R top-chord extensions complying with SJI's "Specifications."
8. Camber joists according to SJI's "Specifications."
9. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

B. BRIDGING

1. Provide bridging anchors and number of rows of bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
2. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
3. Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. MISCELLANEOUS

1. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. Hot-dip zinc coat according to ASTM A123.

2. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.02 SHOP FINISH

- A. Hot Dip Galvanized: As specified in Section 05100 , Structural Metals.

PART 3 EXECUTION

3.01 INSPECTION

Examine the areas and conditions under which open web steel joists are to be installed and correct conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. GENERAL:

Install open web steel joists, bridging, and any required accessories in accordance with manufacturer's recommendations, tolerances, and approved shop drawings, and as specified herein.

- B. WELDING:

The quality of welding shall conform to AWS D1.1-90 Code for Arc Welding in Building Construction Section 4, Workmanship.

3.03 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer to ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will pay for a qualified independent testing and inspecting agency to inspect field welds and bolted connections, to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1 Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

- C. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:
 - 1. Radiographic Testing: ASTM E94.
 - 2. Magnetic Particle Inspection: ASTM E709.
 - 3. Ultrasonic Testing: ASTM E164.
 - 4. Liquid Penetrant Inspection: ASTM E165.
- D. Visually inspect bolted connections.
- E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts."
- F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- G. Perform additional testing to determine compliance of corrected Work with specified requirements.
- H. Special inspection will be provided whenever field welding is performed as required in AWS D1.1. and as follows:
 - 1. Verify conformance of specified job material and proper storage.
 - 2. Monitor conformance with approved WPS.
 - 3. Monitor conformance of WPQ.
 - 4. Inspect weld joint fit-up and perform in-process inspection.
 - 5. Provide 100 percent visual inspection of all welds.
 - 6. Supervise nondestructive testing personnel and evaluating test results.
 - 7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.
- I. Inspect installation of joist to verify conformance with the manufacturer's installation instructions and tolerances.

****END OF SECTION****

Steel Joist Framing
05210-7

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 05311

STEEL ROOF DECK

PART 1 GENERAL

1.01 DESCRIPTION

A. GENERAL:

This section specifies fabrication and erection of steel roof deck.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER:

The CONTRACTOR will pay for special inspection and testing in accordance with Section 01400.

B. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AISI SG-673	Design of Cold-Formed Steel Structural Members
ASTM A36	Carbon Structural Steel
ASTM A611	Steel, Sheet, Carbon, Cold Rolled, Structural Quality
ASTM A653	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron, Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM 780	Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A924	Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.
AWS D1.3	Structural Welding Code Sheet Steel

Reference	Title
Steel Deck Institute (SDI)	Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

- A. Complete shop drawings showing framing and deck layout indicating length, type, cross section, thickness, markings of metal deck units, and size and locations of all openings. Shop drawings shall not be a reproduction of the Contract Drawings.
- B. Details and gages of all accessories and miscellaneous items showing sump pans, cant strips, ridge and valley plates, closure strips and insulation supports.
- C. Manufacturer's ICC Evaluation Report with load tables including design thickness in inches, section properties, allowable gravity load, allowable diaphragm shear loads and allowable construction live loads.
- D. Erection marks. Mark each bundle to correspond to the shop drawings.
- E. Certification from SDI that manufacturer is a member of SDI and that the steel roof deck is designed in accordance with SDI standards.
- F. Certification for installers of deck fastening systems.

1.04 QUALITY ASSURANCE

Steel roof deck shall conform to the requirements of the SDI standard for Steel Roof Deck.

Deck manufacturer shall be a member of the Steel Deck Institute and design of the deck shall be by a qualified professional engineer.

Deck installer shall have minimum three years experience on comparable steel deck projects. Installers shall be trained and certified by manufacturer to install fastening systems.

1.05 DELIVERY, STORAGE, AND HANDLING

Store materials off the ground with one end elevated to provide drainage. Protect from the elements with a waterproof covering, ventilated to avoid condensation. Prevent rust, deterioration and accumulation of foreign materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. SHEET STEEL:

ASTM A653, SS, Grade 33, minimum yield 38 ksi, with Designation G60 galvanized coating.

B. STRUCTURAL STEEL:

ASTM A36.

C. GALVANIZING REPAIR PAINT:

Paint shall be 95 percent zinc dust, organic vehicle primer compatible with galvanized surfaces per Section 05910.

2.02 FABRICATION

A. GENERAL:

1. Form deck units in lengths to span three or more support spacings, with minimum two-inch laps and side laps. Configuration shall be appropriate for side lap connection.
2. Deck profile and gage shall be as shown on the drawings. Acceptable manufacturer is Verco or approved equal.

B. CLOSURE PLATES:

Fabricate closure plates of galvanized sheet steel of same quality as deck units. Provide tight-fitting closure with deck units.

C. FABRICATION TOLERANCES:

Maximum variation in unit alignment shall be 1/4 inch in 40 feet.

PART 3 EXECUTION

3.01 INSPECTION

Check supporting members for correct layout and alignment. Verify that surfaces to receive steel deck are free of debris. Do not proceed with installation until defects are corrected.

Steel Roof Deck
05311-3

Contract 2
Bid Issue

3.02 INSTALLATION

Install steel roof deck and accessories in accordance with the manufacturer's instructions and in accordance with final approved shop drawings and as specified herein.

Fasten steel roof deck to all interior and exterior transverse supports and at side laps and longitudinal supports. Deck fasteners and fastener spacing shall be as shown on the Drawings. End lap of steel roof deck shall be at least 2 inches and shall occur over transverse supporting members.

Coordinate size, location, and details of penetrations with the Drawings, other trades, and details of approved equipment. Pipe and conduit openings in the steel roof deck shall be reinforced according to the manufacturer's recommendation.

1. Cutting and Fittings:

- a. Cut and fit steel roof deck units and accessories around projections through steel roof deck.
- b. Make cuts neat, square, and trim.
- c. Cut openings in steel roof deck true to dimensions using metal saws or drills.
- d. Do not use cutting torches.
- e. Openings greater than 6-in and less than 12-in in greatest dimension shall be reinforced with a 24-in by 24-in flat plate, minimum 20-gauge thickness, centered on the opening.

Suspended ceilings, light fixtures, ducts, piping, conduits, or other utilities shall not be attached to steel roof deck.

3.03 FIELD PAINTING

Touch up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions and Section 05910.

3.04 INSPECTION

The Engineer reserves the right to inspect steel roof deck in the field for compliance with the requirements specified herein and the approved shop drawings. The Engineer may reject or require repair or re-fabrication of steel roof deck or accessories not meeting these requirements.

Special inspection of the decking is required for the type, depth, gage, and attachment of the decking.

****END OF SECTION****

SECTION 05501

ANCHORS TO CONCRETE AND MASONRY

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies anchor systems; bolts and all-thread rods used to attach structural elements and equipment to concrete and concrete masonry. Included are cast-in-place and post-installed anchors; adhesive systems, limited use expansion (wedge type) anchors, nuts and washers. Cast-in-place anchor bolts are specified as hot-dip galvanized or Type 316 stainless steel; all-thread rods are Type 316 stainless steel.

1.02 QUALITY ASSURANCE/QUALITY CONTROL

A. QUALITY ASSURANCE BY OWNER:

Special inspection of anchor bolts shall be performed by the Special Inspector paid for by the Contractor and in accordance with IBC Chapter 17.

B. REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High-Temperature Service
ASTM A320	Alloy-Steel Bolting Materials for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless Steel Bolts, Hex Cap Screws and Studs
ASTM F594	Stainless Steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use

Reference	Title
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC 2006	International Building Code with local ammendments

1.03 SUBMITTALS

Provided the following submittals in accordance with Section 01300:

1. Anchor bolt placement plans.
2. Anchor bolt, nut, and washer material information, including material certifications.
3. Where required here-in or by other sections of the Contract Documents, submit record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Arizona. Calculations shall comply with the provisions of ACI 318 Appendix D. Calculations will not be reviewed by the Engineer and calculations will not be returned to the Contractor
4. Product Data:
 - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete.
 - b. Product data indicating load capacity charts/calculations.
 - c. Chemical resistance.
 - d. Temperature limitations.
 - e. Manufacturers written installation instructions.

PART 2--PRODUCTS

2.01 GENERAL

Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch. [Anchor bolts for equipment mounting and vibration isolation systems shall be provided as specified in Sections 11002 and 11021, respectively.]

Tapered washers shall be provided where mating surface is not square with the nut.

When cast-in-place anchors are specifically indicated, post-installed anchors set in holes drilled in the concrete after the concrete is placed will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.02 MATERIALS

Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless Steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless Steel Threaded Rods	ASTM F593, Type 316
Stainless Steel Nuts and Washers	ASTM A194 Heavy Hex Nuts and Washers (ASTM F594 Heavy Hex Nuts at Adhesive Anchors), Type 316
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36 – Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1 – Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844 – Heavy Hex
Concrete Adhesive Anchors	Hilti “HIT-RE 500-SD”, Simpson “SET-XP”, or equal – Type 316 stainless steel
Masonry Adhesive Anchors	Hilti “HIT-HY 150 MAX”, Simpson “SET”, or equal – Type 316 stainless steel
Masonry Expansion (wedge) Anchors*	Hilti “KWIK BOLT 3”, or equal – Type 316 stainless steel
Concrete Expansion (wedge) Anchors *	Hilti “KWIK BOLT TZ”, or equal, Type 316 stainless steel

*Post installed anchors shall always be an adhesive type anchor system except when Contractor makes a request for a specific application and Engineer approves.

2.03 STAINLESS STEEL FASTENER LUBRICANT (ANTI-SEIZING)

A. Anti-seizing Lubricant for Stainless Steel Threaded Connections:

1. [Suitable for potable water supply.]
2. Formulated to resist washout.

3. Acceptable Manufacturers are Bostik, Saf-T-Eze, or equal.

2.04 ANCHOR BOLT SLEEVES

- A. Provide anchor bolt sleeves as required by equipment manufacturer's design for minor location adjustment.
 1. High density polyethylene plastic of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 3. Acceptable Manufacturers are Contec, Wilson, or equal.

2.05 DESIGN

Anchor bolts for equipment shall be designed by the equipment manufacturer to include seismic and wind forces when applicable.

PART 3--EXECUTION

3.01 GENERAL

- A. Anchor bolts shall be cast- in-place where indicated.
- B. Grouting of anchor bolts using plastic sleeves with non-shrink or epoxy grout, where required by equipment manufacturer's design, shall be in accordance with Section 03600.
- C. The threaded end of anchor bolts and all-thread rod shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.02 CAST-IN-PLACE ANCHOR BOLTS

Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.

After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

Provide anchor bolts with sufficient length to provide for a minimum 10-inch embedment (below any grout pad) unless noted to be longer based on the equipment manufacturer's design.

3.03 ADHESIVE ANCHOR BOLTS

Note that adhesive anchors shall not be substituted for anchor bolts which are specifically indicated to be cast-in-place. Use of adhesive anchors shall be subject to the following conditions:

1. Limit to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.
2. Limit to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F is extremely unlikely. Overhead applications (such as pipe supports) shall not be allowed.
3. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
4. Anchor diameter and material shall be per equipment manufacturer's specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.
5. Embedment depth shall be as specified by the equipment manufacturer (minimum 6 inches) unless noted otherwise.
6. Follow the anchor system manufacturer's written installation instructions.
7. Holes shall have rough surfaces created by using a hammer drill with carbide bit (core drilled holes are not allowed).
8. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation.
9. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer instructions. Anchors shall not be placed in when concrete temperature is below 25 degrees F.
10. Anchors shall be left undisturbed and unloaded for full adhesive curing period which is based on temperature of the concrete.

3.04 EXPANSION ANCHORS

Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 3 through 8 as specified above for adhesive anchors.

Expansion anchors shall not be used in a submerged condition nor in mounting of equipment subject to vibration or cyclic motion.

3.05 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.
- B. Where slanting the drill does not resolve the conflict, notify the Project Representative and resolve the conflict to the satisfaction of the Project Representative in consultation with the Engineer.
- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.
- E. Reinforcing steel in masonry shall not be damaged.
- F. In order to avoid or resolve a conflict, locate embedded reinforcing steel using non-destructive methods and/or redesign the attachment.
 - 1. Redesign shall be done by the Contractor's Professional Engineer currently registered in the State of Arizona.
 - 2. Calculations and details for redesign shall be submitted for record purpose.

****END OF SECTION****

SECTION 05505

MISCELLANEOUS METALWORK

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies fabricated metalwork items and other miscellaneous metalwork.

1.02 QUALITY ASSURANCE

A. GENERAL:

The use of salvaged, reprocessed or scrap materials will not be permitted.

B. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements
AISC 303-05	Code of Standard Practice for Steel Buildings and Bridges
AISC 360-05	Specification for Structural Steel Buildings
AISC Manual	American Institute of Steel Construction, Manual of Steel Construction, Thirteenth Edition
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines

Miscellaneous Metalwork
05505-1

Contract 2
Bid Issue

Reference	Title
ASTM A36/A36M	Specification for Carbon Structural Steel
ASTM A48	Specification for Gray-Iron Castings
ASTM A53/A53M	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A123/A123M	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service
ASTM A240/A240M	Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM A283/A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
ASTM A312	Standard Specification for Seamless and Welded Austenitic Stainless steel Pipes
ASTM A320/ A320M	Standard Specification for Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A325	Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

Reference	Title
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A653	Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A793	Specification for Rolled Floor Plate, Stainless Steel
ASTM A924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A967	Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM A992	Standard Specification for Structural Steel Shapes
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B210	Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B211	Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B632	Standard Specification for Aluminum-Alloy Rolled Tread Plate
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

Reference	Title
ASTM D1056	Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM F436	Specification for Hardened Steel Washers
ASTM F468	Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
ASTM F593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Specification for Stainless Steel Nuts
ASTM F844	Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ICC	International Code Council Evaluation Reports for Concrete and Masonry Anchors
NSF	NSF International
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 29 CFR 1910.27	Fixed Ladders
OSHA 29 CFR 1926.105	Safety Nets
OSHA 29 CFR 1926.502	Fall Protection Systems Criteria and Practices
RCSC	Design Specification for Structural Joints using ASTM A325 or A490 Bolts
IBC	2006 International Building Code

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Procedures: Section 01300.
2. Manufacturer's product data showing conformance to the specification.
3. Detailed Shop Drawings: Submit fabrication drawings showing layouts, connections to structural system, and anchoring details. Submit erection and installation drawings indicating thickness, type, grade, class of metal, coating

system and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

4. Welding procedures and welder certificates and qualifications for the work being performed.
5. U-Channel Concrete Inserts: Manufacturer's product description and allowable load tables.
6. Passivation method for stainless steel fabrications.

PART 2--PRODUCTS

2.01 MATERIALS

Materials for miscellaneous metalwork are specified in Table A.

Table A, Materials for Miscellaneous Metalwork

Material	Specification
<u>Carbon Steel</u>	
Sheets, plates and shapes (except W shapes)	ASTM A36
Steel W shapes	ASTM A992
Pipe	ASTM A53, Grade B
Square/rectangular tubing	ASTM A500, Grade B
Headed Anchor Studs	ASTM A108
Deformed anchor bars	ASTM A496
Carbon steel bolts	ASTM A307, Grade A
High strength bolts	ASTM A325 (Type 1)
Nuts	ASTM A563
Washers	ASTM F844
<u>Stainless Steel</u>	
Sheets and plates	ASTM A240, Type 316 or 316L
Shapes, bars, and similar items	ASTM A276, Type 316 or 316L
Pipe	ASTM A312, Type 316 or 316L
Headed Anchor Studs	ASTM A193 or A320, Type 316

Material	Specification
Bolts	ASTM A193, Grade B8M Class 1, AISI 316 or ASTM A320, Grade B8M Class 1, AISI 316
Nuts	ASTM A194 Grade 8M, SS316
<u>Aluminum</u>	
Sheets and plates	ASTM B209, Type 6061-T6
Bars, flats and similar items	ASTM B211 or B221, Type 6061-T6
Shapes	ASTM B308, Type 6061-T6
Round tubing and pipe	ASTM B241, Type 6061-T6
Square and rectangular tubing	ASTM B221, Type 6063-T52
Pipe	ASTM B211 or B241, Type 6061-T6
Bolts, Stainless Steel	ASTM A194, Grade 8M, Type 316
Nuts, Stainless Steel	ASTM A194, Type 316
Washers, Stainless Steel	ASTM A194, Type 316
<u>Checker Plate</u>	
Steel	ASTM A786
Stainless steel	ASTM A793, Type 304
Aluminum	ASTM B632, Type 6061-T6
<u>Thrust Ties for Steel Pipe</u>	
Threaded rods	ASTM A193/A193M, Grade B7
Nuts	ASTM A194/A194M, Grade 2H
Plate	ASTM A283/A283M, Grade D
<u>Other steel items</u>	
Iron castings	ASTM A48
Eyebolts	ASTM A489
Threaded rods	ASTM A36/A36M

2.02 FABRICATION

A. GENERAL:

Conform to AISC or Aluminum Association standards as applicable. Where Code defined loads apply, also conform to IBC requirements.

Shop and field welding shall conform to the requirements of the AISC Manual of Steel Construction, the Aluminum Association Design Manual, and applicable AWS procedures and specifications as required by the material being welded

Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt, tight, flush, and hairline. Remove all burrs and weld splatter. Ease exposed edges to small uniform radius.

Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.

B. SEAT ANGLES FRAMES:

Provide recessed seat angle frames for grating and for floor plates. Miter corners to ensure accurate fitting. Match depth of recess with grating or floor plate thickness. Anchor frames in concrete with headed studs. Steel angle support frames to be stainless steel, ASTM A276, Type 316, unless indicated otherwise.

C. IRON CASTINGS:

Castings shall be as specified on the drawings. Castings weighing less than 100 pounds shall be hot-dip galvanized after machining. Castings weighing greater than 100 pounds shall be galvanized where specified.

D. LADDERS

Ladders shall be pre-engineered aluminum ladders. Ladders shall be fabricated of alloy 6063-T6. Rungs shall have non-slip grip surface. Finish shall be anodized. Fabricate ladders with rails, rungs, landings and cages to meet applicable requirements of OSHA, CFR Part 1910.27, and ANSI A14.3.

E. COVER PLATES AND FRAMES

Fabricate cover plates weighing not more than 100 pounds per plate with a raised pattern nonslip top surface. Reinforce to sustain a live load of 100 pounds per square foot or as indicated on the design drawings. Frames shall be angles and plates, with headed anchors welded to frame for anchoring to concrete. Miter and weld all corners. Butt joint straight runs. Provide flush drop handles for removal. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Provide 1/8 inch clearance at edges.

F. PIPE SLEEVES

Unless otherwise indicated on design drawings, fabricate pipe sleeves from schedule 40 steel pipe with 3/16" thick by 3' wide seep ring continuously seal welded to the outside of the pipe. Galvanize after fabrication in accordance with ASTM A123.

G. FIXED BOLLARDS

Provide 6 inch galvanized standard weight steel pipe or as indicated on the design drawings. Pipe to be in accordance with ASTM A53. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

H. OTHER MISCELLANEOUS STEEL METALWORK:

Other miscellaneous steel metalwork including embedded and non-embedded steel metalwork, hangers and inserts shall be as specified on the drawings and shall be hot-dip galvanized after fabrication unless otherwise note on the design drawing.

2.03 FABRICATION FINISHES

A. GALVANIZING

For the galvanizing of miscellaneous metal work reference specification 05910.

B. SHOP PAINTING

Surface prepare by blast clean surfaces in accordance with the project coating specification. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat.

C. ALUMINUM SURFACES

Surface condition aluminum before finishes are applied. Remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces. Aluminum finishes for unexposed sheet, plate and extrusions may have mill finish as fabricated. Provide all other aluminum items with a standard mill finish. Provide a coating thickness not less than that specified for protection. Provide decorative type finishes for items used in interior occupied locations or architectural type finish for items used in exterior locations. Provide a polished satin finish on items to be anodized.

D. STAINLESS STEEL PASSIVATION

Stainless steel to be cleaned, descaled, and passivated after fabrication in accordance with ASTM A380. Passivation to removal iron compounds from the surface of the stainless steel.

PART 3--EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Verify measurements at the site. Include field dimensions in shop drawings.
- B. Verify that field conditions are acceptable and are ready to receive work.
- C. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- D. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.02 INSTALLATION OF METAL FABRICATIONS

- A. Install items plumb, level and square, accurately fitted, and free from distortion or defects. Install rigid, substantial, and neat in appearance.
- B. Allow for erection loads and provide temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
- D. Protect encased or embedded dissimilar metals (both metals must be encased or embedded) from galvanic corrosion by means of pressure tapes, coatings or isolators.
- E. Place metalwork to be embedded in concrete accurately and hold in correct position while the concrete is placed or, if indicated, form recesses or blockouts in the concrete. Thoroughly clean the surfaces of metalwork in contact with or embedded in concrete. If accepted, recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place.
- F. Seat angles, supports and guides: Set seat angles for grating and supports for floor plates so that they maintain the grating and floor plates flush with the floor.
- G. Pipe Sleeves:
 - 1. Provide where pipes pass through concrete or masonry.
 - 2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.

3. Provide a center flange for water stoppage on sleeves in exterior or water-bearing walls
4. Provide a rubber caulking sealant or a modular mechanical unit to form a watertight seal in the annular space between pipes and sleeves

H U-Channel Concrete Inserts:

1. Provide as indicated for pipe supports and where otherwise shown on Drawings.

3.03 FIELD REPAIR OF COATINGS

A. Galvanized:

1. Maximum area to be repaired shall be no more than 1/2 of 1 percent of the surface area or 36 sq. in. per ton of piece weight, whichever is less. Damage in excess of this requirement shall be repaired by stripping and recoating entire piece.
2. Clean damaged areas to SSPC-SP5. Repair with zinc-rich paint in accordance with the manufacturer's instructions and with ASTM A780, Annex A2. Minimum thickness requirements shall be in accordance with ASTM A123, Paragraph 6.2.3.
3. Use zinc-rich repair paint.
4. Acceptable manufacturer:
 - a. ZRC Galviline.
 - b. LPS Cold Galvanize
 - c. Approved equal.

- B. Painted: after installation, clean and touch up damaged areas with the same materials used for the shop coat.

3.04 ELECTROLYTIC PROTECTION

- A. Coat surfaces of aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09900, unless indicated otherwise.

3.05 STAINLESS STEEL

- A. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
- B. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
- C. Remove contamination in accordance with requirements of ASTM A380.
- D. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

3.06 FASTENER SCHEDULE

- A. Provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Connections for Carbon Steel Fabrications		
Interior and exterior areas	Galvanized high-strength bolts	Applies to both galvanized and painted carbon steel fabrications
2. Connections of Aluminum Components		
All areas	Stainless steel fasteners	
3. All Others		
Exterior and interior areas	Stainless steel fasteners	

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 05530

GRATING, FLOOR PLATES, STAIR TREADS AND SAFETY STAIR NOSINGS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies grating, floor plates, stair treads and safety stair nosings.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AISC Steel Construction Manual	American Institute of Steel Construction, Steel Construction Manual, 13th Edition.
Aluminum Design Manual	The Aluminum Association, Aluminum Design Manual with Specifications and Guidelines, 2005
ASTM A36	Carbon Structural Steel
ASTM A569	Steel, Carbon, Hot Rolled Sheet and Strip Commercial
ASTM A786	Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B632	Aluminum-Alloy Rolled Tread Plate
ANSI/NAAMM MBG 531	National Association of Architectural Metal Manufacturers, Metal Bar Grating Manual
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. Shop drawings showing placing plans for grating and floor plates, including manufacturer's loading tables.
2. Manufacturer's product data for each product to be supplied.

PART 2--PRODUCTS

2.01 MATERIALS

A. ALUMINUM:

Aluminum grating shall be of alloy 6061-T6 conforming to ASTM B221. Aluminum plate shall be of alloy 6061-T6 conforming to ASTM B209. Aluminum raised pattern floor plate (Checkered plate) shall be aluminum tread plate of alloy 6061-T6 conforming to ASTM-B632.

2.02 FABRICATION

A. GENERAL:

Rough weld beads and sharp metal edges on gratings and plates shall be ground smooth. Welds exposed to view shall be uniform and neat.

Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

B. GRATING:

Grating shall be aluminum unless noted otherwise. Both bearing bars and cross bars shall be continuous. Openings shall be banded with bars having the same dimensions as the bearing bars. Perimeter edges shall be banded with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface. Bars terminating against edge bars shall be welded to the edge bars when welded construction is used. When crimped or swaged construction is used, bars at edges shall protrude a maximum of 1/16 inch and shall be peened or ground to a smooth surface. No single piece of grating shall weigh more than 80 pounds unless specifically detailed otherwise. Fabrication methods employing bending or notching of bearing or cross bars will not be permitted.

C. FLOOR PLATES:

1. Floor plates shall be as specified. Hinged plates shall be as specified and shall be set flush with surrounding floor. No single piece of floor plate shall weigh more than 80 pounds unless specifically detailed otherwise.
2. Unless otherwise specified, floor plates shall be aluminum. Aluminum plates shall be Alcoa aluminum tread plate, Reynolds diamond tread plate, or equal.

D. STAIRS:

Unless otherwise specified, stair stringers shall be galvanized steel with aluminum treads and aluminum grating at landings.

E. STAIR TREADS:

Treads shall match the aluminum grating material and type furnished for landings. Treads shall have skid-resistant surface consisting of aluminum oxide grit, epoxy bonded to the entire tread surface in accordance with manufacturer's recommendations. Nosing shall be abrasive on each tread along one lone edge. Provide carrier angle at each end for attachment to stair stringers.

F. SAFETY NOSINGS AT CONCRETE STAIRS:

Safety stair treads shall be 4 inches wide and shall be Alumogrit, Type 101, as manufactured by Wooster Products, Incorporated; Aluminum, Style A, as manufactured by American Abrasive Metals Company; Style AX as manufactured by Safe-T-Metal Company, Incorporated, or equal.

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL:

Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.

Dissimilar metals, except for aluminum in contact with stainless steel or galvanized steel supports, shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Aluminum in contact with concrete shall be protected by a heavy coat of bituminous paint.

Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the

concrete after it has attained its design strength and the metalwork grouted in place as specified in Section 03300. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned. If accepted, recesses may be neatly cored in the concrete.

B. GRATING AND COVER PLATES:

Grating, floor and cover plates shall be field measured for proper cutouts and proper sizes.

C. STAIRS:

Stairs shall be fitted accurately and field measured where necessary.

D. SAFETY NOSINGS:

Unless otherwise specified, safety stair treads shall be installed on all concrete stairs. Treads shall be secured to concrete with suitable anchors at 15 inches on centers and not more than 4 inches from the ends. Rubber tape, 1/8 inch thick, shall be provided at both ends and cut to fit shape of tread prior to concrete placement.

3.02 CLEANING

Damaged surfaces of galvanized metals shall be repaired as specified in Section 05910.

****END OF SECTION****

ZINC COATINGS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies both hot-dip zinc coating and mechanical zinc coating. Electroplated corrosion protection is not an acceptable substitute for mechanical zinc coating.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A780	Repair of Damaged Hot-Dip Galvanized Coatings
ASTM B695	Coatings of Zinc Mechanically Deposited on Iron and Steel
MILSPEC DOD-P-21035	Paint, High Zinc Dust Content, Galvanizing Repair

Zinc Coatings
05910-1

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Zinc dust-zinc oxide coating manufacturer's product data showing conformance to the specified product.
2. Manufacturer's recommendation for application of zinc dust-zinc oxide coating.
3. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of ASTM A123 or A153, as applicable.

PART 2--PRODUCTS

2.01 MATERIALS

A. ZINC COATING:

Hop-dip zinc coating material shall be as specified in ASTM A123 and A153, as applicable. Mechanical zinc coating shall be as specified in ASTM B695.

B. ZINC DUST-ZINC OXIDE COATING:

Zinc dust-zinc oxide coating shall conform to MILSPEC DOD-P-21035. Coating shall be as manufactured by Z.R.C. Chemical Products Co., Galvicon Co., or equal.

2.02 FABRICATION REQUIREMENTS

Fabrication practices for products to be galvanized shall be in accordance with applicable portions of ASTM A143, A384 and A385.

PART 3--EXECUTION

3.01 APPLICATION

Steel members, fabrications and assemblies shall be galvanized after fabrication in accordance with ASTM A123.

Structural steel connection bolts, screws, nuts, washers shall be hot-dip galvanized per ASTM A153.

3.02 COATING REQUIREMENTS

A. Hot-dip coating weight shall conform to paragraph 5.1 of ASTM A123 or Table 1 of ASTM A153, as appropriate.

B. Mechanically applied coating thickness shall be Class 50 as specified in ASTM B695.

3.03 REPAIR OF DEFECTIVE GALVANIZED COATING

Where zinc coating has been damaged after installation, substrate surface shall be first cleaned and then repaired with zinc dust-zinc oxide coating in accordance with ASTM A780. Application shall be as recommended by the zinc dust-zinc oxide coating manufacturer. Coating shall consist of multiple coats to dry film thickness of 8 mils.

Items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, shall be removed from the project site for repair by the hot-dip zinc coating method.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood blocking and nailers.
 - 2. Wood furring.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.03 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat all rough carpentry unless otherwise indicated.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Furring.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 3. Northern species; No. 2 Common grade; NLGA.
 - 4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.04 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.

3.02 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

****END OF SECTION****

SECTION 06160

SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Composite nail base insulated roof sheathing and roof insulation.

1.02 ACTION SUBMITTALS

- ###### A. Product Data:
- For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.01 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

- ###### A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing:
- ASTM C 1289, Type V with DOC PS 2, Exposure 1 oriented strand board on one face.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Atlas Roofing Corporation; AC Foam Nail Base Insulation or a comparable product by one of the following:

- a. Dow Chemical Company (The).
- b. Johns Manville; a Berkshire Hathaway company.

2. Polyisocyanurate-Foam Thickness: 4 inches.

3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.

- ###### B. Polyisocyanurate Insulation: ASTM C 1289, Type II.

- a. Basis-of-Design Product: Subject to compliance with requirements, provide Atlas Roofing Corporation; AC Foam II or a comparable product by one of the following:

- b. Dow Chemical Company (The).
- c. Johns Manville; a Berkshire Hathaway company.

2. Polyisocyanurate Insulation Thickness: 4 inches.

2.02 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

****END OF SECTION****

SECTION 07190
WATER REPELLENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

- 1. Concrete unit masonry.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of water repellent and substrate indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

PART 2 - PRODUCTS

2.01 PENETRATING WATER REPELLENTS

- A. RTV Silicone Rubber Penetrating Water Repellent: Clear, solvent-based silicone elastomer.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Prosoco, Inc.: Sure Klean Weather Seal Blok Guard & Graffiti Control.
 - b. Professional Products of Kansas: PWS-15.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in representative locations by method recommended by manufacturer.
 - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 - 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

3.02 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
 - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.03 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply coating of water repellent on surfaces to be treated using low-pressure spray to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.04 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 07410
STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes standing-seam metal roof panels.
- B. Soffit panels.
- C. Snow guards.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: 25 psf.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 30.
- F. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A-60.
 - 2. Hail Resistance: MH.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

Standing Seam Metal Roof Panels

07410 - 3

Contract 2
Bid Issue

- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; Zee-Lock or a comparable product by one of the following:
- a. AEP Span; A BlueScope Steel Company.
 - b. ATAS International, Inc.
 - c. CENTRIA Architectural Systems.
 - d. Englert, Inc.
 - e. Fabral.
 - f. Firestone Metal Products, LLC.
 - g. IMETCO.
 - h. Petersen Aluminum Corporation.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- a. Nominal Thickness: 24 gauge.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
3. Clips: Two-piece floating to accommodate thermal movement.
- a. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
4. Joint Type: Single folded.
5. Panel Coverage: 16 inches.

Standing Seam Metal Roof Panels

6. Panel Height: 2.0 inches.

2.03 SOFFIT PANELS

- A. Metal Soffit Panels: Formed standard with two grooves and interlocking side lap; designed for sequential installation by mechanically attaching panels to supports using concealed fasteners.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; L-Panel or a comparable product by one of the following:
 - a. AEP Span; A BlueScope Steel Company.
 - b. ATAS International, Inc.
 - c. CENTRIA Architectural Systems.
 - d. Englert, Inc.
 - e. Fabral.
 - f. Firestone Metal Products, LLC.
 - g. IMETCO.
 - h. Petersen Aluminum Corporation.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 24 gauge.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Panel Coverage: 11-5/8 inches.
 4. Panel Height: 1.0 inches.

2.04 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlisle Residential; a division of Carlisle Construction Materials.
 - b. Grace Construction Products; W.R. Grace & Co. -- Conn.
 - c. Henry Company.
- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.05 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- C. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.06 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.07 FINISHES

- A. Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
 2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

2.08 SNOW GUARD

- A. Snow Guard System: S-5! ColorGard system manufactured by Metal Roof Innovation approved equal. System to include extrusions, prefinished metal strips matching roof panels, splice connectors for crossmember sections, fasteners, and all related items necessary for a complete installation.
1. Crossmember is to be continuous and include splice connectors to join adjacent sections, ensuring alignment and structural continuity. Attach crossmember to clamps using minimum 3/8" diameter stainless steel bolts with flat washers.
 2. Provide S-5-U clamps manufactured by Metal Roof Innovation complete with stainless steel set screws and stainless steel bolt and washer as furnished by the manufacturer to attach the system to the standing seam roof. Clamp spacing as calculated and not exceeding 32" o.c.
 3. Between each rib provide SnoClip as required to prevent snow from sliding underneath snow guard.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.02 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
1. Apply over the entire roof surface.
- B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.
1. Apply over the entire roof surface.
- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.03 METAL PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.04 SNOW GUARD INSTALLATION

- A. Verify that panel seam area is reasonably clean and free of visible dirt and foreign matter at the clamp locations prior to installing clamps. Verify that any required machine seaming is complete prior to installation and that panels are adequately

attached and supported to the building structure to resist any loads imposed on the clamps.

- B. Install system to comply with design calculations and in accordance with manufacturer's instructions. Carefully lay out desired assembly locations true-to-line prior to installing clamps. Clamps should avoid panel attachment clips if the clip is a single piece design. Assemble set screws to clamp and clamp to seam following all manufacturers printed instructions. Both set screws are to be at the same side of clamp. Verify manufacturer's minimum recommended setscrew tension using calibrated torque wrench per manufacturer's instructions. Install snow retention assemblies straight and true-to-line. Secure all material per manufacturer's instructions. Join adjacent sections with splice pieces provided. Do not cantilever cross member more than 6" past the last lamp in an assembly.
- C. Install SnoClips per manufacturer's recommendations.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

****END OF SECTION****

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed steep-slope roof sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

- 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

- 1. Surface: Manufacturer's standard clear acrylic coating on both sides.
 - 2. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- 3. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections.

Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.

- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 - 1. Fabricate from one of the following materials:
 - a. Galvanized Steel: 24 gauge.
 - b. Aluminum-Zinc Alloy-Coated Steel: 24 gauge.

2.6 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from one of the following materials:
 - 1. Galvanized Steel: 24 gauge.
 - 2. Aluminum-Zinc Alloy-Coated Steel: 24 gauge.
- B. Eave, Rake Flashing: Fabricate from one of the following materials:
 - 1. Galvanized Steel: 24 gauge.
 - 2. Aluminum-Zinc Alloy-Coated Steel: 24 gauge.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.2 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

****END OF SECTION****

Sheet Metal Flashing and Trim

07620 - 7

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 07905

PREFORMED JOINT FILLERS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies preformed joint fillers.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D994	Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

PART 2--PRODUCTS

2.01 PREFORMED ASPHALT FIBERBOARD

Preformed asphalt fiberboard joint filler shall be in accordance with ASTM D994 and shall be 1/2 inch thick unless otherwise specified.

2.02 PREFORMED RESIN-BONDED CORK

Preformed resin-bonded cork joint filler shall be in accordance with ASTM D1752, Type II. Cork joint filler thickness shall match the specified joint width.

2.03 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's recommendations for handling and installation of the material.

PART 3--EXECUTION

3.01 GENERAL

Preformed joint fillers shall be placed into position before the concrete is poured. Where it is necessary for the filler to be fixed to existing concrete or other building materials, a suitable adhesive recommended by the filler manufacturer shall be used. Filler surfaces shall be clean and dry prior to the placement of the concrete.

3.02 PREFORMED ASPHALT FIBERBOARD

Preformed asphalt fiberboard joint fillers shall be used for expansion joints in concrete sidewalks, curbs, and roadways.

3.03 PREFORMED RESIN-BONDED CORK

Preformed resin-bonded cork joint filler shall be used for expansion joints in concrete structures. The expansion joint shall be sealed with backer rod and sealant as specified in Section 07900.

****END OF SECTION****

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Urethane joint sealants.
 - 2. Latex joint sealants.

1.02 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.03 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.02 URETHANE JOINT SEALANTS

- A. Urethane Joint Sealant : ASTM C 920.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 2C-SL and 2C-NS by Sika Corporation or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.
 - 2. Type: Multicomponent (M).
 - 3. Grade: Pourable (P) or nonsag (NS).
 - 4. Class: 50.

2.03 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide AC-20 by Pecora or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Tremco Incorporated.

2.04 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.05 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 2. Joint Sealant: Urethane.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between metal panels.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors and louvers.
 - f. Control and expansion joints in ceilings and other overhead surfaces.
 2. Joint Sealant: Urethane.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 2. Joint Sealant: Urethane.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Perimeter joints of exterior openings where indicated.
- c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

2. Joint Sealant: Latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

****END OF SECTION****

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes hollow-metal work.

1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door; ASSA ABLOY.

Hollow Metal Doors and Frames
08110-1

3. Commercial Door & Hardware Inc.
4. Curries Company; ASSA ABLOY.
5. Rocky Mountain Metals, Inc.
6. Steelcraft; an Ingersoll-Rand brand.
7. Stiles Custom Metal, Inc.
8. West Central Mfg. Inc.

2.02 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Maximum-Duty Doors and Frames: SDI A250.8, Level 4.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum 14 gauge, with minimum A40 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard insulation material.
3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 10.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
4. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum 14 gauge, with minimum A40 coating.
 - b. Construction: Full profile welded.
5. Exposed Finish: Prime.

2.03 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.04 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

2.05 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
- 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.06 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: SDI A250.10.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

- b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.02 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

****END OF SECTION****

Hollow Metal Doors and Frames
08110-7

Contract 2
Bid Issue

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 08330
OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Insulated service doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
- C. Samples: For each exposed product and for each color and texture specified.

1.03 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
 2. Testing: According to ASTM E 330.
- B. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 1.
1. Large-Missile Test: For overhead coiling doors located within 30 feet of grade.
- C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Clopay Building Products.
 - b. Cookson Company.
 - c. Cornell Iron Works, Inc.
 - d. Lawrence Roll-Up Doors, Inc.
 - e. Overhead Door Corporation.
 - f. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.
- C. Curtain R-Value: 6.0 deg F x h x sq. ft./Btu.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

Overhead Coiling Doors

08330 - 2

Contract 2
Bid Issue

- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- H. Hood: Match curtain material and finish.
 - 1. Mounting: Face of wall.
- I. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn, outside with cylinder.
- J. Manual Door Operator: Chain-hoist operator.
- K. Curtain Accessories: Equip door with weatherseals.
- L. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.03 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.04 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Metal Exterior Curtain-Slat Facing: 18 gauge.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, 24 gauge.

- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.05 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.06 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders specified in Section 08710 "Door Hardware" and keyed to building keying system.
 - 2. Keys: Three for each cylinder.

2.07 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

2.08 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.09 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide tight fit around entire perimeter.

3.02 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
- B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
 - 1. Permanent lock cores to be installed by Owner.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

- 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
- 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 1. For door hardware, an Architectural Hardware Consultant (AHC).
- C. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- B. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.02 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.03 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- B. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

2.04 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

2.05 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 1. Manufacturer: Same manufacturer as for locking devices.
- B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.06 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 1. No Master Key System: Only change keys operate cylinder.
- B. Keys: Brass.
 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.

2.07 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.08 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

2.09 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

2.010 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.011 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.012 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.013 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Replace construction cores with permanent cores as directed by Owner.

2. Furnish permanent cores to Owner for installation.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- K. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.02 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

3.03 DOOR HARDWARE SCHEDULE

KEY:

B Best	L LCN	S Stanley
H Hager	P Pemko	T Trimco

QTY.	ITEM	NUMBER	MFR
Group 1 Single ext HM, entry			
1 ½	Hinges	FBB179, 4 ½ x 4 ½, 626, NRP	S
pair	Closer	4041H, Cush	L
1	Lockset	45H-7-AB-14H-626	B
1	Threshold	272A x Door Width	P
1	Kickplate	KOO50 10"H x Door Width less 2"	T

Door Hardware
08710-7

Contract 2
Bid Issue

1	Weatherstripping	305CS, head and jamb	P
1	Sweep	315CN	P
1			
Group 2 Double ext HM, entry			
3 pair	Hinges	FBB179, 4 ½ x 4 ½, 626, NRP	S
1	Closer	4041H, Cush	L
1	Lockset	45H-7-AB-14H-626	B
2	Flush bolts	3917 x 12" @ Sill, extended rod @	T
1	Strike	Head	T
1	Threshold	3911	P
2	Kickplates	272A x Door Width	T
1	Weatherstripping	KOO50 10"H x Door Width less 2"	P
1	Sweep	305CS, head and jamb	P
		315CN	
Group 3 Coiling Door			
1	Cylinder	1E Series	B

END OF SECTION

SECTION 08800

GLAZING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Glass for doors and interior borrowed lites.
 - 2. Glazing sealants and accessories.

1.02 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

1.05 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.07 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cardinal Glass Industries
 - 2. Guardian Glass; SunGuard
 - 3. Oldcastle Building Envelope
 - 4. Pilkington North America
 - 5. Schott North America, Inc.
 - 6. Viracon, Inc.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.03 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards
 - 1. GANA Publications: "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum.
- E. Strength: Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.05 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seals.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction

2.06 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.07 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.08 MICELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

Glazing
08800-4

Contract 2
Bid Issue

- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.01 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.03 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.04 SEALANT GLAZING(WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.05 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.06 MONOLITHIC GLASS SCHEDULE

- A. Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.07 INSULATING GLASS SCHEDULE

- A. Clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.

3. Outdoor Lite: Fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: Fully tempered float glass.
6. Safety glazing required.

****END OF SECTION****

SECTION 09900

TABLE OF CONTENTS

PART 1--GENERAL	3
1.01 DESCRIPTION	3
A. SCOPE:	3
B. DEFINITIONS:	3
1.02 QUALITY ASSURANCE.....	6
A. REFERENCES:.....	6
B. STANDARDIZATION:	9
C. QUALITY CONTROL REQUIREMENTS:.....	10
D. INSPECTION AT HOLD POINTS	11
1.03 DELIVERY AND STORAGE.....	12
1.04 SUBMITTALS:	13
1.05 RESPONSIBILITIES OF THE CTR	14
B. COATING SYSTEM INSPECTION	15
C. FINAL REPORT	16
PART 2--PRODUCTS.....	16
2.01 MATERIALS.....	16
2.02 PRODUCT DATA.....	18
PART 3--EXECUTION.....	18
3.01 COATINGS	18
A. GENERAL:	18
B. SHOP AND FIELD COATS:.....	18
C. APPLICATION LOCATION REQUIREMENTS:.....	19
3.02 PREPARATION.....	20
A. GENERAL:	20
B. BLAST CLEANING:	20

C.	SOLVENT CLEANING:	21
D.	METALLIC SURFACES:.....	21
E.	CONCRETE SURFACES:.....	22
F.	MASONRY SURFACES:.....	24
G.	FIBERGLASS REINFORCED PLASTIC (FRP) SURFACES:	24
3.03	APPLICATION.....	25
A.	WORKMANSHIP:.....	25
B.	COATING PROPERTIES, MIXING AND THINNING:.....	26
C.	ATMOSPHERIC CONDITIONS:	26
D.	CONCRETE SUBSTRATE TEMPERATURES AND DETAIL TREATMENT:	26
E.	PROTECTION OF COATED SURFACES:.....	27
F.	METHOD OF COATING APPLICATION:.....	27
G.	FILM THICKNESS AND CONTINUITY:	28
H.	SPECIAL REQUIREMENTS:	29
I.	ELECTRICAL AND INSTRUMENTATION EQUIPMENT AND MATERIALS:.....	29
J.	SOLUBLE SALT CONTAMINATION OF METALLIC SUBSTRATES:	30
3.04	CLEANUP	30
3.05	COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)	30
	Coating System Identification: E-1.....	32
	Coating System Identification: E-1-G	34
	Coating System Identification: E-5 (NSF 61 certified).....	36
	Coating System Identification: EU-1	38
	Coating System Identification: L-1.....	40
	Coating System Identification: S-2	42
	Coating System Identification: S-3	43
3.06	COATING SYSTEMS SCHEDULE (FINISH SCHEDULE)	44
3.07	INSPECTION AND TESTING BY OWNER.....	49
3.08	FINAL INSPECTION.....	50

SECTION 09900
COATING SYSTEMS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This Section 09900 specifies coating systems, surface preparations, and application requirements for coating systems.

B. DEFINITIONS:

Specific coating terminology used in this Section 09900 is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions:

1. Abrasive: Material used for blast cleaning, such as sand, grit or shot.
2. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
3. Anchor Pattern: Profile or texture of prepared surface(s).
4. ANSI: American National Standards Institute.
5. Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
6. Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
7. Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section 09900.
8. Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.
9. Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.

10. Dew point: Temperature of a given air/water vapor mixture at which condensation starts.
11. Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch). Use this definition as opposed to existing definition.
12. Drying Time: Time interval between application and curing of material.
13. Dry to Recoat: Time interval between application of material and ability to receive next coat.
14. Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
15. Feather Edging: Reducing the thickness of the edge of paint.
16. Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.
17. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
18. Hold Point: A defined point, specified in this Section 09900, at which work shall be halted for inspection.
19. Holiday: a discontinuity, skip, or void in coating or coating system film that exposes the substrate.
20. Honeycomb: Segregated condition of hardened concrete due to non-consolidation.
21. ICRI: International Concrete Repair Institute.
22. Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
23. Laitance: A layer of weak, non-durable concrete containing cement fines that is brought to the surface through bleed water because of concrete finishing and/or over-finishing.
24. Mil: 0.001 inch.
25. NACE: National Association of Corrosion Engineers.

26. Overspray: Dry spray, particularly such paint that failed to strike the intended surface.
27. Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
28. Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
29. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
30. Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
31. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
32. Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
33. SSPC: The Society for Protective Coatings.
34. Stripe Coat: A separate coat of paint applied to all weld seams, pits, nuts/bolts/washers and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
35. Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
36. Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.
37. Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
38. TPC: Technical Practice Committee.
39. Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates

during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).

- 40. Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
- 41. Weld Splatter: Beads of metal scattered near seam during welding.
- 42. Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI/NSF 61	Drinking Water System Components Health Effects
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces

Reference	Title
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
FS 595b	Federal Standard Colors
ICRI 03732	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standards	January 1988 Edition of the National Association of Corrosion Engineers, TPC.
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete

Reference	Title
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR - Painting
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC-PA Guide 1	Guide for Illumination of Industrial Painting Project
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC-PA Guide 11	Guide for Coating Concrete
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning
SSPC SP6	Commercial Blast Cleaning
SSPC SP7	Brush-Off Blast Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating
SSPC SP13	Surface Preparation of Concrete

Reference	Title
SSPC-TR2	Wet Abrasive Blast Cleaning
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
WPCF Manual of Practice No. 17	Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

B. STANDARDIZATION:

Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.

The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section 09900 will be considered, provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.

1. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total dry film thickness.
2. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.
3. Requests for consideration of products from CSMs other than those specified in this Section 09900 shall include information listed in paragraph 09900-1.04, Items 1, 2, and 3, demonstrating that the proposed CSM's product is equal to the specified coating system.
4. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, phone number of owner; coating system reference and

number from this Section 09900; type of facility in which it was used, generic type, and year coating was applied.

C. QUALITY CONTROL REQUIREMENTS:

1. The Contractor is responsible for the workmanship and quality of the coating system installation. Inspections by the Construction Manager or the CTR will not relieve or limit the Contractor's responsibilities.
2. The Contractor's methods shall conform to requirements of this specification and the standards referenced in this Section 09900. Changes in the coating system installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.
3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section 09900.
4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
5. For repairs, the Contractor shall provide the same products, or products recommended by the CSM, as used for the original coating.
6. The Contractor shall identify the points of access for inspection by the Owner or the Construction Manager. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Construction Manager's personnel to access safely the work areas.
7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected as specified.
8. The Contractor shall complete the Coating System Inspection Checklist, Form 09900-A, included in Section 01999, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Inspection Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System

Inspection Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.

9. The Contractor shall provide written daily reports that present, in summary form, test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system installation.

D. INSPECTION AT HOLD POINTS

The Contractor shall conduct inspections at Hold Points during the coating system installation and record the results from those inspections on Form 09900-A. The Contractor shall coordinate such Hold Points with the Construction Manager such that the Construction Manager may observe Contractor's inspections on a scheduled basis. The Contractor shall provide the Construction Manager a minimum of two (2) hours of notice prior to conducting Hold Point Inspections. The Hold Points shall be as follows:

1. Environment and Site Conditions. Prior to commencing an activity associated with coating system installation, the Contractor shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.
2. Conditions Prior to Surface Preparation. Prior to commencing surface preparation, the Contractor shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
3. Monitoring of Surface Preparation. Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or blow down cleaning shall be checked to confirm it is free from oil and moisture.
4. Post Surface Preparation – Upon completion of the surface preparation, the Contractor shall measure and inspect for proper degree of cleanliness and surface profile as specified in this Section 09900 and in the CSM's written instructions.
5. Monitoring of Coatings Application – The Contractor shall inspect, measure, and record the wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.

6. Post Application Inspection – The Contractor shall identify defects in application work including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness and other problems as may be observed.
7. Post Cure Evaluation – The Contractor shall measure and inspect the overall dry film thickness. The Contractor shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section 09900 and/or in the CSM's written instructions.
8. Follow-up to Corrective Actions and Final Inspection. The Contractor shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.

1.03 DELIVERY AND STORAGE

Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.

Labels on material containers shall show the following information:

1. Name or title of product.
2. CSM's batch number.
3. CSM's name.
4. Generic type of material.
5. Application and mixing instructions.
6. Hazardous material identification label.
7. Shelf life expiration date.

Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.

Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.

Material Safety Data Sheets (MSDS) for each material shall be provided to the Construction Manager.

The Contractor shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

1.04 SUBMITTALS:

Provide in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked (✓) to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
2. CSM's current printed recommendations and product data sheets for coating systems including:
 - a. Volatile organic compound (VOC) data
 - b. Surface preparation recommendations.
 - c. Primer type, where required.
 - d. Maximum dry and wet-mil thickness per coat.
 - e. Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - f. Curing time before submergence in liquid.
 - g. Thinner to be used with each coating.
 - h. Ventilation requirements.
 - i. Minimum atmospheric conditions during which the paint shall be applied.
 - j. Allowable application methods.
 - k. Maximum allowable moisture content.
 - l. Maximum shelf life.
3. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with

current and promulgated federal, state, and local air pollution control regulations and requirements.

4. Material Safety Data Sheets (MSDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
5. List of cleaning and thinner solutions allowed by the CSMs.
6. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
7. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.
8. The Contractor and CSA shall provide a minimum of five project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.

1.05 RESPONSIBILITIES OF THE CTR

The Contractor shall retain or obtain the services of the CTR to be on site to perform the Contractor and/or CSA application training and to routinely inspect and verify in writing that the application personnel have successfully performed surface preparation, filler/surface application, coating system application, and Quality Control Inspection in accordance with this Section 09900 and to warrantable level of quality. This must include checking the required degree of cleanliness, surface pH for concrete substrates, surface profile of substrates, proper mixing of coating materials, application (including checking the wet and dry film thickness of the coating systems), proper cure of the coating systems, and proper treatment of coating systems at terminations, transitions, and joints and cracks in substrates. Refer to Paragraph 1.05 B. for further details on these CTR requirements. This inspection is in addition to the inspection performed by the Contractor in accordance with this Section 09900.

A. COATING SYSTEM INSTALLATION TRAINING

1. Provide a minimum of 8 hours of classroom and off site training for application and supervisory personnel (both the Contractor's and CSA's). Provide training to a minimum of two supervisory personnel from the CSA and one supervisor from the Contractor. Alternatively, the CTR shall provide a written letter from the CSM stating that the application

personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.

2. One CTR can provide training for up to fourteen application personnel and three supervisory personnel at one time. The training shall include the following as a minimum:
 - a. A detailed explanation of mixing, application, curing, and termination details.
 - b. Hands-on demonstration of how to mix and apply the coating systems.
 - c. A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
 - d. When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

B. COATING SYSTEM INSPECTION

While on site to routinely inspect and verify, the CTR shall perform the following activities to confirm acceptability and conformance with the specifications:

1. Inspect ambient conditions during various coating system installation at hold points for conformance with the specified requirements.
2. Inspect the surface preparation of the substrates where the coating system will terminate or will be applied for conformance to the specified application criteria.
3. Inspect preparation and application of coating detail treatment (for example, terminations at joints, metal embedments in concrete, etc.).
4. Inspect application of the filler/surface materials for concrete and masonry substrates.
5. Inspect application of the primers and finish coats including wet and dry film thickness of the coatings.
6. Inspect coating systems for cure.

7. Review adhesion testing of the cured coating systems for conformance to specified criteria.
8. Review coating system continuity testing for conformance to specified criteria.
9. Inspect and record representative localized repairs made to discontinuities identified via continuity testing.
10. Conduct a final review of completed coating system installation for conformance to the specifications.
11. Prepare and submit a site visit report following each site visit that documents the acceptability of the coating work in accordance with the CSM's recommendations.

C. FINAL REPORT

Upon completion of coating work for the project, the CTR shall prepare a final report. That report shall summarize daily test data, observations, drawings, and photographs in a report to be submitted in accordance with paragraph 09900-2.02. Include substrate conditions, ambient conditions, and application procedures, observed during the CTR's site visits. Include a statement that the completed work was performed in accordance with the requirements of this Section 09900 and the CSM's recommendations.

PART 2--PRODUCTS

2.01 MATERIALS

Notwithstanding the listing of product names in this Section 09900, the Contractor shall provide affidavits, signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements. No coatings shall be applied to a surface until the specified affidavits have been submitted and have been reviewed and accepted. Failure to comply with this requirement shall be cause for rejection and removal of such materials from the site.

The following list specifies the material requirements for coating systems. Coating systems are categorized by generic name followed by an identifying abbreviation. If an abbreviation has a suffix number, it is for identifying subgroups within the coating system. Coating Systems E-5 and E-6 shall be NSF 61 certified.

All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
Epoxy Coatings			
E-1	PPG PMC Carboline International Paint/ICI * Sherwin Williams Tnemec	Amerlock 2/400 Series Carboguard 890 Devran 224 HS Macropoxy 646 Series V69	Amerlock 2/400 Series Carboguard 890 Devran 224 Macropoxy 646 Series V69
E-1-G	PPG PMC Carboline International Paint/ICI * Sherwin Williams Tnemec	Amerlock 2/400 Series Carboguard 894 Devran 223/224HS Macropoxy 646 B67-600 Series V27 or V69	Amerlock 2/400 Series Carboguard 894 Devran 224HS Macropoxy 646 B67-600 Series V69
E-5	PPG PMC Carboline International Paint/ICI Sherwin Williams Tnemec	Amercoat 395FD Carboguard 691 Bar-Rust 233H Macropoxy 646 Series V69	Amercoat 395FD Carboguard 691 Bar-Rust 233H Macropoxy 646 Series V69
Epoxy Polyurethane			
		Primer Coat(s)	Intermediate Coat(s)
EU-1	PPG PMC Carboline International Paint/ICI Sherwin Williams Tnemec	Amercoat Carbozinc 859 Cathacoat 313 Zinc Clad IV Series 90-97	Amercoat 385 Carboguard 890 Devran 233 or 224HS Macropoxy 646 Series V69
			Amercoat 450H Carbothane 134 VOC Devthane 379 Hi Solids Polyurethane Series 1075
Latex Acrylic			
L-1	PPG PMC Carboline International Paint/ICI	Amercoat 148 Carbocrylic 120 UH Gripper 3210	Amercoat 220 Carbocrylic 3359 Dulux Pro 1406

All of U.S. Except California

Coating System	CSM	First Coat(s)	Finish Coat(s)
	Sherwin Williams	Loxon Acrylic Primer	Sher Cryl HPA
	Tnemec	Series 1028 or 1029	Series 1028 or 1029
S-3	Tnemec or approved equal	N/A	Series V626 Dur A Pell GS or approved equal

***See CSM's Product Data Sheets for acceptable thinners for VOC compliance or do not thin.**

2.02 PRODUCT DATA

1. Prior to application of coatings, submit letter(s) from the CTR(s) identifying the application personnel who have satisfactorily completed training as specified in paragraph 09900-1.05 or a letter from the CSM stating that personnel who shall perform the work are approved by the CSM without need for further or additional training.
2. Submit reports specified in paragraph 09900-1.02 C.10 and 09900-1.05 B.12 when the work is underway.
3. Submit the Coating System Inspection Checklists, using Form 09900-A, included in Section 01999, for the coating work.
4. CTR final report in accordance with paragraph 09900-1.05 C.

PART 3--EXECUTION

3.01 COATINGS

A. GENERAL:

Coating products shall not be used until the Construction Manager has accepted the affidavits specified in paragraph 09900-1.04 and 2.01, the Construction Manager has inspected the materials, and the CTR has trained the Contractor and CSA in the surface preparation, mixing and application of each coating system.

B. SHOP AND FIELD COATS:

1. **SHOP APPLIED PRIME COAT:** Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended

by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 09900-3.01B.3. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this Section 09900 shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section 09900, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.

2. **FIELD COATS:** Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.

3. **ADHESION CONFIRMATION:** The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. APPLICATION LOCATION REQUIREMENTS:

1. **EQUIPMENT, NONIMMERSED:** Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.

2. **EQUIPMENT, IMMERSED:** Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.

3. **STEEL WATER TANKS:** The interior surfaces of steel water tanks or reservoirs shall have surface preparation and coating work performed in the field.

D. Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

3.02 PREPARATION

A. GENERAL:

Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet (COATSPEC) and the following. In the event of a conflict, the COATSPEC sheets shall take precedence.

Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.

Where deemed necessary by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.

Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

B. BLAST CLEANING:

When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:

1. Used or spent blast abrasive shall not be reused on this project.
2. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
3. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in item 2 above.

4. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.
5. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of surface preparation work.
6. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness/specified.
7. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.
8. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
9. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. SOLVENT CLEANING:

Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.

Clean white cloths and clean fluids shall be used in solvent cleaning.

D. METALLIC SURFACES:

Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. See Coat Spec for each coating system in this Section 09900. The profile depth of the surface to be coated shall be in accordance with the COATSPEC requirements in this Section measured by Method C of ASTM D4417. Blast particle size shall be selected by the

Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the CSM.

Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200), and as described in the Coat Spec for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.

Blast cleaning requirements for steel, ductile iron and stainless steel substrates are as follows:

1. Steel piping shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) and primed before installation. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.
2. Stainless steel surfaces shall be abrasive blast cleaned to leave a clean uniform appearance with a minimum surface profile of 1.5 to 2.5 mils that is uniform.
3. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
4. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
5. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application.

E. CONCRETE SURFACES:

1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.

Coating Systems
09900-22

Contract 2
Bid Issue

3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 03732 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.
4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.
5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra high-pressure water blast cleaning in accordance with SSPC-SP-13. The selected cleaning method shall produce the requirements set forth below.
 - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.

Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
 - b. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be

used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.

7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness and required surface profile prior to application of the coating system.
8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method and ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed and waterproofed in accordance with Section 07100, perform calcium chloride tests in accordance with ASTM F-1869 once for each 500 sq. ft. of surface area to be coated. Comply with CSM's written recommendations regarding acceptance/non-acceptance of moisture vapor emissions.

F. MASONRY SURFACES:

1. Prepare masonry surfaces such as Concrete Masonry Units (CMU) to remove chalk, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
2. Be certain masonry surfaces are dry prior to coating application. If pressure washing or low-pressure water blast cleaning is used for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or when the minimum ambient temperature is 70 degrees F prior to coating application work.

G. FIBERGLASS REINFORCED PLASTIC (FRP) SURFACES:

Prepare FRP surfaces by sanding to establish uniform surface roughness and to remove gloss from the resin in the FRP. Next, vacuum clean to remove loose FRP dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to evaporate completely before application of coating materials.

H. EXISTING FACILITIES:

Existing equipment and metalwork shall be coated in accordance with the appropriate coating system specified for new work in paragraph 3.05 COATSPEC.

Modified work shall require the full coating system. Other work shall require cleaning and surface preparation as recommended by the CSM followed by two finish coats of the appropriate system.

Contractor shall demonstrate that the existing coating is compatible with field coating by performing the adhesion test specified in paragraph 09900 – 3.01 B.3. Where unacceptable test results are obtained, the Contractor shall follow manufacturer's written instructions as to the necessity of a tie coat to provide a satisfactory bond between the existing coating and the specified field coating. The difference in cost between the specified coatings and that which is compatible with existing coatings, or work required to remove existing coatings, will be paid for as extra work unless identified in the Scope of Work for the project already."

Abrasive blasting shall be used to clean wall surfaces of existing process channels and tanks to be coated. Surfaces to be coated, or recoated, shall be repaired, cleaned, and finished to the standards as specified herein.

3.03 APPLICATION

A. WORKMANSHIP:

1. Coated surfaces shall be free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.
2. The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. A paper blotter test shall be performed by the Contractor when requested by the Construction Manager to determine if the air is sufficiently free of oil and moisture so as not to produce deteriorating effects on the coating system. The amount of oil and moisture in spray air shall be less than the amount recommended by the CSM. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.
3. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other

adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.

4. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
5. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. COATING PROPERTIES, MIXING AND THINNING:

Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. ATMOSPHERIC CONDITIONS:

Coatings shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Coatings systems shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10 degrees F of the dew point, forced dehumidification equipment may be used to maintain a temperature of minimum 40 degrees F and 10 degrees F above the dew point for the surfaces to be coated, the coated surface, and the atmosphere in contact with the surface. These conditions shall be maintained for a period of at least 8 hours or as recommended by the CSM. Where conditions causing condensation are severe, dehumidification equipment, fans, and/or heaters shall be used inside enclosed areas to maintain the required atmospheric and surface temperature requirements for proper coating application and cure.

D. CONCRETE SUBSTRATE TEMPERATURES AND DETAIL TREATMENT:

1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, and/or blistering in the coating system. The application of the filler/surface and the coating system will only be allowed during periods of falling temperature. This will require that application of the filler/surface and coating system shall only occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.

Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the CSM. Should pinholes develop in the filler/surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the CSM's recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler/surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.

2. Perform application detail work per CSM's current written recommendations and/or drawings.

E. PROTECTION OF COATED SURFACES:

Items that have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

F. METHOD OF COATING APPLICATION:

1. Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.
2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with two coats of the specified coating system to match the color scheduled. Electrical and instrumentation equipment specified in Divisions 16 and 17 shall be coated as specified in paragraph 09900-3.03 I.

3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast-cleaned. Coats for blast-cleaned ferrous surfaces and subsequent coats for nonblast-cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.

G. FILM THICKNESS AND CONTINUITY:

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, following application of each coat.
2. The surface area covered per gallon of coating for various types of surfaces shall not exceed those recommended by the CSM. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications. Unless otherwise specified, the average total thickness (dry) of a completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.
3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Construction Manager shall determine the minimum conductivity for smooth areas of like coating where the dry-mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.
4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified dry film thickness.
5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and bugholes in the concrete substrate are completely filled prior to coating application.

H. SPECIAL REQUIREMENTS:

Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces that are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified for system E-2 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the CSM's recommendations or detail drawings.

I. ELECTRICAL AND INSTRUMENTATION EQUIPMENT AND MATERIALS:

Electrical and instrumentation equipment and materials shall be coated by the equipment manufacturer as specified below.

1. FINISH: Electrical equipment shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment. Equipment shall be primed, coated with enamel, and baked. Minimum dry film thickness shall be 3 mils.

Unless otherwise specified, instrumentation panels shall be coated with system E-1 for indoor mounting and system EU-1 for outdoor mounting.

Before final acceptance, the Contractor shall touch up scratches on equipment with identical color coating. Finish shall be smooth, free of runs, and match existing finish. Prior to touching up scratches, Contractor shall fill them with an appropriate filler material approved by the CSM.

2. COLOR: Exterior color of electrical equipment shall be FS 26463 (ANSI/NSF 61) light gray. Interior shall be painted FS 27880 white. Nonmetallic electrical enclosures and equipment shall be the equipment manufacturer's standard grey color.

Exterior color of instrumentation panels and cabinets mounted indoors shall be FS 26463 light gray; unless otherwise specified, exterior color for cabinets mounted outdoors shall be FS 27722, white. Cabinet interiors shall be FS 27880, white.

J. SOLUBLE SALT CONTAMINATION OF METALLIC SUBSTRATES:

Contractor shall test in accordance with SSPC-TU-4 metallic substrates to be coated that have been exposed to seawater or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as wastewater exposure). If testing indicates detrimental levels of soluble salts, those in excess of 25 ppm, the Contractor shall clean and prepare these surfaces to remove the soluble salts.

3.04 CLEANUP

Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in paragraph 09900-3.06, Coating System Schedule. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.

Coating Specification Sheets included in Table 09900A are included this paragraph 09900-3.05.

Table 09900A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-1	Epoxy	Metal	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
E-1-G	Epoxy	Galvanized Steel	Interior; exterior, covered non-corrosive exposure. Do not use in immersion service.
E-5 (NSF 61 certified)	Epoxy	Metal	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
L-1	Latex	Concrete, masonry, plaster, gypsum board	Interior and Exterior including existing exterior coated concrete.
EU-1	Zinc-epoxy-polyurethane system	Ferrous Metal	Exterior, exposed to direct sunlight, moderately corrosive non-immersed.
S-2	Silane/Siloxane or Blended Sealer	Concrete Floors	Wet, non-immersed, non-corrosive. Interior or exterior for waterproofing.
S-3	RTV Silicone Rubber Based Sealer	Concrete or Masonry Walls	Exterior or Interior – Weathering Exposure, Non-Corrosive.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	E-1
Coating Material:	Epoxy
Surface:	Metal
Service Condition:	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
Surface Preparation:	
General:	<p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive and vacuum cleaning blasting prior to receiving finish coats.</p>
Ferrous Metal:	<p>Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) to achieve a uniform, surface profile of 2.0 to 2.5 mils.</p> <p>Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) (to achieve the 2.0- to 2.5-mil surface profile) and spot primed with the specified primer. For ductile iron surfaces, refer to the requirements in paragraph 09900-3.02 D.</p>
Nonferrous and Galvanized Metal:	<p>Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve uniform, minimum surface profile 1.0 to 1.5 mils.</p>

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification: E-1 (continued)

Application: Field

General: Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.

Ferrous Metal: Prime coats shall be an epoxy primer compatible with the specified finish coats and applied in accordance with the written instructions of the CSM.

Nonferrous and Galvanized Metal: Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).

System Thickness: 10 mils dry film.

Coatings:

Primer: One coat at CSM's recommended dry film thickness.

Finish: One or more coats at CSM's recommended dry film thickness per coat to achieve the specified system thickness.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	E-1-G
Coating Material:	Epoxy
Surface:	Galvanized Steel
Service Condition:	Interior; exterior, covered, non-corrosive exposure. Do not use in immersion service.
Surface Preparation:	
General:	Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0- to 1.5-milprofile and spot primed with the primer specified.
Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) impart a 1- to 2-milprofile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0- to 1.5-mil profile uniformly to the galvanized steel surfaces.
Application:	Field
General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
Galvanized Metal:	Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
System Thickness:	5 to 8 mils dry film.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification: E-1-G (continued)

Coatings:

Primer: One coat at CSM's recommended dry film thickness.

Finish: One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

If the coated galvanized steel is to be exposed to ultraviolet light, apply one polyurethane top coat from coating system EU-1 over the second coat of the two epoxy coats specified.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	E-5 (NSF 61 certified)
Coating Material:	Epoxy
Surface:	Metal
Service Condition:	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use. Interior potable and non-potable carbon steel piping.
Surface Preparation:	
Ferrous Metal:	<p>Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.</p> <p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Cleaning shall produce a surface profile of 2.0 to 2.5 mils. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.</p>
Nonferrous and Galvanized Metal:	<p>Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a 1.0- to 1.5-mil profile that is uniform.</p>
Application:	Field
General:	<p>Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.</p>
Ferrous Metal:	<p>Prime coat shall be an epoxy primer compatible with the specified finish coats.</p>

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification: E-5 (NSF 61 certified) (continued)

Nonferrous and
Galvanized Metal:

Nonferrous and galvanized metal above the high water elevation shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).

System Thickness: 10 mils dry film.

Coatings:

Primer:

One coat at the CSM's recommended dry film thickness.

Finish:

One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	EU-1
Coating Material:	Zinc-Epoxy-Polyurethane System
Surface:	Ferrous Metal
Service Condition:	Exterior, exposed to direct sunlight, moderately corrosive, non-immersed.
Surface Preparation:	
General:	<p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-3 (Power Tool Cleaning) and recoated with the primer specified.</p>
Ferrous Metal:	<p>Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) 2.5 – 3.0. Ductile iron surfaces to be coated shall be abrasive blast cleaned in accordance with paragraph 09900-3.02 D.</p> <p>Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC-SP-11 (Power Tool Cleaning to Bare Metal). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.</p>
Galvanized Metal:	<p>Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0- to 1.5-mil profile and spot primed with the primer specified.</p> <p>Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to impart a 1.0- to 2.0-mil profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0- to 1.5-mil profile uniformly to the galvanized steel surfaces.</p>

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification: EU-1 (continued)

For EU-1 over galvanized steel, delete the zinc rich primer.

Application: Field

General: Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.

Ferrous Metal: Prime coats shall be a zinc rich epoxy or polyurethane primer compatible for use with urethane finish coats and applied in accordance with written instructions of the CSM or in the case of CARB or SCAQMD applications, prime with specified primer that is not zinc rich. In these cases, only a two-coat system is applied.

System Thickness: 3 to 4 mils of zinc rich primer, one intermediate or primer epoxy coat at 5 to 6 mils and one finish coat of polyurethane at 2 to 3 mils DFT.

Coatings:

Primer: One coat at CSM's recommended dry film thickness.

Intermediate: One coat at CSM's recommended dry film thickness.

Finish: One coat at CSM's recommended dry film thickness per coat to meet the specified system thickness.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	L-1
Coating Material:	Latex
Surfaces:	Concrete, masonry, plaster, gypsum board.
Service Condition:	Interior and exterior including existing exterior coated concrete.
Surface Preparation:	
Concrete:	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300.
Existing Coated Concrete:	Remove all loose coating down to a sound substrate or intact, well-adhered existing coating by scraping or other means. Then, abrade all surfaces to achieve a 0.5- to 1.5-mil uniform profile and vacuum clean to remove all loose dirt, paint chips, and dirt.
Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be filled with block filler compatible with the specified primer.
Plaster:	Plaster surfaces shall be dry, clean, and free from grit, loose plaster, and surface irregularities. Cracks and holes shall be repaired with acceptable patching materials, keyed to existing surfaces, and sandpapered smooth. Surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. After cleaning, surfaces shall be sealed with a compatible sealer.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification: L-1 (continued)

Gypsum Wallboard: Tape joints and spackled nail heads shall be sanded smooth and dusted. Seal with PVA sealer for interior uses only.

Application: Field

Sealer or filler shall dry a minimum of 48 hours prior to primer application.

Drying time between coats shall be as recommended by CSM.

System Thickness: 4 mils dry film.

Coatings:

Primer: One coat at CSM's recommended dry film thickness.

Finish: Two or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	S-2
Coating Material:	Penetrating Water Repellent (Clear and Non-Film Building)
Surface:	Concrete Floors
Service Condition:	Exterior and Interior.
Surface Preparation:	Clean surfaces of all traces of dirt, dust, efflorescence, mold, salt, grease, oil, asphalt, laitance, curing compounds, paint, coatings, and other foreign materials by brush-off blast, water blasting, and/or chemical cleaners or other preparation as approved by the CSM.
Concrete	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300
Application:	
General:	Drying time before placing into service shall be as recommended by the CSM for site conditions.
System Coverage:	Follow CSM's recommendations.
Color Selection:	Clear.

3.05 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

Coating System Identification:	S-3
Coating Material:	Penetrating Water Repellent (Clear & Non-Film Building)
Surface:	Concrete and Masonry Walls
Service Condition:	Exterior and Interior – For Anti-Graffiti Applications
Surface Preparation:	Clean surfaces of all traces of dirt, dust, efflorescence, mold, salt, grease, oil, asphalt, laitance, curing compounds, paint, coatings, and other foreign materials by brush-off blast, water blasting, and/or chemical cleaners or other preparation as approved by the CSM.
Concrete	Concrete surfaces shall be allowed to age for at least 28 days and allowed to dry to the moisture content recommended by the CSM. Moisture content may be tested by the Construction Manager with a Delmhorst Instrument Company moisture detector, or equal. Loose concrete and laitance shall be removed from surfaces, and voids and cracks shall be repaired as specified in Section 03300
Masonry:	Masonry surfaces shall be allowed to age for at least 28 days. Holes or other joint defects shall be filled with mortar and repointed. Loose or splattered mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used.
Application:	
General:	Drying time before placing into service shall be as recommended by the CSM for site conditions.
System Coverage:	Follow CSM's recommendations.
Color Selection:	Clear.

3.06 COATING SYSTEMS SCHEDULE (FINISH SCHEDULE)

Specific coating systems, colors, and finishes for rooms, galleries, piping, equipment, and other items that are coated or have other architectural finishes are specified in the following coating system schedule. Unless otherwise specified in the coating system schedule, the word "interior" shall mean the inside of a building or structure, and the word "exterior" shall mean outside exposure to weather elements.

Location Description	Surface	Coating System Identification	Standard Color
A. General: All surfaces not specified by area or structure	1. Structural Steel, Metal Decking, and Galvanized Acoustical Decking	Uncoated or E-1	
	2. Galvanized Metal decking	E-1-G	
	3. Equipment and Metal Appurtenances		
	a. Equipment, non immersed, unless otherwise specified		
	1) Indoors	E-1	FS 25051 Blue
	2) Outdoors	EU-1	FS 20040 Brown
	b. Existing equipment		
	1) Not damaged nor modified by work in this contract	Uncoated	--
	2) Damaged, exposed, or modified by work in this contract		
	a) Indoors	E-1 (see paragraph 09900-3.02)	Match existing color
	b) Outdoors	EU-1 without primer (see paragraph 09900-3.02)	Match existing color
	c. Diffusers and grilles on coated surfaces, unless otherwise specified		
	1) Indoors	E-1	Match background color
	2) Outdoors	EU-1	Match background color
	d. Diffusers and grilles on uncoated surfaces, unless otherwise specified		
	1) Indoors	E-1	FS 25051 Blue
	2) Outdoors	EU-1	FS 20040 Brown
	e. Electrical switchgear panels, unit substations, motor control centers, power transformers, distribution centers, and relay panels; indoors and outdoors	See paragraph 09900-3.03 I	ANSI 61 Grey (outside) FS 27880 White (inside)

Location Description	Surface	Coating System Identification	Standard Color
	f. Instrumentation panels, graphic indicating panels, indicating and transmitting field panels, unless otherwise specified 1) Indoors 2) Outdoors g. Existing electrical and instrumentation panels 1) Not damaged by work in this contract 2) Damaged or exposed to outside surfaces by work in this contract a) Indoors b) Outdoors	See paragraph 09900-3.03 I See paragraph 09900-3.03 I Uncoated E-1 (see paragraph 09900-3.02 F) EU-1 without primer (see paragraph 09900-3.02 F)	FS 26306 Grey (outside) FS 27880 White (inside) FS 27722 White (outside) FS 27880 White (inside) -- FS 26306 Grey (Electrical) FS 27722 White (Instrumentation)
	3. Conduit, Piping and Ductwork a. Ferrous, non-ferrous and galvanized piping, and appurtenant hangers and supports, non-immersed, unless otherwise specified. 1) Indoors – noncorrosive 2) Outdoors – noncorrosive b. c. Conduit, outlet and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports on coated surfaces, unless otherwise specified. 1) Indoors 2) Outdoors	E-1 EU-1 E-1 EU-1	FS 25051 Blue FS 20040 Brown Match background color Match background color

Location Description	Surface	Coating System Identification	Standard Color
	d. Conduit, outlets and junction boxes, lighting transformers, lighting, communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps and supports on uncoated surfaces, unless otherwise specified 1) Indoors 2) Outdoors e. Existing conduit, outlet and junction boxes, lighting transformers, lighting communication and small power panels, control stations, piping, lagged ductwork, appurtenant hangers, clamps, and supports 1) Not damaged nor modified by work in this contract 2) Damaged, exposed, or modified by work in this contract a) Indoors b) Outdoors	E-1 EU-1 Uncoated E-1 (see paragraph 09900-3.02 F) EU-1 without primer (see paragraph 09900-3.02 F)	FS 25051 Blue FS 20040 Brown -- Match existing color Match existing color
	4. Concrete, Grout, Masonry and Plaster a. b. Outside concrete walls below grade common with dry area or room c. Walls and ceilings 1) Precast concrete or colored masonry 2) Outdoors, unless otherwise specified 3) Indoors, unless otherwise specified d. Concrete equipment bases unless otherwise specified e. Floors unless otherwise specified f. Existing coated surfaces.	In accordance with Section 07100) S-3 S-3 S-3 E-4 S-2 L-1	-- -- -- -- Match equipment color Match existing color.
	5. Door and Door Frames a. Doors unless otherwise specified 1) Ferrous metal a) Indoors b) Outdoors	E-1 EU-1	FS 20040 Brown FS 25051 Blue

Location Description	Surface	Coating System Identification	Standard Color
	2) Aluminum 3) Other 4) Existing <ul style="list-style-type: none"> a) Not damaged by work in this contract b) Damaged, exposed, or modified by work in this contract <ul style="list-style-type: none"> (1) Indoors (2) Outdoors 	Uncoated Plastic laminate Uncoated E-1 (see paragraph 09900-3.02 F) EU-1 (see paragraph 09900-3.02 F) E-1 EU-1 E-1 EU-1 Uncoated Uncoated E-1 (see paragraph 09900-3.02 F) EU-1 without primer (see paragraph 09900-3.02 F)	-- Formica 947 Brown -- Match existing color Match existing color Match wall color Match wall color FS 20040 Brown FS 25051 Blue -- -- Match existing color Match existing color
	6. Handrails, Gratings, Floor Plates, Manhole Covers, and Hatches <ul style="list-style-type: none"> a. Unless otherwise specified b. Existing <ul style="list-style-type: none"> 1) Not damaged by work in this contract 2) Damaged, exposed, or modified by work in this contract <ul style="list-style-type: none"> a) Indoors 	Uncoated Uncoated E-1 (see paragraph 09900-3.02 F)	-- Match existing color

Location Description	Surface	Coating System Identification	Standard Color
	b) Outdoors	EU-1 without primer (see paragraph 09900-3.02 F)	Match existing color
	7. Metal Stairs, Ladders, Platforms, and Supports Except Tread and Grating		
	a. Indoors	E-1	FS 25051 Blue
	b. Outdoors	EU-1	FS 20040 Brown
	c. Existing		
	1) Not damaged nor modified by work in this contract	Uncoated	--
	2) Damaged, exposed, or modified by work in this contract		
	a) Indoors	E-1 (see paragraph 09900-3.02 F)	Match existing color
	b) Outdoors	EU-1 without primer (see paragraph 09900-3.02 F)	Match existing color
	8. Aluminum Flashing, Light Standards, Supports, and Louvers		
	Indoors and outdoors, unless otherwise specified	Uncoated	--
	9. Precast Concrete Metalwork		
	Fasteners, anchors, supports, etc.	EU-1	Match wall
	10. Other		
	a. Fire hydrants	EU-1	FS 21302 Red
	b. Flap gates	EA-1	Beige
	c. Aluminum slide gates	Uncoated	--
	d. Sluice gates		
	1) Gate	--	--
	2) Stem, except potable	G	--
	3) Operator		
	a) Indoors	E-2	FS 25051 Blue
	b) Outdoors	EU-1	FS 20040 Brown
	e. Tanks		
	1) Filtration and GAC Vessals		
	a) Inside of tank	E-5	See Note 1
	b) Outside of tank	EU-1	FS 25051 Blue
	2) Potable steel water storage tanks		

Location Description	Surface	Coating System Identification	Standard Color
	a) Inside of tank	E-5	See Note 1
	b) Outside of tank	EU-1	FS 25051 Blue
	3) Fiberglass tank	Uncoated	--
	f.	Uncoated	--
	g. Buried, sleeve-type and flanged pipe, couplings, valves, mechanical and electrical penetrations	M-1 or M-2	Manufacturer's color
K. Administration Building	1. Outdoors		
	a. Equipment on roof	EU-1	FS 25051 Blue
	b. Walls	Uncoated	--
	2. Room 5401 Lobby		
	a. Floor	Epoxy terrazzo	National Mosaic Assoc. Std S109
	b. Base	Epoxy terrazzo	NMAS S109
	c. Plaster walls	L-1	FS 23617 Beige
	d. Steel deck ceiling	L-3	FS 23617 Beige
	e. Steel roof trusses	L-3	FS 23617 Beige
	f. Doors	L-3	FS 20040 Brown
	g. Door frames	L-3	FS 23617 Beige
	3. Room 5402 Clerical Area		
	a. Floor	Epoxy terrazzo	NMAS S109
	b. Base	Epoxy terrazzo	NMAS S109
	c. Plaster walls	L-1	FS 23617 Beige
	d. Steel deck ceiling	L-3	FS 23617 Beige
	e. Steel roof trusses	L-3	FS 23617 Beige
	f. Doors	L-3	FS 20040 Brown
	g. Door frames	L-3	FS 23617 Beige
	h. Filing cabinets	Shop coated	Steelcase Tan

Notes:

- Owner will select color from coating manufacturer's list of EPA approved colors for potable water.

3.07 INSPECTION AND TESTING BY OWNER

- Inspection by the Owner or others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Inspection by the Owner is in addition to any inspection required to be performed by the Contractor.

B. The Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section 09900. These inspections may include the following:

1. Inspect materials upon receipt to ensure that are supplied by the CSM.
2. Inspect to verify that specified storage conditions for the coating system materials, solvents and abrasives are provided.
3. Inspect and record findings for the degree of cleanliness of substrates.
4. Inspect and record the pH of concrete and metal substrates.
5. Inspect and record substrate profile (anchor pattern).
6. Measure and record ambient air and substrate temperature.
7. Measure and record relative humidity.
8. Check for the presence of substrate moisture in the concrete.
9. Inspect to verify that correct mixing of coating system materials is performed in accordance with CSM's instructions.
10. Inspect, confirm, and record that the "pot life" of coating system materials is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
11. Perform adhesion testing.
12. Measure and record the thickness of the coating system.
13. Inspect to verify proper curing of the coating system in accordance with the CSM's instructions.
14. Perform holiday or continuity testing for coatings that will be immersed or coatings that will be exposed to aggressively corrosive conditions.

3.08 FINAL INSPECTION

A. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.

- B. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
- C. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

09900-A Coating System Inspection Checklist

Project Name:			
Owner		Coating System Manufacturer(CSM)	
General Contractor (GC)		Coating System Applicator(CSA)	
Area or Structure		Location within Structure	
Coating System (e.g. E-1)		Coating Type (e.g. Epoxy, etc.)	

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			

Step	Description		Name	Signature	Date
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs	GC QC			

Coating Systems
09900-53

Contract 2
Bid Issue

Step	Description		Name	Signature	Date
	to Coating System Following Testing.	CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

**END OF SECTION **

SECTION 09901

COATING FOR STEEL WATER STORAGE RESERVOIR

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies coating systems, surface preparations, and application requirements for coating the new Backwash Storage Tank and the existing Lower Greasewood Storage reservoir.

B. DEFINITIONS:

Specific coating terminology used in this section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions:

1. Dry Film Thickness (DFT): The thickness of one fully cured continuous application of coating.
2. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
3. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of erection or fabrication, where the field or finishing coat is applied.
4. Volatile Organic Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter or pounds per gallon.
8. Touch-Up Painting: The application of a paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D16	Standard Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products
ASTM D2200 (SSPC-Visl-67T)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3359	Methods for Measuring Adhesion by Tape Test--Method A
ASTM D3960	Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4417	Field Measurement of Surface Profile of Blast Cleaned Steel
AWWA D102	Painting Steel Water-Storage Tanks
NSF 61	Drinking Water System Components Health Effects
SSPC	Steel Structures Painting Council Specifications, Vol. 2

B. STANDARDIZATION:

Materials and supplies provided shall be the standard products of manufacturers. Materials in each coating system shall be the products of a single manufacturer.

The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for substitutions will be considered, provided the following minimum conditions are met:

1. The proposed coating system shall use an equal or greater number of separate coats to achieve the required dry film thickness.
2. The proposed coating system shall use coatings of the same generic type as that specified.
3. Requests for substitution shall have directions for application and descriptive literature which includes generic type, percent solids by volume, volatile

organic content (grams per liter), and information confirming that the substitution is equal to the specified coating system.

4. The Contractor shall provide a list of references where paint of the same generic type has been applied. The reference list shall give the project name, city, state, owner, phone number of owner, coating system reference and number, and year paint was applied.

C. INSPECTION:

The Construction Manager will provide, or arrange to have provided, all coating inspections. Test equipment provided by the Contractor as specified in paragraph 09901-3.04 B will be operated by the Construction Manager.

The Construction Manager will perform inspection on all on-site and off-site phases of the surface preparation, abrasive blast cleaning, and application of the coating systems. Specified and optional tank surfaces to have shop-applied primer will be monitored by off-site inspection. The Contractor shall notify the Construction Manager in sufficient time to schedule inspection during shop priming and shall make the shop priming premises open and available to the Construction Manager for inspection. The Contractor shall pay all costs incurred for off-site inspection.

If shop work is not scheduled on a continuous basis to facilitate scheduling by the Construction Manager, all costs incurred for multiple trips to the shop shall be borne by the Contractor. Actual costs incurred for off-site inspection will be incorporated into a change order and deducted from progress payments due the Contractor.

1.03 DELIVERY AND STORAGE

Materials shall be delivered to the job site in their original, unopened containers. Each container shall bear the manufacturer's name, coating type, batch number, date of manufacture, storage life, and special directions.

Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

1.04 SPARE SUPPLIES

The Contractor shall provide one unbroken gallon container of each color and type of paint and each type of solvent and thinner required by the specification. These spare paint supplies shall be stored as required in paragraph 09901-1.03 until delivery is requested by the Construction Manager.

PART 2--PRODUCTS

2.01 COATING SYSTEMS

A. GENERAL:

All materials of a specified coating system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the coating manufacturer for the particular coating system.

B. OUTSIDE COATING:

1. PRIMER: Exterior primer shall be an epoxy compatible for use with Coating System **EU-1**.

2. FINISH COATING: Exterior finish coating shall be Coating System **EU-1**. The color of the finish coat shall be **Tan**.

C. INSIDE COATING:

1. CERTIFICATION: All inside coatings shall be certified in accordance with NSF 61.

2. PRIMER: Inside primer shall be an epoxy compatible for use with Coating System **E-5**.

3. FINISH COATING: Inside finish coat shall be an epoxy white in color, Coating System **E-5**.

2.02 PRODUCT DATA

Before materials are delivered to the job site, the Contractor shall provide the following information in accordance with Section 01300:

1. Manufacturer's standard product data and material safety data sheet for each primer and finish coating.
2. List of materials proposed to be used under this section.
3. Manufacturer's literature and written instructions for surface preparation, mixing, and application of each primer and finish coating.

PART 3--EXECUTION

3.01 COATINGS

A. GENERAL:

Coating products shall not be used until the Construction Manager has inspected the materials and the coating manufacturer's technical representative has instructed the Contractor and Construction Manager in the surface preparation, mixing and application of each coating.

At least 14 days prior to the shop or field application of the coating systems on the steel tank, the Contractor shall schedule and arrange a conference with the coating applicator, Construction Manager, tank manufacturer, and the coating manufacturer to coordinate the following:

1. Tank manufacturer's work schedule for inspection coordination.
2. Surface preparation prior to abrasive blast cleaning.
3. Specification compliance of blast abrasives and surface profile.
4. Schedule of blast cleaning and coating application.
5. List of equipment for cleaning and coating applications.
6. Weather limitations for acceptable work.
7. Inspection facilities and test equipment.

B. COATING SYSTEMS:

1. **SHOP APPLIED PRIME COAT:** Except as otherwise specified, prime coats may be shop- or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended by the manufacturer. Product data sheets identifying the shop primer used shall be provided to the on-site finish coat applicator. Adhesion tests shall be performed on the shop primer as specified in paragraph 09901-3.02 A. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this section shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.

2. **FIELD COATS:** Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until all previous coats have been inspected.

3.02 PREPARATION

A. GENERAL:

Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed except as specified. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants which might interfere with the adhesion of the coatings. The Contractor shall examine all surfaces to be coated and shall correct all surface defects before application of any coating.

Clean cloths and clean fluids shall be used in solvent cleaning. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not come in contact with wet, newly painted surfaces.

The Contractor shall perform an adhesion test in accordance with ASTM D3359 to demonstrate that (1) the shop primer adheres to the substrate, and (2) the specified field coatings adhere to the shop primer. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on all other surfaces shall be considered acceptable. Where unacceptable test results are obtained, the Contractor shall be responsible for removing and reapplying the specified coatings at no expense to the Owner.

B. METALLIC SURFACES:

Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC). Unless otherwise specified, interior ferrous metal surfaces shall be prepared in accordance with SSPC SP 5 (White Metal Blast Cleaning) and exterior ferrous metal surfaces prepared in accordance with SSPC SP 6 (Commercial Blast Cleaning). The profile depth of the surface to be coated shall be 20 to 25 percent of the coating dry film thickness as measured by Method C of ASTM D4417. Blast particle size shall be selected by the contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the manufacturer.

Preparation of metallic surfaces shall be based upon comparison with SSPC-Visl-67T (ASTM D2200), and as described herein. To facilitate inspection, the Contractor shall, on the first day of sandblasting operations, sandblast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear nonyellowing finish. One of these panels shall be prepared for each type of sandblasting and shall be used as the comparison standard throughout the project.

C. ABRASIVE BLAST CLEANING:

The specified limitations on the application of coatings also applies to blast cleaning. Blast cleaning shall only be done when conditions permit the immediate subsequent application of

coating, and only for the area that can be coated with primer or touch-up coating during the same day. Changed humidity or a delay, such as equipment failure, may cause a cleaned surface to color or slightly oxidize from condensation before the coating can be applied. In the event that a surface colors or becomes moist, it shall be blast cleaned again before applying the coating.

Abrasive blast cleaning shall comply with the following:

1. Dry abrasive blast shall be used for cleaning metal surfaces. Sand used for cleaning shall be washed, uniformly graded, dry, and free of contaminants. Sand containing salt or unwashed beach sand shall not be used. When shop blast cleaning with stationary automatic equipment that recycles the blast particles, new abrasives shall be used in the equipment at the beginning of the blast cleaning operations. Use of abrasives that have become contaminated in automatic equipment is prohibited. When shop or field blast cleaning with hand-held nozzles, blast particles shall not be recycled or reused.
2. After blast cleaning and prior to application of coating, surfaces to be coated shall be dry cleaned by dusting, sweeping, and vacuuming to remove residue from blasting. The blasting and the specified primer or touch-up coating shall be applied within the period of an 8-hour working day. Coating shall not be applied over damp or moist surfaces. Prior to application of primer or touch-up coating, any blast cleaned surface not coated within the 8-hour period shall be recleaned.
3. The area of the work shall be kept in a clean condition and blasting particles shall not be permitted to accumulate and constitute a nuisance or hazard. The reservoir inlet, outlet, drain, and overflow piping shall be covered, and blasting particles prevented from being blown into the piping.
4. During blast cleaning, caution shall be exercised to prevent damage to adjacent preapplied coatings. Blast cleaning and coating shall be scheduled such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., shall not damage or come in contact with wet or newly coated surfaces. Damaged coatings shall be restored to their specified condition.

3.03 APPLICATION

A. WORKMANSHIP:

Coated surfaces shall be free from runs, drops, ridges, waves, laps, and brush marks. Coats shall be applied so as to produce an even film of uniform thickness completely coating corners and crevices. Painting shall be done in accordance with the requirements of SSPC Paint Application Specification No. 1.

The Contractor's equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and spray nozzles of the proper sizes.

Each coat of paint shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.

B. PAINT PROPERTIES, MIXING AND THINNING:

Paint, when applied, shall provide a satisfactory film and smooth even surface, and glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Paints shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the manufacturer's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the paint may be thinned immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, paint shall not be thinned more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.

C. ATMOSPHERIC CONDITIONS:

Paints shall be applied only to surfaces that are dry, and only under conditions of evaporation rather than condensation. Paint shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. Coatings shall not be applied when the temperature of the surface to be coated is more than 5 degrees F below the air temperature, or when the surface temperature is over 120 degrees F. During painting, and for a period of at least 8 hours after the paint has been applied, the temperature of the surfaces to be painted, the painted surfaces, and the atmosphere in contact shall be maintained at or above 50 degrees F and at least 10 degrees F above the dew point. Paint, when applied, shall be approximately the same temperature as that of the surface on which it is applied. Fans or heaters shall be used inside enclosed areas where conditions causing condensation exist.

If conditions are adverse as noted above, the application of coating shall be delayed or postponed until conditions are favorable. Dew or moisture condensation should be anticipated and if such conditions are prevalent, coating work shall be delayed until midmorning to be certain that the surfaces are dry. The day's coating shall be completed in time to permit the film sufficient drying time prior to damage by climatic conditions. Climatic conditions will be monitored by the Construction Manager to aid in inspection. If a change in climatic conditions damages a coating application, repair of the damaged coatings to their specified condition shall be made at no additional cost to the Owner.

D. PROTECTION OF COATED SURFACES:

Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the paint is completely dry and hard. After delivery to the site and permanent erection or installation, shop-coated metalwork shall be repainted or retouched with specified paint when it is necessary to maintain the integrity of the film.

E. PROCEDURES:

1. GENERAL: Procedures for application of coatings shall comply with the following:

- a. Coating applicator shall conform to the requirements of SSPC PA-1 and follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- b. Coating applicator shall stir, strain, and keep coating materials at a uniform consistency during application. A different shade or tint shall be used on succeeding coating applications to indicate coverage. Finished surfaces shall be free from defects or blemishes.
- c. If allowed, thinning shall not exceed the maximum allowable amount of thinner per gallon of coating material. Coating materials shall be stirred at all times when adding thinner; flooding the coating material surface with thinner prior to mixing is prohibited. Coating materials shall not be thinned more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- d. Blast cleaned surfaces shall be cleaned as specified in paragraph 09901-3.02 C. Ventilator fans shall be used to clean airborne dust to provide good visibility of working area prior to coating applications. Dust shall be removed from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
- e. Coating applicator shall observe minimum and maximum recoat times between primer and succeeding coating applications to achieve maximum crosslinking of coatings. If the recommended minimum or maximum recoat time is violated, the surface shall be prepared as directed by the coating manufacturer. A second application of the primer or coating shall be applied if the maximum recoat time has been exceeded.

- f. Coating systems shall be applied to the specified minimum dry-film thicknesses as measured from above the peaks of the surface profile. Measurement will be in accordance with SSPC PA-2 and will be corrected for the magnetic effect of the surface profile.
- g. Primer or touch-up coating shall be applied immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Steel surfaces that have surface colored or become moist prior to coating application shall be recleaned by blast cleaning.

2. SHOP-APPLIED PRIMERS: Procedures for application of shop-applied primers shall comply with the following:

- a. Blast-cleaned steel surfaces will be tested by the Construction Manager utilizing chemical and/or ultraviolet (black light) tests to detect oil and other contaminants deposited on the surface from abrasive recycling. Tests will be conducted prior to the application of primers. Contaminated surfaces shall be recleaned using new abrasives in the equipment and the surfaces prepared as specified.
- b. After application of primer to steel surfaces, coating shall be allowed to cure for a minimum of 2 hours before handling, to minimize damage.
- c. When loading for shipment to the project site, spacers and other protective devices shall be used to separate the plates and steel members to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, wood splinters and particles shall be removed from the shop-primed surfaces after separation. Padded chains or ribbon binders shall be used to secure the loaded steel and minimize damage to the shop-primed surfaces.
- d. Shop-primed steel surfaces shall be completely covered with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- e. Shop-primed steel plates and members shall be handled with care during unloading and erection operations to minimize damage. Sliding steel across another plate or member, except for fitting plates into final position during roof construction is prohibited. Shop-primed steel shall not be placed or stored on the ground or on top of other steelwork unless ground or steelwork is covered with a

protective covering or tarpaulin. Steel above the ground shall be placed upon platforms, skids, or other supports.

3. TOUCH-UP OF SHOP-APPLIED PRIMERS: Touch-up of shop-applied primers after erection shall comply with the following:

- a. After erection, the Construction Manager will inspect all surfaces of the tank to determine surface deficiencies in the shop-applied primers. Contaminants that have accumulated on the surfaces of the shop-applied primers during shipment, storage, and erection shall be removed and corrective action performed as noted.
- b. Coating applicator shall remove oil and grease surface contaminants in accordance with SSPC SP-1. The coating applicator shall use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- c. Coating applicator shall remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system by using a high-pressure water blaster or scrubbing all surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Scrubbed surfaces shall be rinsed with clean water.
- d. Loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods shall be removed in accordance with SSPC SP-7. Care shall be taken that remaining primers are not damaged by the blast-cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast-cleaned edges feathered.
- e. Coating applicator shall remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Care shall be taken that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast-cleaned edges feathered.
- f. Repair procedures used on damaged primer shall protect adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- g. If damage to primer in a specific area exceeds 50 percent of the total surface of that specific area, area shall be cleaned by blasting in

accordance with SSPC SP-10 and a second application of the specified primer applied to the total surface of the specific area. Specific areas are defined as follows: underside of roof and support structure, shell interior, roof exterior, and shell exterior.

- h. When primed surfaces have exceeded the manufacturer's recommended recoat time or recoat time when exposed to sunlight, surface shall be blast cleaned in accordance with SSPC SP-10 and a second coat of the specified primer applied.

4. **FIELD-APPLIED INTERIOR PRIMER AND COATING:** Procedures for application of field-applied interior primer and coating shall comply with the following:

- a. Coating applicator shall remove dust from the sandblasted surface and allow ventilator fans to clear airborne dust to provide good visibility of working area. Adequate lights shall be provided.
- b. Dust shall be removed from primer before applying second coat. Total mil thickness shall be verified. Floor shall be coated last.
- c. The coating will be checked with a holiday detector as the work progresses. A final check of the entire coating will be performed when it is complete.

5. **EXTERIOR COATING:** Procedures for application of exterior coatings shall comply with the following:

- a. Coating applicator shall remove sandblasted dust. Primer shall be applied with rollers that leave a smooth surface or by spraying. Rollers shall be used when wind causes unacceptable drift. The finish coats shall be sprayed except spraying is not allowed when wind or other weather conditions are unfavorable.
- b. The mil thickness and the dryness of each coat shall be verified before overcoating.

6. **LIMITATIONS ON COATING APPLICATIONS:** Coatings shall not be applied under the following conditions:

- a. When the air and surface temperature are outside the range recommended by the coating manufacturer.
- b. When the ambient temperature is less than 5 degrees F above the dew point.

- c. When the surfaces are wet or moist.
- d. During rain, snow, fog, or mist.
- e. When it is expected that the air temperature will drop below that recommended by the paint manufacturer or will drop to less than 5 degrees F above the dew point within 8 hours after applying the coating.

Coating applicator shall maintain a thermometer in the shade on the project site and keep informed of the dew point and the humidity from the weather bureau.

F. CLEANING AND COATING OF ROOF PLATES AND FRAMING:

Before erection of the roof framing, all sides of the roof framing members and the roof plates that will be in contact with them shall be cleaned and painted with the specified prime coat. After erection, visible scratches and other damaged painted surfaces shall be sandblasted, primer applied to the recleaned areas, then finish coat applied along with other interior surfaces.

G. UNDERSIDE OF FLAT BOTTOM TANKS:

The underside of flat bottom tanks shall not be coated.

H. CLEANING AND COATING OF OVERFLOW PIPING WITHIN TANK:

The interior and exterior of overflow piping within the tank shall be cleaned and coated as specified for the tank interior.

I. PAINT THICKNESS AND MINIMUM NUMBER OF COATS:

1. GENERAL: The number of coats specified shall be applied unless the measured dry-film thickness is less than specified, in which case additional coats shall be applied.

2. INTERIOR:

Epoxy system	
Primer	5 mils
Finish	<u>5 mils</u>
	10 mils minimum

3. EXTERIOR:

Urethane system	
Primer	5 mils
Finish	<u>2 mils</u>

Coating for Steel Water Storage Reservoir
09901-13

7 mils minimum

3.04 INSPECTION

A. INSPECTION FACILITIES:

Contractor shall provide the Construction Manager with facilities for inspection consisting of the following:

1. Safety equipment and devices required during abrasive blast cleaning and coating operations. Helmet with continuous fresh air supply shall be provided for observation during cleaning operations.
2. Illumination and the manpower to move the lights, whenever required by the Construction Manager. Additional lights and supports shall be sufficient to illuminate all areas to be inspected. The Construction Manager will determine the level of illumination required for inspection purposes.
3. Temporary ladders and scaffolding as required to provide access to the locations requested by the Construction Manager.

B. INSPECTION AND CHECKING:

The Construction Manager will perform such tests as are required to demonstrate substantial compliance with all phases of the surface preparation, abrasive blast cleaning, and application of the coating systems. Test equipment shall include the following: SSPC surface preparation standards, surface profile comparator, test tape, micrometer, abrasive sieve test, ultraviolet lamp, mirror, certified thickness calibration plates, magnetic-type dry-film thickness gage, nondestructive holiday detector, and nonsudsing-type wetting agent. Equipment will be calibrated by the Construction Manager in the presence of the Contractor to verify its accuracy prior to use. The Contractor shall provide the test equipment.

The Construction Manager shall be notified 5 working days in advance of shop and field operations involving abrasive blast cleaning and coating applications. The Construction Manager will determine the degree and surface profile of the shop and field blast cleaned surface. Additional blast cleaning shall be performed over areas not conforming to the specified surface preparation.

The Construction Manager will inspect each coat of primer, touch-up, intermediate, and finish coating to determine thickness and integrity. Each coating application will be checked and deficiencies marked. After observing specified recoat time, additional coating materials shall be applied over area not having the specified minimum dry-film thickness and areas having any holidays or pinholes. After correction of deficiencies, the Construction Manager will reinspect those areas to determine the acceptability of additional coating. Each coating application shall be 100 percent to the satisfaction of the Construction Manager prior to succeeding coating applications.

3.05 WARRANTY

A first-anniversary warranty inspection of the interior and exterior surfaces of the tank will be conducted during the eleventh month following final acceptance of the work by the Owner to determine whether any repair work is necessary. Inspection shall comply with Section 9 of AWWA-D 102 except as specified. The Owner will establish the inspection date and notify the Contractor. The Owner will drain and wash down the tank. The Contractor shall provide lighting and scaffolding for the tank inspection. Where coatings have peeled off, bubbled, or cracked, and any location where rusting is evident shall be considered to be a failure of the coating system. Repairs at failures shall be performed by removing the deteriorated coating; preparing the surface by abrasive blast cleaning and applying the same coating systems as specified in this section. Inspection and repairs shall be performed at no cost to the Owner.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 10441

WARNING SIGNS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies informational and accident prevention signs.

1.02 OPERATING AND DESIGN REQUIREMENTS

A. GENERAL:

Accident prevention signs shall conform as to design with OSHA Section 1910.145 of Subpart J, Part 1910, Chapter XVII, Title 29 of the Code of Federal Regulations. Exit signs shall conform with Section 1910.37(g) of the OSHA Safety and Health Standard for General Industry, Article 10, Section 10.113 of the Uniform Fire Code, and where applicable with local fire regulations.

In addition to the signs identified on the schedule in Part 3 of this section, the following shall be provided:

1. Exit signs shall be provided on treatment plant exits in accordance with Section 16500.
2. "Caution Automatic Equipment May Start At Any Time" signs shall be provided in accordance with paragraph 11000-2.07.

B. DESIGN REQUIREMENTS:

1. SIZE: Sign size shall be as follows:

A - 14 inch x 20 inch
B - 10 inch x 14 inch
C - 7 inch x 10 inch
2. TYPE: The sign type shall be as follows:

Type	Message
I	CAUTION--AUTOMATIC EQUIPMENT MAY START AT ANY TIME
II	DANGER--480 VOLTS
III	DANGER--CHLORINE

IV	NOTICE--UNTREATED WATER
VI	CAUTION--WAIT 5 MINUTES AFTER FAN HAS BEEN SWITCHED ON BEFORE ENTERING BUILDING
VII	DANGER--240 VOLTS
VIII	DANGER--HIGH VOLTAGE
X	DANGER--CONFINED SPACE--HAZARDOUS ATMOSPHERE
XIII	RESTRICTED AREA--AUTHORIZED PERSONNEL ONLY
XVI	LOCK OUT SWITCH BEFORE WORKING ON EQUIPMENT
XIX	CAUTION--AUTOMATIC DOOR

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Sign manufacturer's product data and cut sheets showing sign materials, sizes, dimensions, fonts, colors, and any other applicable data.

PART 2--PRODUCTS

2.01 GENERAL

Sign lettering shall be single stroke and shall contrast in color with the background. For those messages for which there are international symbols, the international symbols shall be used. Chain mounted signs shall have lettering on both sides.

2.02 MATERIALS

Signs shall be 0.100-inch thick fiberglass with embedded fadeproof legends.

PART 3--EXECUTION

Signs shall be distributed as follows:

Location	Number	Size	Message	Mount
Well Pump House—exterior				
Chlorine Room	1	C	III	Door
Chlorine Room	1	B	VI	Door
Gate	1	C	VIII	Fence

Location	Number	Size	Message	Mount
Gate	1	C	XIII	Fence
Treatment Plant— interior				
Process Room	6	C	I	Wall
Pumps	1 each	B	XVI	Wall or Post
Chlorine Room	2	C	I	Wall
Hose bibs	2	C	IV	Wall
Treatment Plant - exterior				
Process Room	1	C	VIII	Door
Chlorine Room	1	C	III	Door
Chlorine Room	1	B	VI	Door
Gate	1	C	VIII	Fence
Gate	1	C	XIII	Fence
Rollup doors	2	B	XIX	Wall
All 240 volt electrical equipment	1 each	C	VII	Equipment Door
All 480 volt electrical equipment: SES, Switchgear, Transfer Switch, Standby Generator, MCC, Switchboard, Motor Starter, VFD, Panelboard, etc.	1 each	C	II	Equipment Door
Pipeline Vaults				
Access Hatches and Manhole Entries	2	C	X	Underside of Hatch or Wall near Ladder

END OF SECTION

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 10520 –
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish and install fire protection specialties where shown on the drawings and as specified herein.

1.2 QUALITY ASSURANCE

- A. Portable Fire Extinguishers: National Fire Protection Association - NFPA 10.
- B. Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating and classification of extinguisher indicated. Provide extinguisher with UL-listed and FM rated pressure indicating gauge.

1.3 SUBMITTALS

- A. Submit manufacturer's product data highlighting all information to show compliance with this specification. Include schedule indicating type, size and location of fire protection specialties.

1.4 PRODUCT HANDLING

- A. Use all means necessary to protect materials of this section before, during, and after installation and to protect installed work and materials of all other trades.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. J.L. Industries, General Triplex, Larsen's Manufacturing Company or equal.

2.2 FIRE EXTINGUISHERS

- A. Wall mounted with bracket
 1. Provide Mark Bracket, MB 846 wall bracket as manufactured by J.L. Industries or equal.
 2. Provide one multi-purpose fire extinguisher, 10 pound capacity, 4A-80BC, Class ABC dry chemical type.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine substrates to which construction attaches or abuts, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of construction of the work of this section.
- B. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- C. Failure to call attention to defects or imperfections will be construed as acceptance and approval of substrate conditions. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation and full responsibility for completed work.
- D. Correct conditions detrimental to the proper and timely completion of the work.

3.2 INSTALLATION

- A. Install the work of this section in strict accordance with the manufacturer's recommendations as approved by the Owner.
- B. Anchor all components firmly into position for long life under hard use.
- C. Installation to be in operating condition in perfect adjustment.

PART 4 QUANTITY

- A. Provide and install (4) fire extinguishers. Install in locations as noted on plans as unless directed otherwise by the Local Authority having Jurisdiction.

END OF SECTION 10520

SECTION 11000

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies general requirements which are applicable to all mechanical equipment. The CONTRACTOR is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. EQUIPMENT LISTS:

Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the CONSTRUCTION MANAGER and CONTRACTOR and are not complete listings of all equipment, devices and material required to be provided under this contract. The CONTRACTOR shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.02 QUALITY ASSURANCE

A. ARRANGEMENT:

The arrangement of equipment shown on the drawings is based upon information available to the OWNER at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. The contractor shall, in determining the cost of installation, include these differences as part of his bid proposal. Structural supports, foundations, connected piping, valves, and electrical conduit specified may have to be altered to accommodate the equipment actually provided. No additional payment shall be made for such revisions and alterations.

B. REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. UNIT RESPONSIBILITY:

The CONTRACTOR shall cause equipment assemblies made up of two or more components to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the CONTRACTOR of his responsibility to the OWNER for performance of all systems.

The CONTRACTOR shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the CONTRACTOR to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, form and style of Form 11000-C specified in Section 01999, shall be signed by an officer of the unit responsibility manufacturer's corporation and shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment *even though the equipment may have been installed in the work.*

D. BALANCE:

Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$U_{per} = 6.015 \frac{GW}{N}$$

Where:

U_{per}	=	permissible imbalance, ounce-inches, maximum
G	=	Balance quality grade, millimeters per second
W	=	Weight of the balanced assembly, pounds mass
N	=	Maximum operational speed, rpm

Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be $G 2.5$ ($G = 2.5$ mm/sec) or better in accordance with ANSI S2.19.

PART 2--PRODUCTS

2.01 FLANGES AND PIPE THREADS

Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

General Requirements for Equipment
11000-3

Contract 2
Bid Issue

Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 BEARINGS

Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of ABMA Methods of Evaluating Load Ratings of Ball and Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

All bearings accessible to touch, and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.03 V-BELT ASSEMBLIES

Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood's Ultra V-belts with matching Ultra-V sheaves and Wood's Sure-Grip bushings, or equal.

Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushings which operate at a peripheral speed of more than 5500 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up grub or cap tightening screws. Bushings shall be key seated to the drive shaft.

Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion proof equipment is specified.

2.04 PUMP SHAFT SEALS

A. GENERAL:

Seals for water and wastewater pump shafts shall be mechanical seals. For industrial wastewater service, or for fluids other than water or municipal wastewater, the recommendations of the seal manufacturer shall be followed for selection of appropriate seals. Unless specified otherwise, stuffing boxes and mechanical seals shall conform to the requirements set forth in this paragraph.

B. MECHANICAL SEALS:

Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self-aligning, and self-centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.

Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service. Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 psia) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 psig.

Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.

Candidate seals include:

1. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal engineering Products, Ltd, Nova Scotia, Canada.
2. AESSEAL RDS seals with Cyclops bushing.
3. John Crane 3710 seals with Type 24SL bushing.

Seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for connection of a clean water flushing supply.

Seals for all vertical pumps (whether column or volute type) shall be provided with a second flush connection. Vertical pumps shall have a vent valve attached to the mechanical seal to eliminate air from the seal chamber prior to pump start; start-up procedures shall include venting instructions; and for remotely started pumps, the vent system shall be automated. Where specified in the detailed specifications, permissive confirmation automatic vent systems shall be provided.

C. SHAFT PACKING – NOT USED:

Where shaft packing is specified, stuffing boxes shall be tapped to permit introduction of seal liquid and shall hold a minimum of five rows of packing. Stuffing boxes shall be face attached. Stuffing box and shaft shall be suitable for field installation, without machining or other modifications, of the mechanical seal specified in paragraph 11000-2.04.B for the applicable pump and operating conditions.

Unless otherwise specified, lantern rings shall be bronze or Teflon, packing shall be die-molded packing rings of non-asbestos material suitable for the intended service and as recommended by the manufacturer, and glands shall be bronze, two piece split construction. Lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Lantern rings shall be drilled and tapped 1/4 NC-20. The impeller end of the packing on all but line shaft pumps with external source water lubricated bearings shall be fitted with a SpiralTrac, Version P packing protection system as manufactured by EnviroSeal engineering Products, Ltd, Nova Scotia, Canada.

The section of each shaft or impeller hub that extends through or into the stuffing box shall be fitted with a replaceable stainless steel sleeve with a Brinell hardness of not less than 500. The sleeve shall be held to the shaft to prevent rotation and shall be gasketed to prevent leakage between the shaft and the sleeve. Minimum shaft sleeve thickness shall be 3/8 inch.

2.05 COUPLINGS

Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.06 GUARDS

Exposed moving parts shall be provided with guards which meet all applicable OSHA requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.07 CAUTION SIGNS

Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION - AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed of fiberglass material, minimum 1/8 inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.08 GAGE TAPS, TEST PLUGS AND GAGES

Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Divisions 15 and 17, respectively.

2.09 NAMEPLATES

Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.10 LUBRICANTS

The CONTRACTOR shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the OWNER's current lubricant supplier. The CONTRACTOR shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment (Section 01660), the CONTRACTOR shall provide the OWNER with three copies of a list showing the required lubricants, after consolidation, for each item of

mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.11 ANCHOR BOLTS

Anchor bolts shall be 316 stainless steel and designed for lateral forces for both pullout and shear in accordance with the provisions of Section 05501. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall conform to the provisions of Section 05501.

2.12 SPARE PARTS

Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

PART 3--EXECUTION

Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

****END OF SECTION****

SECTION 11002

RIGID EQUIPMENT MOUNTS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

1. This section specifies minimum requirements for rigid equipment mounts. Completed equipment mounts shall consist of equipment pads, equipment anchors, and mounting plates (baseplates, soleplates, or fabricated steel frames) set in grout.
2. Equipment mounts shall conform to the requirements specified in the Equipment Mounting Schedule included in this specification. Where equipment mounting requirements are not specifically identified in the Equipment Mounting Schedule, the default mounting configuration for equipment shall consist of Concrete Equipment Pads per details on Sheet S-008 of the structural drawings, mounting plates leveled within 0.005 inch/foot, anchored to the equipment pad with cast-in-place equipment anchors, equipment anchor sleeve length of 10 times the bolt diameter, and the mounting plate grouted in position using non-shrink grout.
3. If a conflict exists between this section and requirements of individual equipment manufacturers, the more restrictive requirements shall prevail.
4. Requirements for non-rigid equipment mounts (vibration isolation systems) are specified in individual equipment specifications. Rigid equipment mounts conforming to the requirements of this Section shall be furnished for the equipment pad and other equipment mounting components supporting the vibration isolation system.
- 5.

B. DEFINITIONS:

Specific equipment mounting terminology used in this section conforms to the following definitions:

1. Baseplate: A mounting plate configured with a top plate and a perimeter edge of the mounting plate that is below the top plate. Baseplates have a cavity between the top plate and a horizontal plane at the bottom edge of the perimeter of the mounting plate.

Rigid Equipment Mounts
11002-1

Contract 2
Bid Issue

2. **Soleplate:** A machined or pre-formed mounting plate with a uniform horizontal surface across the entire underside of the mounting plate, excepting shear lugs/keys, grout pour holes, vent holes, and attachment hardware (nuts, bolts, tapped holes, etc.). Soleplates have a top plate but lack the perimeter bottom edge that extends below the underside of the top plate that is a defining feature of baseplates.
3. **Fabricated Steel Frame:** An equipment mounting plate constructed of rolled steel shapes and plates welded into a frame. Fabricated steel frames do not have top plates.
4. **Equipment Pad:** Concrete foundation (block or slab) supporting and elevating mounting plates above the supporting structural floor slab or local grade.
5. **Mounting Pads:** Milled/machined areas of baseplates, soleplates, and fabricated steel frames where the feet or mounting surfaces of mounted equipment and drivers are bolted to the baseplate, soleplate, or fabricated steel frame.
6. **Leveling Blocks:** Steel blocks temporarily placed under baseplates, soleplates, or fabricated steel frames at leveling positions (at equipment anchors) for the purpose of leveling baseplates, soleplates, or fabricated steel frames prior to grouting.
7. **Shims:** Thin stainless steel plates of uniform thickness used for fine adjustment of level. Shims are used on top of leveling blocks for mounting plate leveling or used between equipment drivers and baseplates, soleplates, or fabricated steel frames for equipment alignment.
8. **Wedges:** Pairs of uniformly tapered metal blocks that are stacked with the tapered surfaces reversed (relative to the other wedge) so that the top and bottom surfaces of the wedges are parallel. Wedges are used between equipment pads and baseplates, soleplates, or fabricated steel frames for the purpose of leveling mounting plates.
9. **Mounting Stud:** Threaded rod or bolts anchored to baseplates, soleplates, or fabricated steel frames for the purpose of mounting equipment or ancillary devices onto baseplates, soleplates, or fabricated steel frames.
10. **Reinforcement Dowels or Reinforcement Hooks:** Steel reinforcement rods embedded in concrete, across a cold joint, for the purpose of transferring loads or force across the joint.

11. Leveling Position: A location on the top of a concrete equipment pad where leveling tools and equipment will be temporarily installed or used for the purpose of leveling baseplates, soleplates, and fabricated steel frames prior to grouting.
12. Grout Manufacturer: Refers to the manufacturer of the grout product used for installation of rigid equipment mounts.
13. Grout Manufacturer's Technical Representative(s): Refers to the technical representative(s) of the Grout Manufacturer. The Grout Manufacturer's Technical Representative shall not be an employee of the CONTRACTOR.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. Referenced documents are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

References to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ACI 318, Appendix D	Building Code and Commentary, Anchorage to Concrete
ANSI/HI 1.4	Centrifugal Pumps – Installation, Operation and Maintenance
ANSI/HI 2.4	Vertical Pumps – Installation, Operation and Maintenance
API RECOMMENDED PRACTICE 686	Recommended Practices for Machinery Installation and Installation Design
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs

Reference	Title
ASTM F1554	Anchor Bolts, Steel, 36, 55 and 105 ksi Yield Strength
MIL-PRF-907E	Anti-Seize Thread Compound, High Temperature
SSPC	Society for Protective Coatings Specifications, Vol. 2
IBC 2012	International Building Code 2012 (including local amendments)

B. QUALITY CONTROL BY CONTRACTOR:

To demonstrate conformance with the specified requirements for rigid equipment mounts, the CONTRACTOR shall provide the services of an independent testing laboratory that complies with the requirements of ASTM E329. The testing laboratory shall sample and test materials installed as part of rigid equipment mounts as specified in this Section. Costs of testing laboratory services shall be borne by the CONTRACTOR.

Where epoxy grout is specified in individual equipment specifications, the CONTRACTOR shall furnish the services of a grout manufacturer's technical representative who has been factory trained by the grout manufacturer. The grout manufacturer's technical representative shall perform training and quality control of epoxy grout installation for rigid equipment mounts as specified in this section.

C. SPECIAL INSPECTION FOR EQUIPMENT ANCHORS

Equipment anchors shall comply with special inspection requirements specified in Section 05501.

1.03 SUBMITTALS

The following information shall be provided in accordance with the submittal requirements specified in Section 01300.

1. A copy of this specification section, including addendum updates, (referenced sections need not be included for Section 11002) with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The CONSTRUCTION MANAGER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the

Rigid Equipment Mounts
11002-4

marked-up specification sections, along with justification(s) for any requested deviations shall be sufficient cause for rejection of the entire submittal with no further consideration. Copies of this specification section shall be numbered and marked (specification number and equipment number) for inclusion (filing) with submittal materials furnished for individual equipment specifications.

2. Name, employer, and statement of qualification for mechanical contractor who will install rigid equipment mounts.
3. Certificates or other documentation issued by the epoxy grout manufacturer that demonstrates that the grout manufacturer's technical representative has been factory trained on installation of epoxy grout for equipment mounts, as specified in paragraph 11002-1.02 B. 2.
4. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate or fabricated steel frame details. Shop drawings shall depict size and location of equipment pads and reinforcement; equipment drains; equipment anchor, size, location, and projection; expansion joint locations; elevation of top of grout and grout thickness; elevation of top of baseplate, soleplate, or mounting block; size and location of electrical conduits; and any other equipment mounting features embedded in equipment pads. Shop drawings for equipment pads, equipment anchors, and baseplate, soleplate, or fabricated steel frames shall be numbered and marked (specification number and equipment number) for inclusion (filing) with the associated equipment submittal requirements.

PART 2—PRODUCTS

2.01 GENERAL

Equipment mounts shall conform to the requirements specified in the Equipment Mounting Schedule.

Equipment and drivers shall be rigidly mounted on a common mounting plate and grouted into place on a concrete equipment pad unless alternate requirements are specified in the Contract Drawings or the Equipment Mounting Schedule in this section. Unless otherwise specified in the individual equipment specification, mounting plates shall be anchored to equipment pads with a layer of grout between the equipment pad and the mounting plate.

2.02 EQUIPMENT PADS

A. MATERIALS

Rigid Equipment Mounts
11002-5

Contract 2
Bid Issue

1. Equipment pads shall be reinforced concrete as shown in the structural drawings on Sheet S-008.
2. Minimum dimensions for equipment pads are shown on structural drawings where the equipment pad is required to provide a minimum mass for vibration dampening.

B. EQUIPMENT PAD DRAINAGE:

1. Equipment pads shall be furnished with drains if required for equipment operation.
2. Locate equipment pad drains at drainage outlets from equipment or mounting plates
3. Route equipment drainage outlets or mounting plate drainage outlets to equipment pad drains
4. Route equipment pad drains to the floor hatch drainage collection system.
5. Drainage piping for equipment pads shall be routed below the finished floor elevation.
6. Exposed drain lines mounted on the floor are not acceptable.

Equipment Mounting Schedule					
Equipment Number	Equipment Pad Detail	Mounting Plate Leveling Tolerance (inch/foot)	Equipment Anchor Sleeve Length	Grout Type	Application Notes
Fe/Mg Filters, GAC Vessels	Detail Type A / S-008	0.02	Per Manufacture Requirement	Non – shrink	
Freestanding floor-mounted electrical panels and equipment	Detail Type E / S-008	0.02	Not Required	Not Required	Mounting for electrical equipment such as MCC, and PLC
Chlortainer	Detail Type D / S-008	0.02	Per Manufacture Requirement	Non – shrink	
Chlorine Pumps	Detail Type A / S-008	0.02	Per Manufacture Requirement	Non – shrink	
Reclaim Pump	Detail Type A / S-008	0.02	Per Manufacture Requirement	Non – shrink	
Sludge Mixing / Transfer Pump	Detail Type E / S-008	0.02	Per Manufacture Requirement	Non – shrink	

Rigid Equipment Mounts
11002-7

Contract 2
Bid Issue

2.03 EQUIPMENT ANCHORS:

A. EQUIPMENT ANCHOR MATERIALS

1. Equipment anchors shall be all thread rod with heavy hex welded nuts, heavy hex bolts, Post-installed anchors (wedge, sleeve, undercut, expansion, and adhesive anchors), or adjustable canister anchors as specified in the Equipment Mounting Schedule.
2. Post-installed anchors (wedge, sleeve, undercut, expansion, and adhesive anchors) shall conform to the requirements of Section 05501.
3. Adjustable canister anchors shall be cast-in-place pre-manufactured adjustable anchor inserts. Adjustable canister anchors shall provide a minimum of 6 inches of vertical bolt height adjustment and lateral adjustment of the anchor bolt while maintaining the anchor bolt in a true vertical orientation. Adjustable canister anchors shall be Jakebolts as manufactured by Unisorb, Heavy Duty Adjustable Anchors as manufactured by Deco, Rowan Adjustable Canister Anchor Bolt, or approved equal.
4. Equipment anchor materials shall be 316 Stainless Steel, Condition CW per ASTM F593.

B. EQUIPMENT ANCHOR DESIGN:

1. The size (diameter) of anchors for clamping/fastening mounting plates to equipment pads shall be as specified by the equipment manufacturer.
2. Equipment anchor size, embedment, and edge distance shall comply with the International Building Code (IBC 2006) and shall be sufficient to resist the maximum lateral and vertical forces specified in Section 01900.
3. The CONTRACTOR shall furnish equipment anchor calculation submittals for all pumps, MCC, and Lighting Transformer. Equipment anchor calculations shall be furnished as product data and submitted with equipment submittals. Equipment anchor calculations shall be sealed by a registered structural ENGINEER licensed in the State of Arizona.

C. EQUIPMENT ANCHOR TENSION

1. Unless alternate bolt torque/tension requirements are specified by the equipment manufacturer, equipment anchors shall be tightened to provide

a final clamping force that produces a tensile stress of 15,000 psi in each equipment anchor. Adjustable canister anchors shall be tightened to the manufacturer's maximum safe working load. Equipment anchors consisting of Post-installed anchors shall be tightened to manufacturer's recommendations.

2. Bolt torque values required to produce the specified bolt tension based on well lubricated plain finish national coarse thread bolts are presented in the following table. Revise bolt torque values per equipment manufacturer's recommendations for alternate thread patterns, thread lubrication, bolt material, or bolt finish.

Bolt diam. (in.)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Final bolt torque for 15,000 psi bolt stress (ft*lbs)	8	15	30	50	80	125	180	250	400

3. Prior to leveling and grouting mounting plates, grouted equipment anchors shall be pull tested to the values specified in the following table.

Anchor diam. (in)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2
Pull test load (kips)	2.1	3.8	6.1	9.1	13	17	22	28	43

D. ANCHOR SLEEVES

1. Equipment anchors shall be fitted with sleeves as specified in the Equipment Mounting Schedule. Sleeve length for equipment anchors shall be 15 times the bolt diameter unless otherwise specified in the Equipment Mounting Schedule. Sleeves may be installed at the CONTRACTOR'S option if not specified in the Equipment Mounting Schedule.
2. Not Used.
3. Anchor sleeves shall be flexible polyurethane foam, steel cylinder/tubes, or ribbed plastic sleeves.
4. Fill steel cylinders/tubes and ribbed plastic sleeves with a flexible room temperature vulcanizing (RTV) sealant prior to embedment/installation.

2.04 MOUNTING PLATES

A. GENERAL:

1. All baseplates, soleplates, and fabricated steel frames shall have edges of surfaces bearing on grout rounded to a radius of not less than 0.25 inch.
2. Perimeter corners of baseplates, soleplates, or fabricated steel frames shall be rounded to a radius of not less than 2.0 inches to avoid producing stress risers on the grouted foundation.
3. Grout pouring holes (minimum 4 inches in diameter for epoxy grout, minimum 2.5 inches in diameter for cementitious non-shrink grout) shall be provided in all baseplates and soleplates and all baseplates and soleplates shall have air release holes.
4. Grout relief or vent holes (minimum 1 inch in diameter) shall be provided in all baseplates and soleplates.
5. Mounting holes for equipment anchors shall be drilled through baseplates, soleplates, and fabricated steel frames.
6. Mounting holes for equipment anchors shall be drilled. Mounting holes shall not be burned out and they shall not be open slots.
7. Terminations requiring connections to baseplates and soleplates shall be acorn nuts welded to the underside of the baseplate or soleplate or nuts welded to the underside of the baseplate or soleplate and plugged with cork, plastic plugs or grease.
8. Where fasteners terminate only into the baseplate, soleplate, or fabricated steel frame, threaded lengths (tapped or embedded in mounting plates) shall be not less than the bolt diameter.
9. Where baseplates, soleplates, or fabricated steel frames are leveled using jackscrews, jackscrew threads shall be tapped in thickened pads or otherwise in sufficient metal to provide ease in adjusting level.
10. Mounting pads and/or mounting surfaces for baseplates, soleplates, and fabricated steel frames shall be milled flat after all welding and stress relieving and shall be coplanar within 0.0005 inch per foot in all directions. Baseplates shall be pre-grouted prior to milling.
11. Baseplates, soleplates, and fabricated steel frames shall provide common support for the equipment and driver (and flywheel, if one is specified).

12. Baseplates, soleplates, and fabricated steel frames for equipment with drivers 20 horsepower and greater shall be furnished with transverse alignment (horizontal) positioning jackscrews for alignment of equipment drivers on horizontal surfaces of baseplates.
13. Alignment/positioning jackscrews shall be in perpendicular directions in a horizontal plane at the mounting position for each corner or foot of the equipment driver. (Additional jackscrews shall be provided for transverse alignment of the flywheel, if flywheels are specified in the equipment specification.)
14. Where specified in individual equipment specifications; baseplates, soleplates, and fabricated steel frames shall be fitted with RK Fixators as manufactured by Unisorb, or approved equal.
 - a. Fixators shall be installed at mounting surfaces for drivers.
 - b. Fixators shall be a three-piece wedge leveling adjustment device incorporating a spherical washer assembly to provide true level height adjustment at each mounting surface for the equipment driver.

B. FABRICATED STEEL FRAMES:

1. Fabricated steel frames shall be plate or fabricated structural steel mounting plates with thickened steel mounting pads for bolting equipment to the mounting plate.
2. Fabricated steel frames shall be rectangular in shape, excepting fabricated steel frames for centrifugal refrigeration machines and pumps which may be T- or L-shaped fabricated steel frames to accommodate the equipment driver and accessories.
3. Fabricated steel frames for split case pumps shall include supports for suction and discharge elbows, if required by the specified configuration.
4. Perimeter members shall be I-beams or C-channel with a minimum depth equal to 1/10 of the longest dimension of the fabricated steel frame. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
5. Fabricated steel frames shall be furnished with mounting pads welded to the fabricated steel frame.

6. Surfaces of fabricated steel frames in contact with grout shall be sandblasted to white metal per SSPC SP-5.
7. Apply a high-strength epoxy primer as specified in 11002-2.06 within 8 hours of sandblasting the fabricated steel frame.

C. BASEPLATES:

1. Baseplates shall be welded steel, cast steel, or cast iron with thickened mounting pads for bolting equipment to the baseplate.
2. Internal stiffeners shall be provided on all cast and fabricated baseplates and shall be designed to allow free flow of grout from one section of the baseplate to another.
3. The minimum acceptable opening in cross bracing and stiffeners shall be 2 inches high by 6 inches wide.
4. All welds shall be continuous and free from skips, blowholes, laps and pockets.
5. Baseplates shall be pre-grouted at the factory after all welding has been completed and prior to machining the mounting pads on the baseplate. Baseplates that have not been pre-grouted at the factory shall be pre-grouted in the field by removing the equipment from the baseplate, inverting the baseplate, and pre-grouting as specified in this Section.
6. The underside of baseplates shall be sandblasted to white metal per SSPC SP-5 prior to pre-grouting.
7. Pre-grouting shall be completed within 8 hours of sandblasting.
8. Pre-grouting shall fill the underside of the baseplate to the bottom edges of the baseplate.
9. Cast iron baseplates shall be sealed to prevent surface bleeding prior to shipment to the project site.

D. PLATE STEEL SOLEPLATES:

1. Plate steel soleplates shall be not less than 1.0 inch thick for equipment with drivers greater than 30 horsepower.
2. Plate steel soleplates shall be furnished with grout keys/lugs or stiffeners on the underside of the soleplate.

3. Excepting grout keys, grout pour holes, vent holes, and attachment hardware (nuts, bolts, tapped holes, etc.) the underside of plate steel soleplates shall be a flat uniform horizontal surface.
4. The underside of plate steel soleplates shall be scribed with the words "THIS SIDE DOWN" using welding rod material prior to milling the mounting pads for equipment or mounting surfaces.
5. Plate steel soleplates without grout pouring holes are acceptable provided that no dimension of the soleplate (width or length) exceeds 18 inches.
6. Surfaces of plate steel soleplates in contact with grout shall be sandblasted to white metal per SSPC-SP-5 prior to shipment to the project site.
7. Apply a high-strength epoxy primer as specified in 11002-2.06 within 8 hours of sandblasting the underside of plate steel soleplates.
8. Where equipment is fabricated or cast with feet or mounting surfaces that are not fastened to a common baseplate or soleplate, as in dry-pit bottom-suction pumps, the equipment may be supported on individual concrete piers or equipment pads in lieu of mounting on a common equipment pad and soleplate. In such instances, the equipment shall be supported at the feet or mounting surfaces on individual plate steel soleplates, which shall be leveled and grouted into place on the individual piers or equipment pads as specified in this section. Where multiple soleplates are installed for an equipment installation, soleplates shall be installed coplanar within 0.002 inch/foot.

E. POLYMER CONCRETE SOLEPLATES:

1. Polymer Concrete Soleplates shall be pre-cast soleplates consisting of polymer concrete with stainless steel inserts for equipment mounting.
2. Mounting surfaces on Polymer Concrete Soleplates shall be coplanar within 0.002 inch/foot. Polymer Concrete Soleplates shall be furnished with a uniform horizontal surface over the entire underside of the mounting plate.
3. Excepting grout keys, grout pour holes and vent holes, the underside of soleplates shall provide a flat uniform horizontal surface.
4. Polymer Concrete Soleplates shall be PoxoBase as manufactured by Basetek, Chembase as manufactured by Goulds, or approved equal.

F. CORROSION RESISTANT FRP BASEPLATES

1. Corrosion Resistant FRP Baseplates shall be pre-formed fiber reinforced plastic fabrications.
2. Corrosion Resistant FRP Baseplates shall be products of the manufacturer of the equipment that is mounted on the baseplate.

2.05 GROUT FOR EQUIPMENT PADS

A. EPOXY GROUT FOR EQUIPMENT MOUNTING:

Where epoxy grout is specified in the Equipment Mounting Schedule, grout for setting bearing surfaces of baseplates, soleplates, and fabricated steel frames on equipment pads shall be Epoxy Grout for Equipment Mounting as specified in Section 03600. Where the term epoxy grout is used in the context of details and specifications for equipment mounting it shall mean Epoxy Grout for Equipment Mounting as specified in Section 03600.

B. CEMENTITIOUS NONSHRINK GROUT:

Where non-shrink grout is specified in the Equipment Mounting Schedule, Cementitious Non-shrink Grout, specified in Section 03600, may be used for setting bearing surfaces of baseplates, soleplates, or fabricated steel frames. Where the term non-shrink grout or cementitious grout is used in the context of details and specifications for equipment mounting it shall mean Cementitious Non-shrink Grout as specified in Section 03600. Training and quality control by the grout manufacturer's technical representative is not required for rigid equipment mounts installed with cementitious non-shrink grout.

2.06 EPOXY PRIMER

Epoxy primer shall be a high-strength, lead free, chrome free, and rust inhibiting two-component epoxy primer specifically designed for use on metal substrates and in conjunction with epoxy grout. The epoxy primer's bond strength to sandblasted metal shall not be less than 1500 psi. Epoxy primer shall be Phillybond Phillyclad 1000 Series, or approved equal.

2.07 ANTI-SEIZE/ANTI-GALLING COMPOUND

Anti-seize or anti-galling compound shall be a molybdenum disulfide and graphite combination in aluminum complex base grease conforming to MIL-PRF-907E. Acceptable products include Jet Lube 550 by Jet Lube, Inc., E-Z Break by LA-CO, or approved equal.

2.08 PRODUCT DATA

The following information shall be provided in accordance with the product data requirements specified in Section 01300:

1. Equipment anchor calculations demonstrating compliance with paragraph 11002-2.03 B.
2. Results of grout strength tests, as specified in paragraph 11002-3.03 C.
3. Completed Rigid Equipment Mount Installation Inspection Checklist Forms (11002-A), as specified in paragraph 11002-3.02 B.
4. List of CONTRACTOR's equipment installation staff that has completed epoxy grout manufacturer's grout installation training specified in paragraph 11002-3.02 A.

PART 3--EXECUTION

3.01 GENERAL

A. GENERAL REQUIREMENTS:

1. Roughen the underside of soleplates and fabricated steel frames and wipe with a residue-free solvent as recommended by the epoxy primer manufacturer before placement of the baseplate, soleplate, and fabricated steel frames on the equipment pad for leveling. Roughen surfaces of mounting plates that will be in contact with grout by power tool cleaning. Cleaning shall be performed by power wire brushing, power sanding, power grinding, power tool chipping or power tool descaling. Cleaning shall impart a minimum profile of 1.0 mil.
2. Prior to placement on the equipment pad for leveling, exposed grout surfaces of pre-grouted baseplates shall be roughened and wiped with a residue-free solvent as recommended by the manufacturer of the epoxy grout used for pre-grouting.
3. Prepare the underside of corrosion-resistant FRP baseplates and polymer concrete baseplates per the baseplate manufacturer's recommendations prior to placement of the baseplate on the equipment pad for leveling.
4. Grout for equipment mounting shall be as specified in the Equipment Mounting Schedule.
5. Grouting for installation of equipment on equipment pads shall take place prior to connecting any field piping or electrical and instrumentation systems.

6. Unless the CONSTRUCTION MANAGER accepts an alternate installation procedure in writing, baseplates, soleplates, and fabricated steel frames shall be leveled and grouted with the equipment removed.
7. Pumps shall be installed in accordance with this section and ANSI/HI 1.4 or ANSI/HI 2.4, as appropriate for the type of pumping equipment installed.
8. Connecting piping with flexible connections and/or expansion joints shall be anchored such that the intended function of these joints is maintained in the piping system without imposing strain on the equipment connections.

B. ALTERNATE PIPING CONNECTIONS:

Where an equipment manufacturer's installation requirements include a rigid connection between the machine and connecting piping systems, the CONTRACTOR shall delete any flexible coupling (including equipment connection fittings) shown on the drawings and install the equipment in the following manner, in lieu of installing the flexible coupling:

1. The equipment pad shall be installed as shown on the detail specified in the Equipment Mounting Schedule.
2. The baseplate, soleplate, or fabricated steel frames supporting the equipment shall be installed, leveled, and grouted in place as specified in this section.
- 3.
4. The piping shall be installed and aligned to the equipment connections and the field piping connections without welding one of the joints for one section of pipe between the equipment connection and the field piping and all valving. All flanged joints shall be bolted up and pressure-tested.
5. All piping shall be fully supported by supports designed to accept their full weight and thrust forces.
6. The final sections of piping shall be aligned with the equipment and field connections without the use of jacks, chain falls, or other devices to force it into alignment.
7. The final piping joints shall be welded only after the previous steps have been completed and accepted by the CONSTRUCTION MANAGER.

3.02 EPOXY GROUT TRAINING AND QUALITY CONTROL

A. EPOXY GROUT TRAINING

Prior to commencing rigid equipment mount installation work on equipment pads, the CONTRACTOR shall furnish the services of a grout manufacturer's technical representative to conduct a training for the workers who will be using epoxy grout for rigid equipment mount installations. The training shall be not less than 4 hours in length and shall cover all aspects of using the products, including form construction for each equipment installation, surface preparation, mixing, application, void prevention/elimination, and clean up. This requirement, however, shall not be construed as relieving the CONTRACTOR of overall responsibility for this portion of the work. The epoxy grout manufacturer shall furnish a list of training attendees who have been satisfactorily trained to perform epoxy grout installation for equipment mounting.

B. EPOXY GROUT QUALITY CONTROL

For equipment mounted with epoxy grout, the epoxy grout manufacturer's technical representative shall provide quality control services for epoxy grout installation in rigid equipment mounts. The epoxy grout manufacturer's technical representative shall be on site to inspect and verify that the installation personnel have successfully performed surface preparation, epoxy grout application, and Quality Control Inspection in accordance with these specifications for a representative portion of the epoxy grout installation work.

Specifically, the epoxy grout manufacturer's technical representative shall perform the following services for at least one rigid equipment mount installation for each equipment type and size installed with epoxy grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria, including but not limited to substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the specifications.
6. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during installation.

Rigid Equipment Mounts
11002-17

7. Inspect epoxy grout for cure.
8. Inspect and record that localized repairs made to grout voids conform to the specification requirements.
9. Conduct a final review of completed epoxy grout installation for conformance to these specifications.
10. Attest to conformance of the CONTRACTOR's work by signing appropriate entries in the "Rigid Equipment Mount Inspection Checklist," form 11002-A in Section 01999.

3.03 INSTALLATION

A. CONCRETE EQUIPMENT PAD PREPARATION:

1. Roughen the top of the equipment pad after the concrete has reached its 28-day compressive strength.
2. Remove all laitance and defective or weak concrete.
3. Roughened surface profile shall be 0.25inch amplitude, minimum.
4. Expose broken aggregate without dislodging unbroken aggregate from the cement matrix and without fracturing concrete and aggregate below the concrete surface.
5. Roughen using a light-duty (15 pounds or less), hand-held chipper with a chisel type tool.
6. Abrasive blast, bush-hammer, jack hammers with sharp chisels, heavy chipping tools, or needle gun preparation of concrete surfaces to be grouted are not acceptable.
7. Demonstrate removal of defective or weak concrete to the CONSTRUCTION MANAGER prior to leveling.
8. The chipped surface of the concrete shall be such that the final elevation of the equipment pad provides the grout manufacturer's recommended thickness between the surface of the equipment pad and the lower baseplate flange, underside of the soleplate, or underside of the fabricated steel frame.

9. All dust, dirt, chips, oil, water, and any other contaminants shall be removed and the surface protected with plastic sheeting until grout is installed.
10. Concrete equipment pad surfaces that have been finished smooth and level for use as leveling positions shall be protected from damage during chipping activities. Alternatively, leveling positions may be restored on chipped surfaces. Leveling positions shall be restored by installing leveling blocks or leveling plates for jackscrews on a high compressive strength epoxy putty (Philadelphia Resins, Phillybond Blue 6A, or equal). Leveling blocks and leveling plates shall be installed level on the epoxy putty.

B. LEVELING:

1. Except where union rules require installation by another trade, all equipment and machinery shall be mounted and leveled by a qualified mechanical contractor.
2. Use precision surveying equipment for leveling.
3. Machinists' spirit levels will not be permitted for leveling purposes for any baseplate, soleplate, or fabricated steel frame with a plan dimension greater than 4 feet.
4. Baseplates, soleplates, and fabricated steel frames shall be leveled to the tolerance specified in the Equipment Mounting Schedule or as otherwise required by the equipment manufacturer, if more stringent.
5. An anti-seize or anti-galling compound specified in paragraph 11002-2.07 shall be applied to all equipment anchor threads prior to beginning baseplate, soleplate, or fabricated steel frame leveling.
6. All baseplates, soleplates, and fabricated steel frames shall be leveled against steel surfaces (jackscrew plates, leveling blocks, leveling nuts, support plates, or other steel surfaces). Use of other materials for leveling purposes is strictly and specifically prohibited.
7. Leveling equipment and tools shall be stainless steel leveling blocks and shims, steel wedges, or jackscrews bearing on leveling plates.
8. Leveling nuts may be used for leveling baseplates, soleplates, and fabricated steel frames weighing less than 200 pounds (including the weight of the equipment if leveled with the equipment on the mounting plate).

9. Leveling blocks shall be stainless steel, 4 inches square and 1.5 inches thick with an open-ended slot terminating in the center for the equipment anchor.
10. Leveling blocks shall be machined flat on all horizontal surfaces and placed under the baseplate or soleplate at each equipment anchor.
11. Shims shall be pre-cut stainless steel, slotted for removal after grouting. Leveling blocks and shims shall be coated with a light oil just prior to beginning the leveling and grouting work. Shims shall be placed so the tabs on the shims are easily accessible.
12. Clamp baseplates, soleplates, or fabricated steel frames in position (after leveling) by installing the equipment anchor nuts and washers.
13. Bolt tension to fix the position of mounting plates during grouting shall be 30 to 60 percent of the final clamping force applied to clamp the mounting plate to the equipment pad.
14. Prior to grouting, verify that the correct level and position of the baseplate, soleplate, or fabricated steel frame has been maintained after clamping it to the equipment pad.

C. GROUTING:

1. Design forms for a minimum of 6 inches hydrostatic head above the final elevation of the grout.
2. Install grout expansion joints at 4 to 6 foot intervals, perpendicular to the centerline of baseplates. Design expansion joints in accordance with the grout manufacturer's written instructions.
3. Coat forms with three coats of paste wax on all areas of the forms that will be in contact with the grout.
4. Wax forms before assembly.
5. Prevent accidental application of wax to surfaces where the grout is to bond.
6. Remove any foreign material, such as oil, sand, water, wax, grease, etc., from concrete surfaces that will contact grout before forms are installed.

7. Forms shall be liquid-tight. Seal any open spaces or cracks in forms, or at the joint between forms and the foundation using sealant, putty, or caulking compound.
8. Vertical and horizontal edges of the grout shall have 45-degree chamfers as specified in equipment pad details. The 45-degree perimeter chamfer strip shall be located at the final elevation of the grout.
9. Match chamfers in concrete portions of the equipment pad.
10. Install block outs at all leveling positions to allow removal of leveling equipment and leveling nuts to be backed off after the grout has cured.
11. Coat jackscrews with a light oil or other acceptable bond-breaking compound prior to grouting.
12. Final elevation of grout on fabricated steel frames shall be at the top of the lower flange of the perimeter I-beams or C-channel.
13. Top of grout elevation for baseplates and soleplates shall be at least 0.125 inch but not more than 0.5 inch above the bottom or underside of the perimeter edge of the baseplate or soleplate.
14. Seal equipment anchor sleeves to protect the sleeved length of the anchor from contact with grout.
15. Wrap exposed portions of equipment anchors with duct tape to protect them from grout splatter and to prevent bonding to grout.
16. Adjust ambient temperature to maintain mounting plate, foundation, and grout temperatures to grout manufacturer's recommended temperature.
17. Mix grout for equipment mounting in accordance with the grout manufacturer's written recommendations.
18. Epoxy grout shall be placed in a manner that avoids air entrapment, using a head box to pour grout into the grout holes.
19. Place grout at one end of the baseplate or soleplate and work grout toward the opposite end to force the air out from beneath the baseplate or soleplate.
20. Pour grout through a head box into grout pouring holes.
21. When the head box is moved to the next grout hole, a 6-inch standpipe shall be placed over the grout hole and filled with grout.

22. Use of vibrating tools and/or jarring (rapping or tapping) forms to facilitate grout flow is not permitted during placement of epoxy grout.
23. Never allow the grout in the head box to fall below the top of the baseplate or soleplate once the grout has made contact with the baseplate or soleplate.
24. Grout placement shall be continuous until all portions of the space beneath the baseplate, soleplate, or fabricated steel frame have been filled.
25. Prepare subsequent batches of grout prior to depleting the preceding batch.
26. Maintain grout height in standpipes after the space under the baseplate, soleplate, or fabricated steel frame has been filled.
27. When the grout has started to take an initial set (typically this is determined by a noticeable increase in temperature and no flow of grout at the vent holes) the standpipes shall be removed and excess grout cleaned from all surfaces.
28. Check for leaks throughout grout pours. Leaks shall be repaired immediately to prevent formation of voids.
29. Check baseplate, soleplate, or fabricated steel frame level and elevation before the grout sets.
30. Cure grout in accordance with the grout manufacturer's written instructions.
31. Where specified in the individual equipment specifications, a grout sample shall be taken for each equipment pad.
 - a. Samples shall be placed in a cylinder of sufficient size to yield three 2-inch cubes as test samples.
 - b. Samples shall be tagged with project name, date, time, the equipment number, and ambient temperature at the time of placement.
 - c. Place samples next to the foundation of the equipment being grouted and cure for 48 hours.
 - d. Test grout samples in accordance with the grout manufacturer's recommendations.

- e. Grout samples shall be tested by the independent testing laboratory specified in paragraph 11002-1.02 B.
- f. Test results shall be reported directly to the CONSTRUCTION MANAGER.

D. COMPLETION:

1. Upon acceptance by the CONSTRUCTION MANAGER and the equipment manufacturer's representative and after the grout has reached sufficient strength, grout forms and block outs at leveling positions shall be removed. Leveling blocks and shims or wedges and support plates shall be removed, and leveling nuts and jack screws shall be backed off to allow the grout to fully support the baseplate, mounting block, or soleplate. Take care not to damage the grout during removal of extended shimming material or leveling equipment and tools.
2. The equipment anchor nuts shall be tightened, using calibrated indicating torque wrenches, to develop the full bolt tension specified in 11002-2.03 C.
3. Equipment anchor nuts shall be tightened in increments of not more than 25 percent of the final torque value in an alternating pattern to avoid stress concentration on the grout surface. After tightening equipment anchor nuts to final values, apply additional wax, grease, or mastic to all exposed portions of the equipment anchor beneath the baseplate, soleplate, or mounting block.
4. After applying additional wax or mastic to exposed portions of equipment anchors, block outs (pockets) for access to leveling nuts, leveling blocks and shims, or wedges shall be filled with the grout material installed under baseplates, soleplates, or fabricated steel frames and pointed after the equipment anchor nuts have been tightened to final values. Jackscrews shall be removed and holes in the baseplate, soleplate, or fabricated steel frames filled with a flexible sealant (silicone rubber) or a short cap screw.
5. Check for baseplate, soleplate, or fabricated steel frame movement (soft foot) by individually loosening and re-tightening each equipment anchor. Vertical movement at each equipment anchor shall be measured and recorded during loosening and retightening and shall not exceed 20 micrometers (0.001 inch). Vertical movement shall be measured using a magnetic-based dial indicator on the baseplate, soleplate, or fabricated steel frame referenced to the epoxy grout surface of the equipment pad or other approved method. Soft foot conditions shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or fabricated steel frames.

6. Check for grout voids by tapping along the upper surfaces of the baseplate, soleplate, or mounting block. Grout voids shall be sufficient cause for removal and reinstallation of grout and baseplates, soleplates, or fabricated steel frames. Grout voids shall be marked. At the discretion of the CONSTRUCTION MANAGER, grout voids may be repaired as specified in Chapter 5, Section 3.16 of API RP 686.

3.04 FINAL INSPECTION

The CONSTRUCTION MANAGER will conduct a final inspection with the CONTRACTOR for conformance to requirements of this section.

****END OF SECTION****

SECTION 11100

SLUICE GATES

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies self contained sluice gates of cast iron construction.

B. TYPE:

Sluice gate types specified are:

1. TYPE A: Sluice gates shall be of cast iron construction with full metal wedges, flat frames, and wall thimbles.

C. OPERATING REQUIREMENTS:

Equipment No.	Size, inch	Gate type	Opening ^a direction	Bottom ^a seating	Frame ^a type	Design head, feet		Operator type
						Seating	Unseating	
SLG 1	10" SQ	A	U	FB	SC	6	6	Manual, Type II

^aAbbreviations:

U = upward opening; D = downward opening; FB = flush bottom;
S = standard; SC = self-contained (yoke type); C = conventional

D. COMPONENT SIZING:

Operating forces used for determining the strength of gate components comprising of yokes, frames, discs, stems, disc nut pockets, and other load-bearing members shall be based on the sum of the guide friction force (computed using an opening breakway friction factor of 0.70) and the weight of disc and stem.

When the gate is in motion, the operating forces shall be based on the sum of the frictional force (using a guide friction factor of 0.35) and the weight of disc and stem.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event

of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A126	Gray Iron Casting for Valves, Flanges and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM B98	Copper-Silicon Alloy Rod, Bar and Shapes
ASTM B103	Phosphor Bronze Plate, Sheet, Strip and Roller Bar
ASTM B139	Phosphor Bronze Rod, Bar and Shapes
ASTM B584	Copper Alloy Sand Castings for General Applications
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWWA C501	Cast Iron Sluice Gates

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-

up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Certificate of Unit Responsibility attesting that the Contractor has assigned, and that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
3. Plan, cross section, and details showing proposed mounting for each size and typical application of gate.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Type A Cast iron sluice gates shall be Rodney Hunt, Waterman, or equal, modified to meet specified requirements.

2.02 EQUIPMENT

A. SLUICE GATES:

Sluice gates shall meet the requirements of AWWA C501 except as otherwise specified. Sluice gates shall be of the heavy-duty type. Frames shall be flat back.

Sluice gates shall be provided, unless otherwise specified, with one-piece F-section cast iron wall thimbles. The vertical centerline shall be shown by permanent marks at the top and bottom of the machined face with the word "top" marked near the top center of the thimble opening.

Stems and stem guides shall be provided in accordance with AWWA C501, Sections 3.11 and 3.12. Unless otherwise specified, gates shall have single rising stems. Stems shall have 29-degree acme threads and be turned straight and true and honed to a smooth 63 micro-inch or better finish. Stem couplings, where required, shall be of the stem material. Stem guides shall be of the split, bronze bushed, adjustable type.

B. TYPE A SLUICE GATE MATERIALS:

Component	Material
Gate, guide and frame	ASTM A126, Class B, cast iron

Component	Material
Seating faces	ASTM B103 or B139, bronze
Wall thimbles	ASTM A126, Class B, cast iron
Stems	ASTM A276, stainless steel, Type 304
Wedges, thrust nut, stem couplings	ASTM B584, bronze, CA872
Fasteners and adjusting hardware	ASTM A276, stainless steel, Type 304, or ASTM F593 and F594, stainless steel, group 1 or group 2
Yoke	ASTM A126, Class B, cast iron
Flush bottom seal	Neoprene
Flush bottom retainer	ASTM A276, stainless steel, Type 304 bar

2.03 OPERATORS

A. GENERAL:

Operators specified include hand-crank, handwheel, and T-wrench. Operators shall meet AWWA C501 specifications, except as otherwise specified, and shall be designed to meet the operating requirements specified in paragraph 11100-1.01 C. Plastic stem covers shall be provided as specified in AWWA C501, Section 3.14.5.

On both crank and handwheel manual operators, gears and bearings shall be enclosed in a weatherproof cast iron housing, and pressure type fittings shall be provided for grease lubrication of the bearings and gears. A maximum effort of 40 pounds pull on the crank or handwheel shall operate the gate under the specified operating conditions.

B. TYPE I:

Operator shall be the manual, geared, crank type. The operator shall be either pedestal or bench mounted as specified. Pedestal type floor stands shall be the offset type or the standard type with wall mounting bracket. The crank shall be 15 inches long.

The geared floor or bench stand shall have a weatherproof, cast iron housing, with a bronze operating nut, mounted on a high- strength cast iron pedestal baseplate. The operating nut shall be internally threaded with 29-degree acme threads corresponding to stem threading. Tapered roller bearings or ball bearings shall be located above and below the bronze operating nut to support the output thrust of the floor stand. The pinion shaft shall be mounted on tapered roller or needle bearings to resist axial and radial thrusts. Mechanical seals shall be provided around the operating nut and the pinion shaft to prevent lubrication from leaving the unit and moisture from entering the sealed housing. The reduction gear case shall be precision machined and equipped with tapered roller or needle bearings and sealed about the reduction shafts.

Operators shall be self-locking at any position of stem travel. The input shaft shall be fitted with an AWWA nut.

C. TYPE II:

Operator shall be the manual handwheel type. The operator shall be either pedestal or bench mounted as specified. Pedestal type floor standards shall be the offset type or the standard type with wall mounting bracket. Pedestal or bench stands shall be cast iron. The head of the pedestal or bench stand operator shall have a solid bronze internally threaded operating nut. The operator shall be mounted on antifriction roller bearings. Handwheels shall be removable from the operator.

D. TYPE III:

Operator shall be the T-wrench type, including floor box, thrust bearings, and lift nut. Floor box shall be of fabricated steel, with galvanized steel hinged cover and embedded in the floor or mounted on a wall bracket as specified on the drawings. Floor box depth shall be such that the gate stem and operating nut does not protrude above the floor under any condition. Wall brackets shall be cast iron or fabricated steel. Thrust bearings shall be roller or ball bearing type, replaceable and protected by seals. Accessible pressure type grease fittings shall be provided for bearing lubrication. Operating nuts shall be AWWA standard 2-inch square head nuts. T-wrenches shall be 4 feet long, aluminum, with socket to match the operating nut.

2.04 COATING SYSTEM

Sluice gates shall be shop coated with coating system EP as specified in Section 09900.

2.05 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Product information, calculations, charts, or graphs to verify that the product provided meets the requirements set forth in this specification.
2. Affidavits of compliance in accordance with AWWA C501.
3. Applicable operation and maintenance information as specified in Section 01730.

PART 3--EXECUTION

3.01 INSTALLATION

Unless otherwise specified, sluice gates shall be installed in accordance with manufacturer's instructions.

3.02 TESTING

Shop seat clearance and operating tests shall be performed as per Section 4.2 of the AWWA Specification C501, and field operating and leakage tests shall be conducted as specified in Section 6.3 of the AWWA Specification C501.

****END OF SECTION****

SECTION 11324

SUBMERSIBLE TURBINE PUMPS FOR WATER WELL SERVICE

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE AND DEFINITIONS:

1. SCOPE:

This section specifies submersible turbine pumps for pumping fluids which may contain mildly abrasive small diameter solids. The pumping arrangement shall be complete with a wellhead surface discharge assembly and a submersible motor incorporated into the pump assembly.

The well has not yet been drilled. Pump design requirements are based on an assumed well yield of 50 - 200 gpm. Pump design requirements may change depending on actual well production.

2. DEFINITIONS:

PACL: For the purpose of this section and sections referencing this section "PACL" wherever used shall mean Pump Application Capacity Limits and is used in these specifications in lieu of the terms Preferred and Allowable Operating Region. PACL is defined in terms of percentage Best Efficiency Flow (BEPQ) to define the margins (based upon suction specific speed) that respectively identify the minimum and maximum flows defining acceptable performance regions for pumps covered by this specification section and any specification section referencing this section. Refer to paragraph 11324-1.04 B.

B. TYPE:

Equipment furnished under this section shall be a constant speed multi-stage submersible deep well turbine pumps designed specifically for pumping water from a well casing which may contain incidental quantities of abrasive solids. The pump shall be complete with a submersible motor, inlet strainer, suction casing, bowls, discharge column, check valves and pitless adaptor.

C. EQUIPMENT LIST:

Item	Equipment No.
Pump 1	P-1
Pump 2	P-2

D. PUMPED FLUID AND OPERATING CONDITIONS:

The fluid to be pumped by the equipment furnished under this section will be groundwater. The pumps shall be specifically designed to pump this fluid and shall operate without clogging or fouling caused by material in the pumped fluid within any operating condition within the range of service specified. The pumps will be started and stopped by a soft starter without using a deep well pump control valve or VFD.

E. PERFORMANCE REQUIREMENTS:

The performance requirements presented in tabular form below are intended to describe the results of hydraulic calculations developed using a mathematical modeling program specifically developed for the purpose. The model was intentionally used to develop the limits of expected extremes in static head, variation of coefficients for pipeline resistance and turbulence losses through fittings and valves. Equipment furnished under this section shall be fully suitable for continuous operation at any specified condition or any condition lying between the extremes of the operating conditions specified in the following table. The notes presented at the end of the table are intended to be complimentary to the information presented in the table.

Equipment number	<u>P-1</u>	<u>P-2</u>
<u>Operating Condition</u>		
<u>Condition A^{1, 4}</u>		
Capacity, gpm	50	200
Head, ft	1300	1475
NPSHA, feet	350	150
<u>Condition B^{2, 4}</u>		

Submersible Turbine Pumps for Water Well Service
11324-2

Capacity, gpm	From H/Q curve	From H/Q curve
Head, ft	1100	1075
NPSHA, feet	550	550

Condition C^{3, 4}

Capacity, gpm	From H/Q curve	From H/Q curve
Head, ft	1470	1645
NPSHA, feet	250	50

NOTES:

1. Condition A shall be taken as the rated operating condition. Condition A shall be used for pump selection. Performance at the rated condition shall be guaranteed in accordance with Section 11324-1.02 C.2. Condition A has been selected to obtain the rated pumping capacity for the installation. Pumps furnished under this section should be selected to achieve Condition A performance, but also operate continuously without objectionable vibration or cavitation at the head specified under Conditions B and C. Condition A shall be located in the PACL as established in this Section.
2. Condition B head is presented to indicate operating conditions when the pump is operating against minimum anticipated system head. Condition B shall be located in the PACL as established in this Section.
3. Condition C is the anticipated continuous duty maximum head condition. Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition. Condition C shall be located in the PACL as established in this Section.
4. Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 2.1 – 2.4. Net positive suction head available (NPSHA) in the above tabulation is referenced to the project elevation of **6,750** feet above sea level and is calculated in accordance ANSI/HI 2.3 for average barometric pressure and maximum temperature conditions, and has been adjusted to the first bowl elevation noted on the drawings. Calculated NPSHA has been reduced by five feet as an allowance for uncertainties associated with the pumped fluid and well conditions, and no reduction in NPSH margin limitations specified in Section 11324-1.03 E will be permissible due to the inclusion of this allowance.
5. Maximum expected surge pressure is **100** psig.

F. DESIGN REQUIREMENTS:

Equipment provided under this section shall conform to the following:

	<u>P-1</u>	<u>P-2</u>
<u>Pump</u>		
Discharge column, inches with pitless adapter	2.5	5
Speed, maximum, rpm	3600	3600
Maximum efficiency, min., percent ¹		
Bowl	74	74
Pump	72	72
<u>Motor</u>		
Motor, maximum, HP	40	125
Speed, maximum, rpm	3600	3600
Service Factor	1.15	1.15
Volts, Hertz, Phase	460,60,3	460,60,3
Full Load Motor efficiency, min., percent	83	83
Full Load Motor power Factor, min., percent	80	80
<u>Well</u>		
Casing, inches	8-5/8	14

All components of the specified equipment shall be designed and sized for equipment weight plus the maximum hydraulic downthrust at all points on the pumping curve. Additionally, pumps shall be provided with drivers having a momentary upthrust capacity equal to or exceeding 30 percent of the downthrust rating. Pump shall not exceed the rated power of the motor at any point on the curve.

NOTE:

1. The maximum efficiency is the minimum acceptable peak efficiency and is not required to coincide with any specified operating condition in paragraph 11324-1.01 E. Pump efficiency shall be the ratio of the pump output power (water horsepower) divided by the pump input power (brake horsepower) required to deliver the total head, with meanings as defined in HI 1.2.6 and 2.2.6 and 2.2.3.8. Pump efficiency shall be within 2 percent of bowl efficiency when calculated at the point of peak bowl efficiency on the pump's head/capacity curve.

1.02 QUALITY ASSURANCE:

A. REFERENCES:

This section contains references to the document(s) listed below. These documents are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section or any referencing section and those of the listed documents, the following order of precedence shall prevail (in the order of primacy):

1. This section
2. The referenced section
3. The referenced document

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement For Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISC	American Institute of Steel Construction Manual of Practice
ANSI/HI 2.1 – 2.4	Vertical Pumps
ANSI/HI 9.1 – 9.5	Pumps – General Guidelines
ANSI/HI 9.6.1	Centrifugal and Vertical Pumps for NPSH Margin
ANSI/HI 9.6.2	Centrifugal and Vertical Pumps for Allowable Nozzle Loads
ANSI/HI 9.6.3	Centrifugal and Vertical Pumps Allowable Operating Region
ANSI/HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
ASME Code	ASME Boiler and Pressure Vessel Code
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

Reference	Title
ASTM A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A582	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A584	Copper Alloy Sand Castings for General Applications
AWWA E102	Submersible Vertical Turbine Pumps
ISO 1940	Mechanical Vibration – Balance Quality Requirements for Rotors in a Constant (Rigid) State
ISO 9001	Quality Systems
MIL STD 167-2	Mechanical Vibrations of Shipboard Equipment (Reciprocating Machinery and Propulsion System and Shafting)
NSF/ANSI 61	Drinking Water System Components – Health Effects

B. QUALITY CERTIFICATION:

All manufacturers and manufacturing sites proposed by the Contractor for supply of equipment furnished under this section and sections referencing this section shall be prepared to document quality assurance procedures conforming to ISO 9001. The documentation shall include the manufacturer's written Quality Assurance/Quality Confirmation (QA/QC) program and the documentation plan conforming to ISO 9001.

C. PERFORMANCE CONFIRMATION:

1. **HYDROSTATIC TESTS:** All pressure sustaining parts shall be subjected to factory hydrostatic tests. Hydrostatic tests shall conform to the requirements of ANSI/HI 14.6, revised to be tested for a minimum of thirty (30) minutes.

2. **PERFORMANCE GUARANTEE:** Pump performance, including efficiency and NPSH3, shall be guaranteed by the pump manufacturer to the criteria specified under this paragraph.

Equipment performance documentation, including test data, shall include sufficient test points (not less than 8) to document hydraulic performance along the complete head/capacity curve from shutoff to maximum capacity and shall cover all full speed operating points specified in the detailed specification section referencing this Section. Tests conducted at specified

Submersible Turbine Pumps for Water Well Service

11324-6

operating conditions shall be the inlet throttled to product the NPSHA indicated for that specific condition in the detailed specification. NPSH3 tests shall be performed for not less than four full speed operating conditions, but not less than all specified operating conditions and at Best Efficiency.

Test procedures shall conform to those set forth in ANSI/HI 14.6 acceptance grade 1U, and as specifically detailed in these specifications. Performance tests shall be conducted at the specified maximum speed. Affinity relationship-predicted test results will not be accepted. For column type pumps, performance documentation shall include curves showing both bowl efficiency and overall efficiency (including inlet, bowl, column and discharge head losses) at maximum operating speed for the application.

Acceptance criteria for head and capacity test results, based upon the rated condition specified in the detailed specification shall be as required in ANSI/HI 11.6 and 14.6, acceptance grade 1U.

Acceptance criteria for NPSH3 at any specified operating condition shall be the values proposed by the Contractor in the submittal curves submitted under paragraph 11324-1.04 and duly accepted by the Construction Manager, with a tolerance of plus 0, minus unlimited.

The guarantee shall include a statement to the effect that the pump will operate within the operating regions specified in the detailed specification, within meanings as defined in ANSI/HI 9.6.3. The guarantee shall be in writing, shall be signed by an officer of the manufacturing corporation, and shall be notarized. Under no circumstances shall deviations from specified operating conditions result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

3. NON-WITNESSED TESTS: All pumps shall be performance tested in accordance with ANSI/HI 14.6, Acceptance Grade 1E. The factory tests shall include test data for each full speed performance requirement (Condition Points A, B and C specified in paragraph 1.01-E). The test setup in the manufacturer's test facility shall duplicate as closely as possible the inlet conditions in the proposed installation, using temporary baffles and other means. Not less than eight (8) test points shall be taken, including not less than three within ± 8 percent (in terms of rated flow) of the rated condition (Condition Point A) and not less than two test points within ± 4 percent of the pump's best efficiency point at the test speed. In addition, one test point shall be sufficient to define head and power requirements at shutoff head.

For pumps with a NPSH margin 120% of that required in paragraph 11324-1.03 E.2, NPSH3 test are not required. For all other pumps, NPSH3 tests shall be performed to confirm the data used to establish NPSHA margin for each specified operating condition as specified in paragraph 11324-1.03 E. NPSH3 tests for vertical pumps shall be performed using the method described for Figure 2.74 or Figure 2.75 in ANSI/HI 14.6. All NPSH3 tests shall

extend from 30 percent to 140 percent of Best Efficiency Flow at full speed, or to not less than 10 percent (in terms of flow) past the flow at Operating Condition B, whichever is greater. Failure to achieve specified performance or performance proposed in accepted submittal documents (capacity and head, efficiency or NPSH3), whichever is more restrictive, shall be cause for rejection. Acceptance tolerances shall be as set forth in paragraph 11324-1.02 C.2.

All test procedures shall be in strict conformance with the referenced standards, except prediction of performance of a trimmed impeller from test data of the larger impeller will not be permitted. If trimming is required, the pump shall be retested. Under no circumstances shall deviations from specified operating conditions, though allowed by the referenced standards, result in overload of the driver furnished with the equipment, nor shall such deviations result in power requirements greater than the driver's nameplate (1.0 service factor) rating.

The Contractor shall furnish the Construction Manager with not less than 2 weeks' advance written notice of the date and place of the non-witnessed tests.

All test results, including test logs and generated curves, shall be certified correct by an officer of the pump manufacturer's corporation and shall be notarized. Contractor shall submit test results as Product Data.

1.03 DESIGN REQUIREMENTS

A. GENERAL:

Equipment furnished this section shall be designed for a minimum service life of 20-years. All components associated with the rotating elements in the drive train, including equipment supports and supports for rotating elements, shall be selected and designed to function without damage or disassembly at reverse rotational speeds up to 150 percent of maximum operational speed during flow reversals through the pump. The complete pumping unit shall operate without overload on any component at any point along the pump's entire full-speed operating curve. Pumps required by virtue of the specified operating conditions to operate against a closed valve or throttled for any period of time exceeding five seconds shall be furnished with drivers sized to operate continuously at the power requirement for that condition even though the power requirements at the rated condition may be less.

B. PUMP SELECTION:

Pump selection for a given application shall be predicated on locating the specified most frequent operating condition(s) in the PACL. These points will always include Condition Points A and B and additionally will include any other Condition Points indicated in the detailed specification as continuous duty conditions, or any additionally specified for inclusion in the PACL. Condition Point A shall be the pump's rated condition and shall be guaranteed to meet both specified head and flow within the limit established in ANSI/HI 14.6, acceptance grade 1U.

A given pump's PACL shall be determined as a percentage of Best Efficiency Flow (BEPQ) at the given speed, the pump's suction specific speed as determined in accordance with ANSI/HI 1.3, paragraph 1.3.2.2 and the relationships presented in the following table.

Limiting Flow, percent Best Efficiency Point Flow (BEPQ)*

Suction Specific Speed, less than but not greater than:	Clear Liquid pumps, minimum limit	Clear Liquid Pumps, maximum limit
7000	50	125
8000	57	122
9000	60	120
10000	65	120
11000	68	110
12000	72	112
13000	78	110

* Straight line interpolation may be used for intermediate values of suction specific speed

Exceptions to the foregoing will be considered by the Construction Manager only when the Contractor can provide certified test data demonstrating conclusively a wider region of stable pump performance. The test data shall include suction pressure pulse information as well as actual service information for the same impeller design and trim, operating at the same speed, capacities and head for the same size pump as required for the specified application.

Proposed pump selections shall be selected to allow not less than a five percent increase in head by replacement of the impellers with ones of larger diameter or of different hydraulic design, variable speed capability, or use of a blank stage. Pump selections proposing maximum diameter impellers for the proposed pump model and casing size will not be accepted.

The pumps shall operate without cavitation or damaging vibration over the entire specified range of flow and head conditions and shall be specifically selected for NPSH margin requirements detailed in paragraph 11324-1.03 E. Pump selections which do not provide the specified margin will be rejected.

All pumps furnished under sections referencing this section shall be designed in accordance with applicable portions of ANSI/HI 2.1 – 2.6 and ANSI/HI 9.1 – 9.6 and the requirements of this section.

Unless otherwise noted or specified, pump head capacity curves shall slope in one continuous curve within the specified operating conditions. No points of reverse slope inflection capable of causing unstable operation will be permitted within the specified zone of continuous duty operation. Pumps with head/capacity curves as described in paragraph 9.6.3.3.12 of ANSI/HI 9.6.3 are specifically prohibited if these characteristics will cause unstable operation within the specified range of operating conditions and where startup/shutdown conditions entail operation against a slow opening/closing valve.

Vertical pumps shall have bells selected to provide a maximum intake velocity of 4.0 feet/second when operating at the maximum specified flow or the flow resulting from the lowest specified operating head at maximum speed, whichever is the greatest. Pump discharge column sizes shall be selected to limit the calculated average velocity at peak flow (as defined previously) to no more than 12 feet/second.

C. CRITICAL SPEEDS AND NATURAL FREQUENCIES:

1. LATERAL ROTOR DYNAMICS: The complete pumping unit, including all related frames, supports, enclosures, and casings, shall be free from dangerous critical speeds from 20 percent below to 30 percent above the operating speeds required to achieve the specified performance characteristics. The logarithmic decrement for each damped natural frequency (forward or backward) shall be greater than +0.3, and the amplitude magnification factor shall not exceed 3, for any natural frequency within this range.

Process sensitivities are such that operation at infinitely variable speed within the specified operational conditions is an absolute requirement. Any remedy imposing a locked-out speed interval or intervals will not be considered an acceptable remedy for identified critical speeds. Acceptable remedies include combinations of adjustments in rotor geometry or materials, and the substitution of energy absorbing couplings. Other remedies may be considered so long as they are justified in writing and the proposal sealed and signed by the design professional retained by the manufacturer to perform the system mass elastic system analyses.

2. TORSIONAL AND COMBINED SHAFT STRESS: The pump rotor shall be free from torsional response which produces combined (steady plus alternating torque induced) stresses exceeding 30 percent of the material's elastic limit (but no more than 18 percent of the material's ultimate tensile strength) at any speed from 10 percent below to 20 percent above that required by the specified operating conditions, or during startup, shutdown or motor control transients. In accordance with MIL STD 167-2, under no circumstances shall combined (torsional steady and alternating) peak shear stresses, at points of stress concentration calculated in accordance with the requirements of this section, exceed 4 percent of the material's ultimate tensile strength, nor more than 50 percent of the material's fatigue limit, whichever is less.

D. COMPONENT DESIGN CRITERIA:

Unless otherwise specified, combined stresses in steel frames and supports shall not exceed those permitted by the AISC Manual of Practice. Combined stresses in cast, forged, rolled, or fabricated pressure retaining components, frames and supports shall not exceed that allowed for the given material in Section VIII, Division 1 of the ASME Code. Design pressures for pressure-retaining parts shall be not less than twice the pump's shutoff head at the manufacturer's listed maximum operating speed. Pump casing strain at any head on the full speed operating curve (including allowances for increases caused by specified multi-stage

applications) shall not result in distortions at the bearing housings greater than the maximum allowable by the bearing manufacturer to provide the specified bearing life.

The term “combined stresses” in this section shall mean the sum of all operating stresses, including stresses induced by dynamic and static forces as developed via the analysis procedures stipulated in this section. Static forces (x, y, z, and moments in all planes) shall include the relevant maximum nozzle loads specified in ANSI/HI 9.6.2 or as stipulated by the pump manufacturer. Dynamic forces shall include both steady state and transient stresses induced by operating conditions within the zone of operation established by the specified operating conditions.

Unless otherwise recommended by equipment manufacturer, all pump discharge nozzles shall be restrained using the equipment connection fitting specified in Section 15085.

E. NET POSITIVE SUCTION HEAD MARGIN LIMITATIONS:

1. GENERAL: Pumps furnished under this section shall be selected for NPSH (Net Positive Suction Head) margin limitations using the suction energy methodology set forth in ANSI/HI 9.6.1-2000. Net Positive Suction Head Required - 3 Percent Reduction (NPSH3) characteristics for the candidate pump shall be based upon documented test data not more than five years old, performed on a pump not more than two nominal pump diameters larger or smaller than the proposed pump with an impeller of the same geometry as that proposed for the pump to be used for the subject application, and operating at the same speed as the pump for the proposed application. The Contractor shall document the basis for pump selection based upon NPSH margin limitations as set forth in this paragraph.

NPSH3, as used in the following paragraphs, shall mean the NPSH3 at the impeller eye, determined in accordance with ANSI/HI 2.6. The Contractor shall cause the pump manufacturer to document the method used to determine NPSH3 for the proposed pump and justifying compliance with the NPSH margin limitations established under this paragraph for each specified operating condition in material submitted under paragraph 11324-1.04. The documentation shall include justification of the NPSH3 tests used to develop NPSH3 characteristics, including the following:

- a. Date, test procedure, and test logs of original NPSH3 information used to project requirements for pump selected for the application.
- b. Test pump size, impeller diameter, impeller model, eye diameter, and speed.
- c. Calculations projecting NPSHR test information to NPSHR curve information for the pump proposed for the application.
- d. Calculations demonstrating compliance with the NPSH margin requirements established in this paragraph.

The Contractor shall cause the pump manufacturer, using suction energy rules in selecting pumps proposed for each application, to apply criteria set forth in the individual paragraphs below. Percentages stated below shall apply to pump capacity on the selected pump's head/capacity curve at the speed required to achieve the specified operating condition.

The Contractor shall submit the manufacturer's suction energy calculations justifying the proposed pump selection with the material required under paragraph 11324-1.04. **For pumps with a NPSH margin 120% of that required in paragraph 11324-1.03 E.2, NPSH3 test documentation is not required.**

2. NPSH MARGIN RATIO: The methodology set forth in ANSI/HI 9.6.1 shall be employed for determining NPSH margin:

- a. A minimum NPSHA/NPSHR margin ratio of 2.0 shall apply to low suction energy pumps at any operating condition within 85 percent and 115 percent of best efficiency capacity. The minimum acceptable NPSHA/NPSHR margin ratio for low suction energy pumps at any other location on the pump's head/capacity curve shall be 2.5.
- b. Notwithstanding item a., above, the manufacturer shall use the methodology in ANSI/HI 9.6.1 to determine the proposed pump's suction energy based upon the pump's performance at best efficiency capacity and head at the speed required for meeting Condition Point A and B. In employing the suction energy method, the suction nozzle size shall be the impeller eye diameter for the proposed pump.
- c. If the proposed pump's suction energy, as determined in item b. falls into the "high" and "very high" region in Figure 3 in ANSI/HI 9.6.1, the minimum acceptable NPSHA/NPSHR margin ratios shall be 2.5 and 3.0, respectively, for specified operating conditions within the zone defined by ± 15 percent of best efficiency capacity 3.0 and 3.5 respectively, for specified operating conditions falling outside the ± 15 percent zone.

F. ELECTRIC MOTORS:

Unless otherwise specified, pumps shall be electric motor driven. All motors shall be selected to be non-overloading at any operating point along the pump's full speed operating curve, including all points located beyond specified operating conditions.

1.04 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section and the referencing section and all other applicable specification sections governing the pump, drive and driver, supports and specified appurtenances. The specification copies shall be complete with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*
2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
3. Certificate of Unit Responsibility attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this section and paragraph 11000-1.02 C. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
4. Documentation of certification of quality as specified under paragraph 11324-1.02 B.
5. Predicted pump performance curves for each condition point specified showing head, power, efficiency, and NPSH required on the ordinate plotted against capacity (in gpm) on the abscissa. Curves for variable speed pumps shall be provided to demonstrate operation at all speeds required to achieve the specified reduced speed operating conditions. All curves shall clearly display the specified operating conditions and the

manufacturer's limits for the POR and AOR, as specified in paragraph 11324-1.03 B.

6. NPSH margin calculations performed for each specified operating condition in accordance with paragraph 11324-1.03 E. 2. For pumps with a NPSH margin 120% of that required in paragraph 11324-1.03 E.2., NPSH3 information required under paragraph 11324-1.03 E. 1 does not need to be submitted, but shall be submitted for all other pumps.
7. Submersible motor information, including motor cable specifications and size.
8. Drawings showing general dimensions and confirming the size of pumps, motors, drives and specified appurtenances; piping connections; construction details of equipment; wiring diagrams; and weight of equipment.

1.05 UNIT RESPONSIBILITY

The Contractor shall assign unit responsibility, as specified in paragraph 11000-1.02C, to the manufacturer of the pumps provided under this section. All mechanical equipment components, at least, of this entire equipment assembly shall be furnished by the pump manufacturer. This manufacturer is the unit responsibility manufacturer and has unit responsibility, as described in paragraph 11000-1.02C, for the equipment assembly specified in this section. A completed, signed, and notarized Certificate of Unit Responsibility (Form 11000-C, Section 01999) shall be provided.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

The Owner and Engineer believe the following manufacturers are capable of producing equipment and products, which will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product will comply with the requirements of this Section. The pump manufacturer shall be Fairbanks-Morse, Floway, Flowserve, Goulds or equal. Motor manufacturers shall be Hitachi or equal. Units shall meet requirements of AWWA E102 unless modified by these specifications.

2.02 MATERIALS

Materials shall conform to the following:

Component	Material
-----------	----------

Submersible Turbine Pumps for Water Well Service
11324-14

Suction case (Suction inlet)	Cast iron, ASTM A48, Class 30
Discharge adapter (Top bowl flange)	Cast iron, ASTM A48, Class 30
Bowl wear rings	Bronze, ASTM B584, or cast iron, ASTM A48
Bowl assembly	Cast iron, ASTM A48, Class 30
Pump shaft	Stainless steel, ASTM A276, Type 416
Impeller	Bronze, ASTM B584
Impeller lock collets	Steel, ASTM A108, Grade 1020 or 1213
Pump bearings (Bowl bearings)	Bronze, ASTM B584
Discharge column pipe	Steel, ASTM A53, Class B, Standard Weight
Motor Adapter	Cast iron, ASTM A48, Class 30
Motor coupling	Stainless steel, ASTM A582, Type 416
Discharge elbow	Carbon steel, ASTM A53
Strainer	Stainless steel, ASTM A240, Type 304
Bolts, studs, and nuts	Stainless steel, ASTM A276, Type 304
Pitless Unit	Baker Manufacturing Company, Monitor Division

2.03 EQUIPMENT FEATURES

A. MOTOR ADAPTER:

The bottom of the pump shall be fitted with a one piece casting motor adapter designed to serve as the suction inlet, lower bearing housing and motor adapter piece. The coupling housing portion shall be designed to prevent the entrance of abrasive material into the top end of the motor. The coupling connecting the motor to the pump bowl assembly shall be of sufficient size and strength to withstand maximum torque generated by the motor.

B. STRAINER:

The suction inlet shall be provided with a strainer having a net inlet opening area of not less than four times the impeller inlet area. The strainer or mesh openings shall be sized to prevent passage of particles larger than the solids handling capability of the impeller.

C. SUCTION INLET:

The suction case shall be designed to provide conservative entrance velocities and evenly distribute the flow to the impeller. The inner surface of the case shall be smooth and free from

projections or cavities. The pump shaft lower bearing shall be housed in a streamlined casing, centered and held in place by means of rigid cast vanes.

D. PUMP BOWL:

The pump bowl shall be flanged for registered fit. Flow passages through the bowl shall be NSF 61 epoxy-lined. All pump bowls shall be designed to handle the two times the head at the rated capacity or 1.5 times the shutoff head of the pump, whichever is greater. Bowls shall not be designed to different pressure depending on stage.

Bowl assembly shall be equipped with wear rings. One bowl wear ring shall be installed for each bowl in the bowl assembly. Bowl wear rings shall be installed by the Manufacturer on the suction side of the bowl seat.

E. IMPELLER:

The impeller shall be constructed free from projections, cavities, or abrupt transitions. The impeller surfaces shall be either polished or NSF 61 epoxy-lined.

Impellers shall be of the enclosed type, with the shroud designed to rotate against wearing rings installed in the bowl assembly. Impellers shall be secured to the pump shaft using tapered collets or keyways.

F. SHAFTS:

Shafts shall be sized to prevent excessive elongation and transmit the required torque without distortion in both the forward and reverse direction. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. The pumping units shall utilize a single pump shaft extending from the suction case through a discharge case or upper bowl case containing an upper pump shaft bearing.

G. BEARINGS:

Suction case, bowl, and lower tube bearings shall be close tolerance, sleeve type. Bearings shall be lubricated by the process fluid or grease lubricated. The top case of the bowl assembly shall contain an extra long sleeve bearing with a sand cap. Intermediate bearings shall be furnished at each bowl assembly. The bearings shall have a minimum B-10 life expectancy of 100,000 hours for continuous service.

H. DISCHARGE COLUMN PIPE:

Column pipe shall be designed to support the weight of all equipment full of water. The pipe will be secured so that it will not unscrew. Discharge columns shall be fabricated with interchangeable pipe sections and unless otherwise specified, shall be joined with threaded couplings. Column interior shall be free of offsets, burrs, discontinuities, or irregularities. The

column shall be supplied in sections not exceeding 20 feet in length. Adapters will not be permitted at any point between the discharge head and the upper pump bowl. Lubrication for threads shall be Food Grade oil approved by the Food and Drug Administration (FDA).

I. SURFACE PLATE: PITLESS UNIT SYSTEM

Pitless Unit System includes well cap, lift-out bail, hold down hooks, lift out pipe, discharge body with support ring, spool with or without check valves and pressure equalizing passages.

1. PITLESS UNIT

The Pitless Unit shall be equal to Baker Manufacturing Company, Monitor Division, Model 5PS1214WBWE05.5T4ES (250 MCM, 3 conductor plus ground). The unit should be factory assembled, before shipping to the site. The pitless unit must conform to the Recommended Standards for Water Works, Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers, Health Education Services, Albany, NY., and/or Water Systems Council PAS-97 (04).

2. WELL CAP

The Watertight Cap shall be secured to the pitless casing with a compression gasket. The top of the cap can be removed without affecting the sealed conduit or wiring. The heavy duty watertight cap will have a separate protected downward facing stainless steel screened well vent with pipe nipple. Construction of the cap and well vent will be of heavy duty gray cast iron and painted with a green enamel finish.

3. UPPER CASING

The Upper Casing is factory assembled to the discharge body, and the lift out and hold down mechanism are factory assembled to the spool. Upper casing thickness must conform to the Recommended Standards for Water Works, and be coated with a rust protective coating. The upper casing must provide a watertight connection from the discharge body to the well cap. The discharge port center line to be 4 feet below grade, and the pitless upper casing to extend 1.5 feet above grade.

4. SPOOL

The spool shall include API 8 round thread female end for a male drop pipe connection and shall be constructed of lead-free galvanized heavy duty gray cast iron, ductile iron, or steel with a lead-free galvanized plating on the wetted surface of over .010 inches thick. The spool will have o-ring grooves machined into the spool retaining the o-rings when setting or pulling the system. The positive pressure o-ring seals shall be constructed of neoprene or equivalent. Spool

shall be designed to accommodate probe tubes or water samplers and NPT ports for discharge pressure taps. O-ring protection should be provided to prevent the seals from dragging on the upper casing when the pump is installed or removed.

5. DISCHARGE BODY

The Discharge Body shall be constructed of lead-free galvanized ductile iron or lead-free galvanized steel. O-ring seat to be designed to prevent crevice and galvanic corrosion, dissimilar metals should be avoided. Discharge body designed to be strong enough to prevent distortion due to vertical movement of discharge pipe thereby allowing spool to bind in the discharge body. Minimum I.D. of the discharge body to be equal to or greater than I.D. of the well casing for ease in well servicing.

6. HOLD-DOWN MECHANISM

The Pitless Unit spool should have a hold down mechanism, factory assembled to spool and capable of preventing rotation of the pitless spool relative to the discharge body, at full rated locked rotor torque of the submersible pump motor. The spool must also have a factory assembled lift out pipe and bail, or spider capable of 48000 lbs. rated load, to allow lifting a water filled drop pipe and pump out of the well for service. Components to be constructed of ductile iron or steel with a corrosion resistant coating. Optional Check Valves are not to be provided in the removable spool of the pitless unit.

J. MOTOR:

The motor shall be of the submersible electric motor type, capable of continuous operation at nameplate rating under water at a maximum temperature of 77 degrees F with 0.5 feet per second water velocity and suitable for across the line starting and shall be capable of reduced voltage starting.

The maximum horsepower rating of the motor and Service Factor shall be as specified in Section 11324-1.01F. The motor nameplate full load rating shall not be exceeded at any point on the pump performance curve.

The motor's full load efficiency rating and power factor shall not be less than the amount specified in Section 11324-1.01F. The full load efficiency shall include 100% of the thrust bearing's rated loading.

The motor shall be oil filled "wet winding type". It shall be filled with a 50/50 solution of water and food grade propylene-glycol.

Motor shall be designed to be properly cooled by passage of water past the motor.

Motor materials of construction shall be carbon steel, cast iron fitted, epoxy coated. All wetted fasteners and washers shall be of Type 316 stainless steel. Mating threaded components shall be of non-galling alloys.

The motor shall be totally enclosed, utilizing an elastomer expansion diaphragm for the equalization of internal and external pressure.

The motor shall be equipped with a double rubber type shaft seal to seal the motor at the point that the shaft extends through the casing.

Replaceable carbon composite material sleeve type radial bearings shall be provided at each end of the motor.

Thrust bearings shall have capacity to carry the weight of all rotating parts plus the hydraulic thrust at shutoff head. This shall be an integral part of the driver. The pivotal shoes shall be stainless steel and the thrust driver (or thrust bearing) shall be of carbon composite material. Antifriction bearings shall be designed such that the L_{10} calculated life shall be no less than 8,800 hours. Thrust bearings shall also be able to support downthrust conditions for a minimum of five minutes with the discharge valve closed.

The motor leads shall be sealed at the motor top bracket.

The submersible multiconductor cable shall be stranded and sized per the manufacturer's recommendation and the contract drawings for the motor size specified in Section 11324-1.01 F., meeting ASTM class B. Cable assembly and wire insulation shall be heat and moisture resistant suitable for continuous immersion in water. The cable shall have sufficient area to meet ICEA requirements for operation in air. Cable shall be mechanically shielded where it passes the pump bowls. Sufficient cable shall be provided to reach from the motor to the wellhead splice box without splices. The length of cable shall include adequate length to account for sagging of the cable, or wrapping around the column pipe. The cable shall be supported on the column pipe with stainless steel straps every 20 feet.

K. FLOW INDUCERS/COOLING SHROUD

Size and material as required by pump supplier/manufacturer.

2.04 COLUMN CHECK VALVE

The pump column shall be equipped with 3 column check valves. Check valves shall have a ductile iron body, designed to prevent flow reversal. Check valves shall be nominal size as column pipe, threaded to match the column pipe. Valves will meet all strength requirements for the column pipe. The check valve shall be Danfoss Flomatic or Goulds with break-out plug option.

2.05 SPARE PARTS

Spare parts shall include all special tools and test equipment required for the proper servicing of all equipment, as well as one set of spare parts as recommended by the pump manufacturer.

2.06 BALANCE

Balancing for pumps with suction nozzle sizes 6 inches in diameter and greater and all associated components shall conform to the requirements set forth ISO 1940 or ANSI 2.19 Grade 2.5. Major rotating elements (e.g. impellers) and shafts shall be separately balanced and then together as an assembly or "rotor." All rotors shall be dynamically balanced to an ISO 1940 G6.3 minimum for rotating speeds up to 1800 RPM. Speeds above 1800 RPM shall have an ISO 1940 G2.5 minimum balance quality if impeller weight exceeds 100 lbs. Impellers larger than 24 inches in width along the shaft centerline shall be two plane balanced. For extended shaft pumps, the rotor is defined to be the impeller(s) and shaft(s) up to the first coupling with the line-shaft.

All balance logs, certified correct and signed by an officer of the manufacturing corporation and notarized, shall be furnished as Product Data in accordance with paragraph 11324-2.07.

2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300.

1. Performance guarantee as specified in paragraph 11324-1.02 C.2.
2. Operation and maintenance information specified in Section 01730.
3. Critical speed calculations demonstrating compliance with paragraph 11324-1.03 C.
4. Installation Certification Form 11000-A as specified in paragraph 11324-3.01.
5. Training Certification Form 11000-B as specified in paragraph 11324-3.05.
6. Certification of satisfactory factory testing of each unit as specified in paragraph 11324-1.02 C. The certified material shall include copies of test logs and resulting performance curves.

PART 3--EXECUTION

3.01 GENERAL

All pump inlet and discharge nozzles shall be connected to field piping using equipment connection fittings conforming to the requirements of Section 15085. Restraining rods on equipment connection fittings shall be designed specifically to restrain the unbalanced hydraulic thrust developed by the pump when operating at full speed against a closed valve. Equipment with pump nozzle sizes 12 inches in diameter and greater shall be installed under the presence of a factory authorized installation specialist or specialists. Under no circumstances shall any installation procedures take place without the installation specialists present. Upon completion of installation work, the Contractor shall submit a complete, properly signed certification Form 11000-A as specified in Section 01999.

3.02 FIELD TESTING

After the completion of installation, each pumping unit shall be field tested to demonstrate compliance with the performance requirements as specified in Section 01660. For all units with variable speed drives and any unit with pump nozzle size 12 inches in diameter and greater, the testing procedure shall be a plan developed jointly by the Contractor and the equipment manufacturer to demonstrate performance of each item of equipment at all specified operating conditions.

Disposal of water during the testing operation shall be discharged using the flush valve and flush line. Contractor shall protect the site and drainage from damage caused by discharge.

Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage. Field tests shall consist of measuring flow, discharge pressure, pumping water level, motor voltage and amperage at a minimum of three (3) points evenly spaced on the pump curve. Each control device, item of mechanical, electrical, and instrumentation equipment, and control circuits shall be considered in the testing procedures to demonstrate that the equipment has been properly serviced, aligned, connected, calibrated, and adjusted prior to operation.

3.03 DISINFECTION

The well pumping unit shall be disinfected after placement of final pumping equipment. Disinfection procedures shall be per AWWA C-654-13. Contractor shall be responsible for any retesting costs for failed results and of disposal of chlorinated water.

3.04 WATER QUALITY TESTING

The well shall be pumped for a sufficient period of time so that construction sediments are removed from the casing. The Contractor shall sample pumped water by using a clear jar test. The Contractor shall sample the well within the first minute of operation and then sample the well every ten minutes thereafter for a minimum of the first hour of operation. The well shall be pumped until the sample is clear and no sediment is observed as approved and directed

by the Construction Manager. The Contractor shall be responsible for all pumping costs, disposal or storage of water, and any associated permits.

3.05 TRAINING

Training shall conform to the requirements of Section 01664 and shall include separate training sessions for each operator shift maintained by the Owner and a separate session for maintenance personnel. The training session for maintenance personnel shall include complete field and shop disassembly and subsequent reassembly of one complete pumping unit selected by the Construction Manager. Field disassembly demonstrations are exempted so long as the training session includes a step-by-step tutorial (including video on DVD format) of the removal/disassembly/reassembly/reinstallation process. Unless otherwise specified, the training requirement is waived for constant speed pumping equipment with suction nozzle sizes 6 inches in diameter and smaller and for all pumps with connected power requirements 10 horsepower and less. Upon completion of all training requirements, the Contractor shall submit certified Form 11000-B as specified in Section 01999.

****END OF SECTION****

SECTION 11700

CHLORINE CONTAINMENT SYSTEM AND ACCESSORIES

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

Chlorine containment system for compressed chlorine in single one-ton cylinder complete with nitrogen gas operated failsafe valve, nitrogen gas supply line to fail-safe actuator, 120 V.A.C. electrical supply line to fail-safe actuator, alarm supply line to fail-safe actuator, scale system with electronic indicator, interior vessel rollers, pressure relief valve, pressure/vacuum gauge and pressure switch, seismic bracing, pressure supply flex hoses (interior), halogenated lubricant, valves, fittings, cylinder loading system (fixed), and manufacturer's on-site consultation services during installation and testing.

B. DESIGN REQUIREMENTS:

Gas containment vessel shall be designed to operate a single one-ton chlorine gas cylinder with vacuum-operated chlorine feed systems. The gas containment system shall provide for a design pressure of 250 psig at 300 degrees Fahrenheit; minimum design metal temperature (MDMT) shall be -20 degrees Fahrenheit at 250 psig; 1/16" corrosion allowance provided; service - chlorine containment.

1.02 SUBMITTALS

The following shall be submitted in accordance with Section 01300 and shall include the following information.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. A copy of the contract document control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. Electrical wiring diagrams.
4. Catalog information and detailed drawings as applicable for each component to indicate compliance with specified requirements.
5. Drawings showing all required external connections.
6. List of materials and coatings used.
7. Certification and ASME Code data reports in accordance with the ASME Code and, as applicable, 49 CFR 178.337 or other similar codes. The certification shall include certification of hydrostatic testing.

1.03 QUALITY ASSURANCE

A. STANDARDS:

Components and installation shall comply with the Uniform, Standard and National Building and Fire Codes.

Welding shall be in accordance with ASME Code Section IX using any of the following PPC welding procedures:

1. SMAW P1-B1
2. GTAW/SMAW P1-42-1A
3. SMAW/SAW P1-1A
4. GTAW P1-1A
4. FCAW P1-1 ¾ (for non-pressure welds only)

All completed welds shall be visually inspected per inspection procedures QVE-1 Revision 2. Spot radiograph welds per UW-52 of ASME Code Section VIII, Div 1. One increment of weld shall include a junction.

Fabrication shall be in accordance with ASME Code Section VIII, Div. 1. Vessel shall bear a stainless steel ASME nameplate. Nameplate shall bear the applicable code symbols. Manufacturers shall be authorized by ASME to apply the applicable code symbols.

B. FACTORY TESTING:

After fabrication, but prior to application of coating, tank shall be tested in accordance with ASME Code. Tanks shall be hydrostatically tested at the factory to 375 psig per UG99.

C. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility as specified in Section 11000 paragraph 1.02.C to the chlorine containment system equipment manufacturer for the equipment specified in this section. A certificate of unit responsibility shall be provided.

1.04 WARRANTY

The chlorine gas containment vessel shall be warranted by the manufacturer for full replacement for twelve months from the date of final acceptance.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS:

Chlorine Containment System and Accessories
11700-3

Contract 2
Bid Issue

The equipment specified in this section shall be TGO Technologies, Inc. "Chlortainer", or equal and specified accessories. Weigh scale shall be Force Flow with Wizard 4000 indicator/transmitter, or equal.

2.02 MATERIALS:

Component	Material
Containment vessel	Carbon steel
Door O-ring	Viton
Chlorine valves	
Body	Aluminum silicon bronze Alloy B
Stem	Monel
Interior chlorine transfer hoses	Monel 400 with Type 316 stainless steel cover
Pressure relief valve	
Body	Carbon steel
Trim	Monel
Seat	Teflon
Spring	Inconel X750
Cylinder loading system frame	Carbon steel

2.03 EQUIPMENT FEATURES

A. GENERAL:

Containment system shall consist of a cylindrical containment vessel for a single one-ton chlorine cylinder. The chlorine gas containment system shall operate with a vacuum-operated solution feed system (provided by others). Containment vessel shall include a nitrogen gas/ electrically operated fail-safe valve, nitrogen gas supply and fail safe actuator, 120 VAC electrical connection to fail safe actuator, interior vessel rollers, pressure relief valve, vacuum/pressure gauge, pressure supply flex hoses (interior), valves, piping and fitting accessories, and weighing system. A container loading system shall be provided.

B. CONTAINMENT VESSEL:

Vessel shall be 40-inch diameter. Vessel door design shall be chain drive horizontal double bolt door design closure. Door O-ring shall be provided. Cylinder holding bay within vessel shall be provided with interior rollers, Force Flow Model 21L Roller Trunnions or equal. Bosset connections shall be provided for one primary chlorine gas draw point and one alternative chlorine gas draw point. Ton container valves shall be provided on the exterior for each connection. Ton container valves shall be Sherwood Type 1214 X1-B1, or equal. Two threaded elbow-coupling manual connections shall be welded into interior of vessel. One connection shall be provided for pressure check valve and other connector shall be provided for vacuum/pressure gauge. A ton container valve shall be provided for each elbow coupling connection. Ton container valves shall be Sherwood Type 1214 X1-B1, or equal. A coupling connection into interior of vessel shall be provided for pressure relief valve. All necessary fittings compatible with chlorine service shall be provided to accomplish connection of valves, switches and gauges to containment vessel.

Chlorine Containment System and Accessories

11700-4

Contract 2
Bid Issue

The containment vessel interior shall be sandblasted to SSPC-SP-10 and then coated to 2.5 to 3.0 Mils DFT with Carbonzinc 11 HS (inorganic zinc primer). The vessel exterior shall also be blast cleaned to SSPC-SP-6, then prime coated to 4 to 6 Mils DFT with Ameron 385 Epoxy (Red), or equal. Finish coat exterior with Devoe Coatings Devthane 379 Polyurethane, or equal to 2 Mils DFT. Color BL-6 (OSHA Safety Blue).

C. INTERIOR TRANSFER HOSES:

Provide one chlorine transfer hose within interior of containment vessel. Transfer hose shall be corrugated material specified. Each transfer hose shall be gas pressure tested at a minimum of 750 psig. Each transfer hose shall be ¼ inch inside diameter x 38 inches in length with ¼ in. MNPT ends. One yoke adaptor #5888-D-1/2-1/4 NPT, one yoke assembly #U1953 ASSY 628, and one ½ x ¼ in.-3000 lb. threaded 90 degree Monel 400 elbow shall be provided for each transfer hose.

D. VESSEL PRESSURE RELIEF VALVE:

Provide one pressure relief valve per containment vessel. Valve shall be connected to containment vessel interior. Valve size shall be ¾ inch MNPT inlet, 1 inch FNPT outlet. Valve shall be Crosby 900 Omni Trim Valve Model No. 951631 MA Inconel X750 Spring or equal. Set at 225 psig.

E. VESSEL VACUUM/PRESSURE GAUGE AND SWITCH:

Pressure/vacuum gauge and diaphragm shall be Ashcroft, 3.5 inch dial, 30 inch vacuum, 100 psi pressure range, diaphragm-protected (Viton), ¼ inch threaded with Monel 400 nipple, gauge type #35-1009AW-02L-30/100 or equal, diaphragm type W/25-310UH-02T or equal, Halocarbon fill. Provide appropriate connectors for connection of gauge to vessel interior elbow connector. Pressure switch shall be Mercoid Series A1F or equal, diaphragm-protected, with NEMA 4X enclosure. Diaphragm seal shall have Halocarbon fill.

F. CYLINDER LOADING SYSTEM:

Cylinder loading system shall be manufactured by TGO Technologies or equal and accommodate a single one-ton chlorine cylinder. The cylinder support bed shall include rollers on which the cylinder can be easily slid directly into the containment vessel. The loading system shall be mounted to concrete with stainless steel anchor bolts and fasteners. Anchor bolts and fasteners to be supplied and installed by Contractor. Installation shall be per Manufacturer's instructions.

G. FAIL-SAFE VALVE SYSTEM:

Fail-Safe actuator and valve system shall consist of an electro-pneumatic actuated ball valve with nitrogen supply system. One fail-safe actuator and valve system shall be provided. One backup manually operated valve system shall be provided. Fail safe assembly shall include actuator, Jamesbury VPVL051SR6 or equal; limit switch, Stonel Quartz QN33C02SRA-TGO-02 or equal; and solenoid valve, Asco EF8320G714/120V or equal. Ball valve shall be Jamesbury 4CBC-7173XTB-2 or equal, ½ inch, Monel body, Hastalloy ball, Teflon seats, chlorine cleaned. Backup manual valve

Chlorine Containment System and Accessories

11700-5

Contract 2
Bid Issue

shall be ½ inch, Monel body, Hastalloy ball, Teflon seats, chlorine cleaned. Nitrogen system for pneumatic operation of fail-safe valve system shall include one 55 cubic foot capacity high pressure nitrogen gas cylinder with a supporting stand; one pressure regulator, Harris 25-80P-580 or equal, and one pigtail assembly of ¼ inch-1500 psi, 72 inch long Teflon tube with braided stainless steel covering, with one safety relief valve.

H. CHLORINE WEIGHT SCALES:

One weigh scale shall be provided for the containment vessel, sized and designed for the containment system and associated single one-ton gas cylinders. The chlorine weighing scale system shall be within the dimensions of the equipment it supports. A single digital readout and transmitter system shall be provided. Digital readout shall be of the dual display type and shall have the capability to display net, gross, and tare values. Readout shall be equipped with a digital keyboard for easy entry of tare values. The weight indicator shall be provided with a weight transmitter 4-20 mA DC for remote signal transmission of scale contents (chlorine weight).

2.04 PAINTING

Vessel painting shall be as specified herein. Pipe painting shall be in accordance with Section 09900. If any damage to the paint system occurs, the equipment shall be repainted as directed by the OWNER.

2.05 ANCHOR BOLTS

Anchor bolts and nuts shall be of ample size and strength for the purpose intended and sized by the equipment manufacturer, using methods designed to transfer the full, ultimate strength of the anchor bolt to the concrete foundation. See TGO Technologies, Inc installation instructions for size recommendations. Anchor bolts shall be supplied and installed by Contractor. Installation shall be per Manufacturer's instructions.

2.06 SPARE PARTS AND ACCESSORIES:

The following spare parts shall be furnished:

- One (1) ½" valve rebuild kit (ball & packing)
- One (1) Viton O-ring for 40-inch closure
- One (1) flex hose: one interior, one exterior
- One (1) pressure/vacuum gauge with diaphragm seal
- One (1) Type 628 yoke and high flow yoke adapter
- Two (2) twisted ton chlorine wrenches
- Six (6) vessel closure locking nut gaskets
- One (1) leak test assembly w/chlorine ton valve
- Eight (8) Teflon packing for chlorine valve
- One (1) TGO Complete Failsafe valve
- One (1) CGA Fitting

Chlorine Containment System and Accessories
11700-6

One (1) 1-lb. Container 25-5S Grease
One (1).Harris (testing) Nitrogen Regulator
One (1) Nitrogen Safety Relief valve
One (1) 55-lb Nitrogen Container filled

The following special tools and equipment shall be furnished:

One (1) 1/4 in. Drive Torque Wrench - SK Professional # SKT0400
One (1) 1/4 in. Drive 5/16 in. 12 pt. Socket - Westward # 5MV50
One (1) Combination Wrench 5/16 in. - Proto # J1210EF
One (1) Combination Wrench 7/16 in. - Proto # J1214ASD
One (1) Grease Gun - Westward # 4BY69
Two (2) Multi-Purpose Grease - ThermaPlex # 70614

2.07 PRODUCT DATA:

The following information shall be submitted in accordance with Section 01300:

1. Installation instructions.
2. Dimensional drawings as required for installation, including clearance requirements.
3. Operations and maintenance information specified in Section 01730.
4. Installation Certification Form 11000-A as specified in paragraph 11700-3.01.
5. Training Certification Form 11000-B as specified in paragraph 11700-3.03.

PART 3--EXECUTION

3.01 INSTALLATION AND TESTING

The Contractor shall install and test the equipment in strict conformance with the manufacturer's recommendations. Vacuum regulators (by others) shall be connected to the supply valve on the containment vessel. The equipment shall be checked, tested, and placed in operation by a factory-trained manufacturer's representative. The manufacturer's representative shall provide a minimum of 2 full (8 hr) days of service to fulfill the requirements of this paragraph and those specified in paragraph 11700-3.03. Installation of the chlorine containment system shall be certified on Form 11000-A as specified in Section 01999. Installation, testing, and commissioning shall be carried out in accordance with Sections 01660 and 01662. Unless otherwise specified, equipment unit shall be anchored to structural systems and shall resist all forces incidental to equipment operation.

3.02 START-UP

Chlorine Containment System and Accessories
11700-7

Contract 2
Bid Issue

A. CLEANING:

All parts of equipment or piping that may come in contact with chlorine shall be free of oil or grease before being put into service. Valves shall be dismantled, thoroughly cleaned with suitable solvents, and repacked if necessary. Any pipe dope inside the pipe shall be removed and oil or grease shall be removed with suitable solvent. The interior of all piping and valves shall be clean and thoroughly dry. Cleaning shall comply with paragraph 15050-3.05 E.

B. INITIAL OPERATION:

Chlorine gas shall be admitted to the system only after the installation of all equipment is completed and the system has been tested and thoroughly checked for leaks. Testing shall comply with paragraph 15050-3.04 D.

3.03 TRAINING

The Contractor shall provide the services of a factory-trained manufacturer's representative to provide training. A minimum of 2 hours of training on operating and maintenance procedures for the chlorine containment system shall be provided to plant operations staff. Training shall conform to Section 01664 and shall be certified on Form 11000-B in Section 01999.

****END OF SECTION****

SECTION 11727

CHLORINE GAS FEED SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. SCOPE:

The chlorination system specified in this section shall be provided by a single supplier or manufacturer.

Provide the provide labor, materials, tools, equipment and services required to furnish, install and test the chlorination system as shown on the Drawings, as specified herein, and as required for a complete functioning system.

B. The chlorine gas feed system shall be a vacuum operated type consisting of:

1. Two (2) cylinder-mount standard (non-switchover) vacuum regulators for 150 lb cylinders.
2. One (1) standard (non-switchover) vacuum regulator with drip leg for ton container, to be mounted externally to ton container containment system (chlortainer - see specification 11700).
3. One (1) automatic switchover module.
4. Two (2) rotameter panels with three (3) rotameters each - three (3) rotameters with 0 - 10ppd range on one panel and three (3) rotameters with 0 - 20ppd range on the other. Each panel shall also include three (3) solenoid valves and six (6) isolation ball valves to allow isolation of each rotameter/solenoid valve combination.
5. Two (2) injectors with $\frac{3}{4}$ " inlet/outlet connections
6. Two (2) booster pumps sized appropriately for chlorine feed rates.
7. Pressure gauges for water line to/from booster pumps and to/from injectors.
8. Safety Equipment, Two (2) Self Contained Breathing Apparatuses (SCBAs) with 30 minute air tanks, and SCBA enclosure.

9. One (1) dual cylinder weight scale with 4-20 mA signal output.
 10. Chlorine Residual Analyzer system.
 11. One (1) Chlorine Gas Leak Detection system.
 12. Necessary vacuum & vent tubing, fittings, and wrenches.
- C. System shall have a maximum capacity of 200 pounds per day (PPD) of gaseous chlorine and sized to feed 80 PPD of chlorine, 60 PPD for pretreatment application and 20 PPD for post treatment residual application.
- D. System shall be manually controlled having a feed range of 20:1 and the capability to control within $\pm 4\%$ of the indicated feed rate.
- E. Ton cylinder containment equipment is specified in section 11700. 150 lb. chlorine cylinders and 1 Ton chlorine containers shall be supplied by Owner.

1.02 QUALITY ASSURANCE

A. REFERENCE STANDARDS:

Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. Recommendations of The Chlorine Institute, Inc.
2. Occupational Safety and Health Act
3. Joint Industrial Council
4. Instrumentation, Systems, and Automation Society
5. International Building Code – 2006

B. MANUFACTURER'S QUALIFICATIONS:

Equipment shall be the standard product in regular production by manufacturers of chlorination equipment and shall essentially duplicate equipment that has been in satisfactory operation in at least five (5) installations for a period of at least five (5) years.

The single supplier or manufacturer of the chlorination system will have to provide certain components, as noted, from other manufacturers in order to meet all the requirements of this Section.

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300.

A. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
2. A copy of the contract document process and instrumentation diagrams P-101 and P-102, and mechanical layout drawings M-100 and M-120 relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. Marked product literature for all the devices and components. Include electrical connection diagrams.
4. Equipment wiring diagrams identifying internal and face mounted components and connections to remote equipment.
5. Pump motor data sheets.
6. Shop drawings indicating construction and installation details, a complete detailing of the materials construction and equipment weights.
7. Dimensioned drawings of all equipment and accessories as a complete system including cross-section views.

8. List of spare parts and maintenance items to be provided.

PART 2 PRODUCTS

2.01 VACUUM REGULATORS

- A. The vacuum regulators shall be rated for 200PPD of chlorine.
- B. They shall be designed to reduce full chlorine gas supply pressure to a vacuum without venting.
- C. A self-aligning yoke designed to Chlorine Institute recommendation per drawing 189 shall be provided as an integral part of the vacuum regulators.
- D. The units shall include a selector knob and icons to indicate the chlorine gas container status. Each regulator shall include easy to read indication of the following positions:
 1. Operating
 2. Empty
 3. Off
- E. An off position shall be provided to isolate the diaphragm and internal components from atmospheric air when the operator changes containers.
- F. Vacuum regulators shall contain internal pressure relief capability.
- G. Vacuum regulators shall not include automatic switchover capability (non-switchover).
- G. The check valve assemblies shall close in the event of leakage past the primary valve.
- H. Vacuum regulators shall be Siemens (Wallace and Tiernan) S10K or approved equal.
- I. Regulators for 150 lb. cylinders shall be cylinder mounted.
- J. Regulator for the ton cylinder shall include drip leg and shall be mounted on the exterior of the chlorine containment vessel. See project drawings.

2.02 AUTOMATIC SWITCHOVER

- A. A remote automatic switchover module shall be furnished to change over to new supply as the on-line supply is depleted.
- B. Switchover shall be equipped with manual release handle for manual switchover.
- C. Switchover shall be non-isolating, such that when the switchover is accomplished gas shall continue to be drawn from the former source until the container is empty.
- D. Switchover shall be wall or panel mounted and have easy to read indication for indication of operation status, including indication of which source is active.
- E. Switchover shall be Siemens (Wallace and Tiernan) Series 55-410 or pre-approved equal.

2.03 ROTAMETER PANELS

- A. Rotameters shall have needle valve type or v-notch type rate control, with manually adjustment capability.
- B. Rotameters shall be Siemens (Wallace and Tiernan) S10K or approved equal.
- C. Solenoid valves shall be 2-way, direct acting, and shall be suitable for chlorine gas vacuum service. Valves shall be ½-inch and operate at negative pressure and up to 120 degrees F. Unpowered position shall be normally closed. Power requirement shall be 110 VAC.
- D. Panels shall include ½" manual schedule 80 PVC ball valves on inlet and outlet of each flow branch as shown on project drawings. Ball valves shall be suitable for chlorine gas vacuum service.
- E. Rotameter panels and associated vacuum solenoids shall be pre-assembled and mounted on a ½" thick plastic back panel suitable for wall mounting.
- F. The rotameter tubes, solenoid valves and ball valves shall be serviceable without removing the panel upon which they are mounted from the wall.

2.04 INJECTORS

- A. The gas feed system shall have two PVC ¾" fixed throat injectors to generate the operating vacuum for the system.
- B. One injector shall be capable of feeding against a backpressure of 130 PSI with an operating pressure of 245 PSI, at a flow rate of 7 gpm to provide sufficient vacuum to inject up to 60 PPD chlorine gas.

- C. One injector shall be capable of feeding against a backpressure of 105 PSI with an operating pressure of 215 PSI, at a flow rate of 3.5 gpm to provide sufficient vacuum to inject up to 20 PPD chlorine gas.
- D. Injectors shall include built-in double check valve protection to prevent water from back flooding into the vacuum regulator.
- E. A corp stop type injection quill for diffusing the chlorine solution created in the injector into the water piping, as shown in the project drawings shall also be furnished as a part of this system.
- F. The injector shall be mounted directly on the injection quill. A section of flexible hose shall be connected to the inlet side of the injector. See project drawings.
- G. Injector shall be capable of mounting in either the vertical or horizontal plane.
- H. Injector shall be Siemens (Wallace and Tiernan) S10K 3/4" Standard Injector or approved equal.

2.05 CHORINE INJECTOR SOLUTION BOOSTER PUMPS

- A. The booster pump for residual application shall be a Grundfos Model CR 1S-11, with three-quarter (0.75) horse power 480 VAC three phase motor or approved equal.
- B. The booster pump for pretreatment application shall be a Grundfos Model CR 1-11, with one and a half (1.5) horse power 480 VAC three phase motor or approved equal.

2.06 PRESSURE GAUGES, WATER/SOLUTION SERVICE

- A. The pressure gauges for suction/discharge lines from the booster pumps shall be 2 inch, 270-degree movement and suitable for stem mounting. The pressure gauges shall have a 1/4 inch NPT process connection.
- B. The pressure gauges for suction/discharge ends of the injectors shall be 2 inch, 270-degree movement and suitable for stem mounting. The pressure gauges shall have a 1/4 inch NPT process connection.

2.07 SAFETY EQUIPMENT

An emergency repair "Kit A" for 150 lb chlorine cylinders shall be supplied.

2.08 SELF CONTAINED BREATHING APPARATUS (SCBA)

The SCBA shall be an MSA Workmask, or approved equal, suitable for use with chlorine gas, with 30-minute air tank.

2.09 SCBA ENCLOSURE

The wall mounted enclosure for the 30 minute SCBA shall be constructed of fiberglass reinforced plastic (FRP).

2.10 CHLORINE CYLINDER SCALE

- A. Chlorine cylinder scales shall be the CHLOR-SCALE model 150[®] with TUF-COAT[™] coating and SOLO[®] G2 digital display, as manufactured by Force Flow Equipment or approved equal. A quantity of one set of dual chlorine cylinder scales shall be provided as a part of the chlorination system and shall be of the digital readout/electronic load cell type. Scale platforms shall be constructed of non-corrosive PVC plastic and sized to accept 150 lb. chlorine cylinders up to 10.5 inches in diameter. Platform height shall be no more than 1 5/8 inches higher than height to allow easy handling and unloading of cylinders. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact and UV light. Full scale accuracy shall be < 1%.
- B. Scale shall be of the single load cell design. Weight shall be transferred via a pivoted platform to a single stainless steel canister load cell of the electronic strain gauge type. Load cell shall be mechanically sealed with o-rings. Potted-type load cells shall not be accepted. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 10 feet. Cylinder chaining bracket shall be wall mounted and use a double coil chain and a spring loaded snap hook to sure cylinder. Chaining bracket shall have an integral tool rack for storing cylinder change-out tools.
- C. A remote mounted 4½ digit LCD indicator shall be housed in a NEMA 4X, UL approved enclosure. LCD Indicator shall be backlit with .5" characters for ease of readability in low light conditions. To allow indication of net weight, indicator shall be equipped with a sealed ten-turn knob for tare adjustment. Indicator shall output net weight via a 4-20mA signal for remote monitoring. Indicator shall have two adjustable set points for alarms or liquid level control. Set points shall activate (2) 1/2A dry contact relays. Power: 115 Vac.
- D. Scales shall carry a Full Five (5) Year Factory Warranty. "Limited" Warranties shall be considered unacceptable.

2.11 TON CYLINDER EQUIPMENT

One (1) Ton cylinders require secondary containment. A Chlortainer containment system for a one (1) ton cylinder is specified in specification 11700.

Chlorine Gas Feed System
11727-7

Contract 2
Bid Issue

2.12 CHLORINE RESIDUAL ANALYZER

A. GENERAL:

An on-line chlorine analyzer shall be provided to continuously measure free chlorine residual. Each chlorine monitor shall consist of a direct measuring chlorine sensor, flow cell, sensor interconnect cable with quick disconnect plug, and an electronic monitor housed in a NEMA 4X enclosure suitable for wall, pipe, or panel mounting.

Accuracy: ± 0.02 ppm or 0.5% of full scale. Range 0 – 5.00 ppm.

B. FREE CHLORINE MONITOR:

Chlorine sensor shall be a direct measuring polarographic sensor utilizing a special polymeric membrane to isolate the sensing electrodes from the sample and eliminate the potential for electrode contamination. The membrane shall allow chlorine to diffuse into the sensor where it shall react with the sensing electrode, generating a signal that is linearly proportional to chlorine concentration.

Chlorine sensor shall be constructed with a quick disconnect receptacle to allow easy sensor servicing or exchange. Chlorine sensor shall be furnished for insertion installation. The sensor assembly shall also contain a precision RTD temperature sensor to continuously measure sample temperature to allow temperature compensation of the measured chlorine value.

C. CHLORINE INDICATING ANALYZERS:

The chlorine analyzer shall provide an AC powered instrument for operation on 115 VAC single-phase line power. The monitor shall provide two isolated 4-20 mA outputs configurable for chlorine, temperature, pH or PID control. Analog outputs shall be both ground isolated and isolated from each other.

Chlorine analyzers shall also contain two SPDT relays. Relays shall be programmable for either control or alarm function, or relays may be assigned to diagnostic functions for use in indicating trouble conditions at a remote location.

Diagnostic functions shall be incorporated into the transmitter. The 4-20 mA output shall be capable of being assigned to safely rise to 20 mA, fall to 4 mA, or be left alone, during diagnostic failures. Diagnostic error messages shall be displayed in clear language; no confusing error codes shall be displayed.

Provide output hold and output simulate functions to allow for testing or remote receiving devices or to allow maintenance without disturbing control systems.

E. CALIBRATION TOOL:

1. Provide photometer or color disk kit to use in calibration, Hach CN-66F, or equal.

2.13 CHLORINE GAS LEAK DETECTOR

A. SYSTEM PERFORMANCE REQUIREMENTS:

The chlorine gas detection system shall measure and display gas concentration and provide alarms when preset limits are exceeded in Chlorine Room. The system shall consist of a NEMA 4X alarm module and a remote mounted gas sensor/transmitter.

The gas leak detection system shall meet the following performance requirements:

1. Power Supply Module Requirements:
 - a. Input: 115 VAC, 60 Hertz with battery back-up
 - b. Output: Regulated, 13.7 VDC, 1A
2. Operating Temperature Range: -40° to 55° C.
3. Relative Humidity Rating: 0-99% non-condensing.
4. Enclosures (Sensors and Monitor/Transmitter): Corrosion Resistant, NEMA 4X designed for wall mounting, UL approved.
5. Gas Measuring Ranges:
 - a. Standard Range: 0-10 ppm.
6. Accuracy: $\pm 5\%$ of reading.
7. Repeatability: $\pm 2\%$ of reading.

B. RECEIVER MODULE:

Receiver module shall provide a high intensity digital LED display of gas concentration, plus alarm indicator LED's for Warning, Alarm, and Trouble. Two programmable alarm setpoints shall be provided for warning personnel of differing levels of leakage. Gas leak alarms shall be indicated by flashing LED indicators on the alarm receiver.

The concentration of the gas shall be displayed directly in PPM units. Three alarm relays shall be provided for external alarming functions. Each alarm relay shall be independently assignable to either the low or the high alarm setpoint, and shall also be programmable for latching and/or fail-safe operation.

Alarm module shall consist of a NEMA 4X enclosure containing one modular receiver, and one power supply. The enclosure shall contain a hinged window to allow access to controls without tools, and shall be suitable for wall or surface mounting.

Each receiver shall provide an isolated 4-20 mA output signal proportional to gas concentration, and shall also contain remote reset input terminals to allow alarm acknowledgment from a remote location.

1. Alarms: Two adjustable concentration alarms, set point adjustable from 5-100%.
2. Alarm indication: High Intensity LED Bars for Warning (low setpoint) and Alarm (high setpoint). Indicators shall operate as follows:
 - a. Warning level indicator shall be non-latching.
 - b. Alarm level indicator shall be latching.
3. Alarm relays: Three assignable alarm relays.
 - a. Functions: Each relay shall be user-assignable for either “alarm” setpoint level (warning or alarm), and shall be configurable for normal/fail-safe, and latching/non-latching, and fast/slow operation.
 - b. Contact Rating: 10A at 120 VAC.
4. Trouble Alarm: Front panel LED indicator and SPDT, factory set for fail-safe operation.
 - a. Functions: Indicates loss of sensor/transmitter input or failure of sensor.
 - b. Contact Rating: 10A at 120 VAC.
5. Gas Alarm Beacon: Red rotating flashing beacon to indicate gas leak mounted outside the building at the entrance door and a warning sign not enter and to call NTUA when Beacon is flashing – indicating a gas leak.

C. POWER SUPPLY:

The power supply in the receiver module shall be a modular design providing DC power to up to two receiver modules. A third DC output shall be provided to float charge a standby battery system to provide battery backup to the entire detection system in the event of power failure. The power supply shall operate from 115 volts AC, without adjustment, and shall also contain a power failure relay for remote power failure indication.

Battery backup module shall be housed in a NEMA 4X enclosure and shall be suitable for operating the detector for at least 4 hours in the event of power outage. Battery backup units shall contain protective circuitry to isolate the battery in the event that battery voltage drops to levels where battery damage might result.

D. ACCEPTABLE PRODUCT:

The chlorine gas detector shall be Siemens (Wallace and Tiernan) or approved equal.

2.14 SPARE PARTS

Provide the following spare parts with the chlorine gas feed system:

1. One (1) spare booster pump (for each booster pump).
2. One (1) spare educator/injector assembly.
3. One (1) spare pressure gauge (for each pressure range).
4. Three (3) spare solenoid valves.
5. One (1) spare rotameter.
6. One (1) complete set of all special tools required for maintenance of chlorine gas leak detection equipment.

Provide the following for each chlorine sensor provided with chlorine residual analyzer:

1. Ten (10) spare membranes or one spare complete sensor
2. Electrolyte, if applicable
3. Spare parts kit that includes all o-rings and special hardware

2.15 PRODUCT DATA

Provide the following in accordance with the requirements of Section 01300.

1. Manufacturer's operation and maintenance information as specified in Section 01730, including:
 - a. Final reviewed submittal.
 - b. Record of Analyzer configuration settings.

2. Installation forms specified in Part 3.
3. Training forms specified in Part 3.
4. Training information as specified in Section 01664

PART 3 EXECUTION

3.01 INSTALLATION

- A. The equipment shall be installed per the contract documents and manufacturer's recommendations.
- B. Configure the leak detector leak alarm to be fail-safe and closed under normal conditions.

3.02 FIELD SERVICES

- A. A factory trained technician shall provide eight on-site hours of start-up and training service for this system. Training shall be per Section 01664.
- A. A factory trained technician shall provide monthly on-site analyzer calibration and chlorinator adjustment service for one year from date of initial service. Service to be scheduled in advance with and witnessed by NTUA Operations personnel.

3.02 WARRANTY

- A. In addition to the requirements of General Conditions, the equipment/system warranty, unless otherwise stated, shall be one year from start-up or 18 months after shipment.

**** END OF SECTION****

SECTION 11825

PACKAGE GRANULAR ACTIVATED CARBON ADSORPTION SYSTEM FOR DRINKING WATER TREATMENT

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies a vertical pressure adsorption system utilizing granular activated carbon media for adsorption treatment of potable water in removing total organic carbon compounds (TOC), taste, and odor from municipal ground water supplies. Main components are denoted on contract drawing P-102. Equipment for this specification must be furnished by the same manufacturer as iron and manganese removal equipment specified in section 11830.

B. TYPE:

Equipment provided under this section includes vertical steel pressure vessels, underdrain systems, inlet distributors/backwash collectors, rate of flow control valve, differential pressure switch, flow meter, motor operated valves, combination air/vacuum valve, and all necessary auxiliary equipment to provide a complete system capable of meeting specified performance requirements. GAC media is specified in Section 13540.

C. EQUIPMENT LIST:

Item	Equipment No.
GAC Adsorption Vessel C	FLT-C
GAC Adsorption Vessel D	FLT-D
Pressure Differential Switches	DPS-C, DPS-D
Combination Air/Vacuum Valves	A/V-C, A/V-D
GAC System Control Valves	V1-C, V1-D V2-C, V2-D V3-C, V3-D V-4C, V-4D

Item	Equipment No.
	V5-C, V5-D, V6-C, V6-D
GAC System Backwash Flow Meter	FM-5
GAC System Backwash Rate of Flow Control Valve	FCV-5

The Pressure Differential Switches, and Magnetic Flow Meter shall be integrated with the filter control panel specified in Section 11830 PRESSURE FILTERS – IRON AND MANGANESE REMOVAL.

D. PERFORMANCE AND DESIGN REQUIREMENTS:

1. **GENERAL:** The adsorption equipment provided under this section shall be designed specifically for adsorption and removal of organic compounds (disinfection by-product precursors), taste, and odor in the treatment of potable drinking water from ground water sources. Disinfection of adsorption system components will be required at startup. As such, all immersed system components shall be suitable for exposure to 12.5 percent sodium hypochlorite or a chlorine solution of 50 mg/l as Cl₂. Operation and control of the adsorption process shall be by the control panel specified in section 11830. The design of the adsorption vessels shall ensure that the media is adequately fluidized to promote efficient cleaning of the media during hydraulic washing cycles without any measurable media losses (less than 5 percent per year) or clogging of the underdrain system and inlet/backwash collector. The system shall not require air scour cleaning.

2. **OPERATING CONDITIONS:**

Inlet water characteristics:

pH	7-9
Temperature, °C	15-20
TOC, mg/L	1.5-2.5

Operating Pressure, psig	130
--------------------------	-----

3. **DESIGN REQUIREMENTS:**

Pressure vessels:

Number, minimum	2
-----------------	---

Package Granular Activated Carbon Adsorption System for Drinking Water Treatment
11825-2

Contract 2
Bid Issue

Diameter, maximum, ft	11
Straight wall height, ft	As required by adsorption vessel manufacturer to achieve a 40% bed expansion without excessive media loss
Working pressure, psig	150 @ 100 °F
GAC media depth, minimum, ft	As required by GAC adsorption system manufacturer to achieve specified empty bed contact time (EBCT) and prevent short circuiting of contaminants
Support media depth, minimum, ft	N/A
GAC media volume / tank, minimum, cu ft	700 (based on empty bed contact time (EBCT) of 7.5 minutes per tank at max design flow)
Interconnecting system:	
Pipe diameter, inches	6 and 8
Control Valve type	Butterfly
Rate of Flow Control Valve type	Globe
Power Requirements	
1 Phase 120 Volts, 60 Hz	

4. PERFORMANCE REQUIREMENTS:

Max. treated water TOC concentration, mg/L	0.1
Maximum pressure loss through entire GAC adsorption system at design maximum flow rate in series mode, clean condition, psi	10
Maximum design flow rate, gpm	700
Minimum total EBCT, minutes	15
Minimum EBCT per vessel, minutes	7.5 assuming 2 adsorption vessels
Backwash rate, maximum, gpm	1045
Minimum vessel media life, months	12

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASME	Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A36	Structural Steel Bars, Plates, and Shapes Other Than Wide Flange Beams

ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. Through 144 in.
AWWA C504	Rubber-Sealed Butterfly Valves
IBC	International Building Code
NSF 61	ANSI/NSF Standard Drinking Water System Components – Health Effects
SSPC	Paint Application Specification No. 1
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning

B. UNIT RESPONSIBILITY: NOT USED

C. SHIPMENT, PROTECTION AND STORAGE:

Equipment shipment, protection, and storage shall conform to the requirements specified in Section 01605.

D. WARRANTY

In addition to the warranty in the General Conditions, the adsorption system manufacturer shall agree to the Iron and Manganese Removal Equipment Warranty and Service Agreement included as Part 4 of this Section.

E. WELDING PROCEDURES AND QUALIFICATIONS

1. Welding Procedure: Weld procedure used for the qualification of welders shall be witnessed and evaluated by a certified AWS QCI welding inspector from and independent testing laboratory utilizing calibrated equipment.
2. Qualifications of Welders:
 - a. Welders shall be qualified for the welding process and the procedure to be used under ASME Boiler and Pressure Vessel

Code, Section IX, Part QW; or AWS Structural Welding Code, Section 5.

- b. Welders shall have verifiable evidence that their qualification is current and valid under the applicable code.
- c. Welder Qualification Certification shall be witnessed and evaluated by a certified AWS QCI welding inspector from an independent testing laboratory utilizing calibrated equipment.

3. Welding Tests

- a. The owner has the option of requesting tests, as noted below.
- b. Test Methods:
X-ray: Paragraph UW-52, Section VIII, ASME Boiler and Pressure Vessel Code. Other non-destructive tests.
- c. Test Coupons:
In accordance with ASTM E-8. Welded seam shall develop strength of adjacent sheet or plate.
- d. Cost of tests:
Test failure: Cost borne by Contractor including follow-up tests after repair. Test satisfactory: Cost borne by Owner as extra work.

4. Certification of Welders

- a. Certification of welders: Submit verifiable evidence of qualification to the Engineer at least seven days prior to work.
- b. Submit welding procedures with supporting qualification records for approval.

F. GENERAL WELDING PROCEDURES

- 1. Used shielded metal arc welding (SMAW) method, or flux cored arc welding (FCAW) method, unless the Engineer approves another method prior to use.
- 2. Welds shall be fused with metal base, uniform in appearance, free from cracks and reasonably free from irregularities.
- 3. Restart in weld zone on clean and sound metal.

4. Limit porosity and slag inclusions in accordance with Section VIII, ASME Boiler and Pressure Vessel Code.
5. Repair defective welds by chipping, grinding, flame gouging, or air-arc gouging.
6. Do not undercut alongside of finished pass.
7. Use procedures or welding sequences that will minimize eccentric stresses, shear or distortion in the weld.
8. Butt welds shall have complete penetration and fusion.
9. Finished weld bead shall be central to the seam.
10. Artificial or forced cooling of welded joints is not permitted.
11. Low hydrogen electrode storage shall be in accordance with AWS D.1., Article 4.5.
12. Manual welding shall be performed in two layers.
13. Passes shall not exceed ¼ inch in throat dimension.
14. Welds shall be thoroughly cleaned after each pass.

1.03 ENVIRONMENTAL CONDITIONS

The equipment furnished under this section will be located indoors as shown and shall be suitable for the environmental conditions specified in Section 01800.

1.04 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for

determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control one-line diagrams drawing E-402 relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. Conduits and circuits that need to be provided by the Contractor shall be identified and verified on the diagrams. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. A copy of all related contract process and mechanical drawings with all piping, foundations, supports, and layout sizes and dimensions required for installation either confirmed by a checkmark (✓) or adjustments marked in red ink.
4. Manufacturer's catalogue, shop drawing and/or other data confirming conformance to specified requirements, including dimensions, equipment weights, and locations of process water and backwash connections and carbon fill and removal connections.
5. Flow and pressure drop information.
6. Material specifications for all pipe, fitting, and valves.
7. Installation requirements, showing clearances required for maintenance purposes.
8. Structural design calculations per Section 01890.
9. Drawings and catalog information detailing all instrumentation.
10. Manufacturer's recommended maintenance schedule detailing the required maintenance and frequency of maintenance.
11. Certified statement indicating that the manufacturer has the experience specified in paragraph 11825-2.01 and a reference list of installations of similar systems within the United States.

12. Process and instrumentation diagrams.
13. Equipment weight – empty and filled with media and water.

1.05 CONTROL STRATEGY

The Control Strategy for the GAC system is specified in specification 11830, paragraph 1.05 F and G.

PART 2--PRODUCTS

2.01 MANUFACTURERS

- A. This specification and related project drawings are based upon equipment and materials manufactured by Pureflow Filtration Div. Whittier, CA, 90608-0469, (800) 926-3426 that are deemed suitable based upon past performance and pilot test results, and are intended to constitute a standard for quality and performance suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. Evaluation and approval of “or equals” or substitutes will be in accordance with General and Supplemental Conditions (See 00700-7.04 and 7.05).
- B. Manufacturers shall have a minimum of 5 years of proven experience with GAC adsorption treatment of US municipal groundwater for the removal of organic compounds and taste and odor.

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Adsorption vessel	ASTM SA-516 Gr. 70
Structural steel	ASTM A36
Inlet Distributor Piping	Sch. 80 PVC
Underdrain Piping	316 Stainless Steel Sch. 40
Underdrain nozzles or wedge-wire wrapping	316 stainless steel Sch. 40
Filter internal fittings and accessories	316 Stainless Steel

Process piping	Carbon steel, ASTM A53 Grade B
Piping flanges	Carbon steel, ANSI B16.5

2.03 EQUIPMENT

A. PRESSURE VESSEL:

The pressure vessels shall be of welded steel construction and shall be provided with structural steel legs to support the vessels. Vessels shall be designed and fabricated in accordance with the ASME code and shall be so stamped and certified. In addition, vessels including support systems and anchors shall be designed and installed in accordance with Section 01900. Structural calculations shall be performed and signed by a structural or civil engineer registered in the State of Arizona.

Vessels shall be provided with one 24-inch elliptical manway on the sidewall and one 14-inch by 18-inch, minimum, manway on the bottom head. Manways shall be complete with manhead, yoke, and gasket. Flanged connections shall be provided for inlet/outlet piping and combination air/vacuum valve. Four 2" nozzles shall be provided on the side of each vessel. Three shall serve as in-bed sample ports to allow sampling the entire water column within the bed. One shall serve as a vent for the underdrain area. Support points for vent and media transfer lines shall be provided.

B. INLET DISTRIBUTOR/BACKWASH COLLECTOR:

Each vessel shall be provided with a header/lateral type inlet distributor/backwash collector system. The distributor/collector shall be designed for even distribution of flow over the entire vessel bed and for the uniform collection of backwash water during the backwash cycle. Provision shall be made for field leveling of the distributor/collector to ensure uniform distribution/collection.

Header/lateral type distributors shall be designed with Sch. 80 PVC pipe and type 316 stainless steel threaded fittings and accessories. Laterals shall terminate in upturned 90° elbows with vertical piping extending from the upturned elbows providing the specified freeboard.

C. UNDERDRAIN SYSTEM:

Each adsorption tank shall be provided with a header/lateral type underdrain system designed to uniformly distribute backwash water and for collection of treated water. Mal distribution of the flow shall not exceed 5 percent over any part of the underdrain system.

The underdrains shall also be designed to reduce the water velocity without impeding its flow, thereby preventing channeling in the media. Costs for any repairs or replacement of the underdrain system or GAC media as a result of poor distribution shall be borne solely by the Contractor.

Header/lateral type underdrain system shall be designed with type 316 stainless steel pipe and threaded fittings. Underdrain systems shall be properly supported to prevent damage during media installation or operation. The underdrain systems are to be fitted by the filter manufacturer prior to shipment, shipped loose and installed by the Contractor after vessel concrete is in place.

The underdrain shall require a concrete fill of the tank bottom head plus a section of the tank straight shell up to the bottom of the nozzles or orifice openings, or up to within 2 inches of the laterals if nozzles are not used. All concrete is to be furnished and installed by the Contractor.

D. GAC MEDIA:

One (1) complete GAC media load shall be provided for installation by the contractor. Vessels shall be provided with GAC media as specified in Section 13540 required by the Adsorption System manufacturer.

The Adsorption System manufacturer's representative shall witness initial installation of the GAC media, and shall promptly notify the consulting engineer in the event that the contractor deviates from the manufacturer's installation instructions, or should any irregular or unusual events occur during installation of the adsorption equipment. Upon completion, the manufacturer shall furnish a letter to the engineer stating that the installation was witnessed by the manufacturer, or an authorized representative, and that the media was installed in accordance with the manufacturer's recommendations.

E. PROCESS PIPING:

The GAC system shall include all the process piping and valves required to operate the vessels in series with either vessel as the lead unit, or with either vessel off-line. The piping and valves shall also allow the off-line vessel to be backwashed while the other vessel is in normal operation without interruption. All the features and capabilities indicated on the process drawings in the Project Manual shall be included. All process piping and valves shall be factory-welded and field assembled. All process piping supports shall be provided by the Manufacturer.

All process piping shall be Schedule 40 welded steel with 150 pound flanges at valves and equipment connections. Flanged connections to the process piping shall include influent water to the system, treated water out, and backwash supply and discharge. Steel pipe flanges will conform to American National Standards Institute (ANSI) 16.5.

Flexible couplings shall be provided between adsorption system face piping and interconnecting piping.

Vent piping shall be a minimum of 1" diameter, Schedule 40.

Carbon fill piping shall be 3" diameter Schedule 40. Carbon discharge piping shall be 4" diameter, Schedule 40 polypropylene lined carbon steel with polypropylene-lined flanged fittings and quick-connect fitting for connection to truck fill hose. Carbon fill and discharge piping shall be provided with quick couplings for connection to a truck fill hose. The quick couplings shall

Package Granular Activated Carbon Adsorption System for Drinking Water Treatment

be 4" Quick Disconnect Adaptors constructed of aluminum as manufactured by Dover Corp. as Kamlock connectors or equal.

All process piping and fittings shall be fusion bond epoxy coated inside. External surfaces shall be coated as described in Paragraph 2.04.

F. MAGNETIC FLOW METER

1. The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity settings from two to 33 feet per second. Standard accuracy of the pulse output shall be +/- 0.5% of rate +/- 0.01% of full scale (33 ft/sec) for all meters.
2. The meter shall incorporate a high impedance amplifier of 1,012 ohms, or greater, eliminating the need for electrode cleaning systems. The meter shall utilize bi-polar pulsed DC oil excitation with auto-integrated zeroing each half-cycle. Manual zero adjustments shall not be required, even at start-up. Power consumption shall be no more than 15 VA, regardless of meter size. Input power required will be from 85 to 260 VAC, 46-65 Hz, with DC input option available.
3. The magnetic flow meter shall be microprocessor based with integral electronics. Remote-mounted electronics up to 650 feet shall be available where specified. The housing is to be powder coated cast aluminum with a NEMA 4X rating.
4. The meter's analog and pulse outputs shall be independently selected by push buttons. The analog output shall be isolated 0/4-20 mAdc into 700 ohms load. The pulse output shall be an open collector output with a maximum frequency of 1000 Hz with configurable pulse width (0.5 to 2 sec). An open collector status output shall indicate either system or process error, or flow direction. An auxiliary input shall be available for positive zero process error, or flow direction. A low flow cutoff will be standard which can be turned on or off by push buttons.
5. A 2-line, 16-digit LCD backlit display shall indicate flow rate and / or total flow. The totalizer value is protected by EEPROM during power outages, and utilizes an overflow counter. The display shall also be capable of indicating error messages such as empty pipe condition, error condition, and low flow cutoff.
6. The meter body shall be capable of temporary submersion to 30 feet of water for up to 48 hours where specified. The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes. Ground probes, rings or straps will not be

Package Granular Activated Carbon Adsorption System for Drinking Water Treatment

11825-12

Contract 2
Bid Issue

acceptable.

7. The meter body shall be available flanged.
8. Liner and electrodes shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5mS/cm.
9. Backwash flow meter (Equipment # FM-5) shall be 8" diameter, installed in the GAC backwash inlet line to accurately measure backwash flow rate. The design backwash flow rate shall be 1045 gallons per minute (gpm) at 60°F (15°C).
10. Flow meter manufacturer shall be Siemens or equal.
11. Flow meter shall be installed with properly engineered upstream and downstream pipe diameters for undisturbed flow, a minimum of five (5) diameters upstream and three (3) diameters downstream, for each element.

G. RATE OF FLOW CONTROL VALVE:

1. Backwash flow control valve shall be 200 lb. class, with brass trim, Y-strainer, and position indicator and manual control. Valve shall have a flanged (flat face) cast body and cover, conforming to ASTM-A-126-CI-B, epoxy lined in accordance with NSF 61, removable brass seat, and o-ring of Buna-N.
2. Backwash flow control shall be pilot operated, manually set and shall be based on a backwash design flowrate of 1045 gpm per vessel. Backwash rate of flow control valve shall be manufactured by ClaVal.
3. Backwash flow control valve shall be installed with properly engineered upstream and downstream pipe diameters, per manufacturer recommendations, for undisturbed flow.

H. CONTROL VALVES:

1. Butterfly valves shall be a one piece ductile Iron lug body with lug drilled and tapped to mate to ANSI 125 / 150 flat faced flanges. Valves 14" and smaller shall incorporate a tongue and groove design with reinforcing rings around the primary disc and stem seal. Valves shall conform to the latest revisions of ISO 5752 table 5 for short body, and ISO 5211 for mounting pad and stem dimensions.

2. Pressure rating: 2" through 12" valves are rated 230 psi, tested to 110% of full rating, and shell tested to 150% of full rating, and dead end service rating of 200 psi. Valves 14" through 48" are tested to 150 psi.
3. Materials of construction:
 - a. Disc: 316SS, spherically machined and polished
 - b. Seat: EPDM or BunaN, food grade
 - c. Shaft: Type 316 SS through shaft design with octagonal disc drive, type internal SS pin. Blow out proof.
 - d. Bearing: Upper – heavy duty Delrin
Lower – heavy duty bronze
 - e. Stem packing: Nitrile O-ring
 - f. Body Coating: Resin coated (in accordance with NSF 61) with baked finish

I. ELECTRIC VALVE ACTUATORS

1. Actuator shall conform to the latest version of AWA C-540 for quarter turn electric motor actuators.
2. Enclosure shall conform to IP67, NEMA 4 or 4X, and be able to withstand submersion in water for up to 6 ft. head for thirty minutes.
3. Power supply shall be 110v, 1 ph, 60 hz, squirrel cage induction type motor, air cooled, designed for actuator use, (fan motors are unacceptable) motor to be protected by a minimum of two thermo switches. Wiring insulation class to be F according to NEMA MG1.
4. Control power to be 110vac / 1ph.
5. Motor shall have a minimum duty rating of 70%.
6. Actuator shall have a minimum of two torque switches with an option of two additional.
7. Actuator shall four limit switches standard with an option of four additional, the switches shall be silver or gold plated. 250 VAC 16A Rated.

8. Indication shall be by Continuous Mechanical Positioning.
9. Actuator to have a lever operated declutchable manual override that reengages on return of power.
10. Actuator to have externally adjustable travel stops.
11. Switch and motor compartment to have an anti-condensation heater that is always energized, 20 Watt (24/120/220 VAC and 24 vdc).
12. Actuator gearing to be permanently lubricated with Grease Moly (EP) type, oil bath lubrication is not acceptable.
13. Actuator to have a minimum of two conduit entries $\frac{3}{4}$ " NPT.
14. Actuator gearing to be supported by a carbon steel or ductile iron base, (aluminum is not acceptable), actuator cover can be hard anodized aluminum or steel coated with a dry powder, epoxy baked polyester resin.
15. Gearing shall be worm gear type with carbon steel SS worm gear, and aluminum bronze segment gear. (Aluminum or plastic gears are not permitted).
16. Acceptable actuator manufacturers are Aume Model SG, Limitorque Model LY, and ReMote Control Model RCEL, or equal.

J. MISCELLANEOUS EQUIPMENT, VALVES, GAUGES, AND TUBING

1. Adsorption system shall be provided with ANSI Certified combination air/vacuum valves, located at the high point of the adsorption vessel or high point of inlet piping, whichever is higher. Combination air/vacuum valves sizing shall be as specified or as required by the adsorption system manufacturer for the service intended. Combination air/vacuum valve shall be as manufactured by Valmatic or equal. Combination air/vacuum valves shall have a removable cover, cast iron body, stainless steel internals and shall be factory tested at 200 Pounds Per Square Inch Gauge (psig). A ball valve shall be provided for isolation between adsorption vessels and combination air/vacuum valves.
2. Ball valves shall be bronze port with national pipe thread end connections. The body end cap, ball and stem shall be of bronze with stainless steel ball stem and reinforced Teflon polyethylene seats and stem seals. Ball valves, up to 1-1/2", shall have a minimum pressure rating of 700 pounds per square inch (psi).

3. The process piping shall be equipped with pressure gauges to indicate the pressure entering and exiting each vessel and to provide information on pressure drop across each adsorption unit and the system.
 - a. Each vessel shall be provided with an indicating differential pressure switch. The switch shall be rated at 5.0 amps @ 115 volts AC for remote indication as manufactured by United Electric.
 - b. Pressure Gauges shall be 3.5" stainless steel, liquid filled, with 1% accuracy. Pressure gauges shall be supplied for appropriate range of operating pressures.
4. Tube Fittings shall be of the push-to-lock / push-to-unlock type. Any 90° elbows shall be of the swivel type as well as push-to-lock.
5. Isolation Valves shall be placed where any tube fittings are to be in a pipe under liquid or pneumatic flow..

K. INSTRUMENTATION:

All instrument enclosures not elsewhere specified shall be rated NEMA 4.

L. CONTROL PANEL:

The GAC system will be controlled by the control panel specified in Section 11830.

2.04 COATINGS

A. Internal Coating:

1. The filter vessel shall be internally cleaned and epoxy lined with a minimum 12 mil, holiday free, dry film thickness, as herein stipulated.
2. Epoxy lining shall be NSF certified, E-5 per Section 09900 for contact with potable water and suitable for contact with sulfides and the media recommended by the manufacturer.
3. Epoxy shall be applied in accordance with the manufacturer's standard prepared instructions, and as follows:

- a. All weld splatter and other projecting irregularities shall be removed by chipping or grinding, resulting in a smooth and continuous surface, free of irregularities, pits, or edges. All sharp corners shall be ground to a 1/8 inch radius, and be free of pinholes and undercuts. All contaminants shall be removed by solvent washing.
- b. All wetted surfaces shall be sandblasted to a shadow free white metal surface per SSPC-SP-5, and shall have an angular profile of 2 or 4 mils. The white metal shall be a pictorial standard VIS-1.
- c. The entire surface shall be cleaned of all loose material, such as dust or grit, with a commercial type of vacuum cleaner, or by brushing.
- d. The first coat shall be spray applied to the properly prepared surface within four hours after completion of blast cleaning at a temperature above 50 degrees F. The thickness of the sprayed wet film shall not exceed the 0.015 inches per coat as checked by an Interchemical Wet Film Thickness Gauge (or equal). The spraying shall be done by the multiple pass method. Each coat shall be cured with adequate ventilation until nearly tack free before application of the succeeding coat. Two coats shall be applied to achieve a finished dry film thickness of 12 to 15 mils, as determined by a non-destructive magnetic gauge (electrometer or equal). Coating shall extend through all flange necks and across full flange face.
- e. After finished coating is thoroughly cured, the entire surface shall be tested for porosity with a 67 volt holiday detector (Tinker & Razor, or equal). All holidays or irregularities shall be repaired by the applicator.
- f. All carbon steel piping fittings shall be internally cleaned and NSF approved fusion bonded epoxy lined as recommended by the manufacturer.

B. External Coating

- 1. External surfaces shall be commercially sandblasted per SAPC-SP6.
- 2. External surfaces shall be coated with TNEMEC Series 69 Epoxy, 4-6 mils DFT.
- 3. All piping and pressure vessels shall be stretch wrapped to protect equipment before shipping.

4. The filter vessel must be lifted by lifting lugs only. Face piping and all loose items must be mounted on pallets, and be protected for shipment in a way that no damage will be done to the equipment and external coating.

2.05 SPARE PARTS

The following spare parts shall be provided in the indicated quantities:

1. 2 – manway gaskets
2. 1 – 4-inch butterfly valve
3. 2 – 6-inch butterfly valve
4. 1 – 8-inch butterfly valve
5. 3 – actuators for butterfly valves (1 for each valve size)
6. 1 – combination air/vacuum valve
7. 1 – backwash flow control valve
8. 1 – differential pressure switch
9. 2 – pressure gauges (0-150 psig)
10. 1 – 4-inch ball valve
11. 1 – 3-inch ball valve
12. 1 – 1-inch ball valve
13. 1 – 2-inch ball valve
14. 2 – complete quick-connect hose fitting assemblies
15. 100 – LF of 3” coiled hose
16. 100 – LF of 4” coiled hose
- 17.

Spare parts shall be tagged and stored as specified in paragraph 11000-2.12.

2.06 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Operation and maintenance information specified in Section 01730, including final reviewed submittal and as-built drawings.
2. Installation certification Form 11000-A as specified in part 3 of this Section.
3. Training certification Form 11000-B as specified in part 3 of this Section.
4. Certified copies of ASME inspection reports.
5. GAC Adsorption Equipment Warranty and Service Agreement in Part 4.

PART 3--EXECUTION

3.01 SHOP ASSEMBLY AND INSPECTION

Adsorption vessel piping shall be completely assembled in the fabrication shop for inspection and testing before the shipment to project site. Disassembly for shipping shall include the labeling of each piece as shown on a reproducible copy of the assembly drawing. The contractor shall receive the piping in pre-assembled sections, convenient for the purpose of shipping and installation (by others).

A representative of NAVAJO TRIBAL UTILITY AUTHORITY, or their consulting engineer, shall have full access to the manufacturer's shop and design facilities, providing proper notice is given and such access does not interfere with manufacturer's production of other work. The purpose of this access shall be to determine the quality of workmanship, adherence to the agreed schedule, and status of required shop drawings. Final inspection at the manufacturer's facilities will be performed on the equipment, assembled, as it would be in the field. After inspection, the units may be disassembled into subassemblies commensurate with shipping limitations.

3.02 INSTALLATION

The equipment shall be installed (including loading of media) and tested in accordance with the recommendations and supervision of a qualified manufacturer's representative. The installation and initial operation shall be certified on Form 11000-A specified in Section 01999.

3.03 TESTING

The equipment provided under this section shall be subject to performance and operational testing and commissioning as specified in Sections 01660 and 01662. Testing shall be supervised by an authorized representative of the manufacturer of the adsorption system. The Contractor shall provide all necessary temporary piping and valves to convey test flows to waste. Waste discharged can be connected to the backwash drain piping through a suitable air gap. Valves or orifice plates shall be used in the temporary piping to cause back pressure similar to that which will be experienced when the system is on line and fully operational.

Following successful commissioning of the adsorption system, acceptance testing shall begin. Acceptance tests for the adsorption system shall consist of continuous operation for a minimum of 30 days during which time the adsorption system will be operated in accordance with the manufacturer's instructions. Adsorption system shall operate throughout the test at a minimum empty bed contact time per vessel equivalent to that specified in Part 1 of this Section. To achieve the specified production empty bed contact time per vessel, it is acceptable to conduct the acceptance test with less than all adsorption vessels in operation.

The acceptance test shall be performed by the Contractor and witnessed by the Construction Manager, Owner, and a manufacturer's representative. The Owner will sample

adsorption system effluent at least 4 times per day and analyze the samples for TOC concentration at all sample ports on the vessels. The Contractor will also monitor empty bed contact time, pressure differential, and exhaustion rate (if applicable), and provide this information to the Construction manager. The equipment performance will be acceptable if the monitored parameters meet conditions specified in Part 1 of this Section.

If the equipment fails the acceptance test, the Manufacturer will be allowed 30 days to modify the equipment and the acceptance test will be repeated.

3.03 TRAINING

A minimum of 8 hours of training conforming to the requirements of Section 01664 shall be provided. Training shall be certified on Form 11000-B specified in Section 01999.

PART 4—EQUIPMENT WARRANTY AND SERVICE AGREEMENT

The following Iron and Manganese Removal Equipment Warranty and Service Agreement is included in this section:

THIS PAGE LEFT INTENTIONALLY BLANK

GAC ADSORPTION EQUIPMENT WARRANTY AND SERVICE AGREEMENT

PARTIES: Navajo Tribal Utility Authority (NTUA), Ft. Defiance, Arizona, hereinafter referred to as Owner, and

_____, hereinafter referred to as Manufacturer.
(GAC System Manufacturer)

REGARDING: Manufacturer provided GAC Adsorption System Package for TOC removal, hereinafter referred to as GAC System.

WHEREAS: Manufacturer will be furnishing the GAC System as part of the Lower Greasewood Water System Improvements Project. A complete description of the GAC System is contained in specification Section 11825 of the Lower Greasewood Water System Improvements Project, Contract No. 2 documents.

NOW THEREFORE, based on the above and the terms and conditions contained herein, the PARTIES agree as follows:

1. Warranty Period

The warranty period shall be for 2 years following successful acceptance testing (but no later than 30 months from shipment) of the equipment.

2. Equipment Warranty

Manufacturer shall furnish and warrant a GAC system as provided by the manufacturer, free of defects in materials and workmanship, including damages that may have been incurred during shipping. Failed equipment or components shall be replaced at no cost to the Owner. Equipment components provided by the Manufacturer that has been built and supplied by manufacturers other than Manufacturer, shall also be warranted by Manufacturer. Recommended preventive maintenance, as provided by Manufacturer as part of the submittal requirements in Section 11830, will not be included as a repair of component replacement.

This warranty shall include the coatings applied to the GAC system. During the warranty period, the Manufacturer shall recoat any portion of the GAC system that exhibit any failure in the coating systems including, but not limited to, peeling, blistering, chalking, rust bleed through, or any other evidence of coating deterioration. Any recoating required as a result of these problems shall be done in accordance with Section 09900 of the Lower Greasewood Water System Improvements Project, Contract No. 2 contract documents.

3. Service During Warranty Period

In the event of an equipment failure during the 2-year warranty period, Manufacturer shall provide the services of a factory-trained technician to trouble-shoot and make necessary warranty repairs. The initial trouble-shooting may be by telephone. However, if in the Owner's opinion, the problem cannot be resolved by telephone, Manufacturer shall provide on-site services of the factory-trained technician at no cost to the Owner. Manufacturer's service technician shall be on-site in Greasewood, Arizona, within 10 calendar days of the Owner's request.

Upon request by Manufacturer, the Owner shall provide Manufacturer with equipment operation and maintenance records.

4. Service Following Warranty Period

For a minimum of 5-years following the 2-year warranty period, Manufacturer shall maintain the capability of providing the services of a factory-trained technician for trouble shooting and service. The cost of the service technician shall be at Manufacturer's standard service rates. A service technician shall be on-site in Greasewood, Arizona, within 10 calendar days of the Owner's request.

IN WITNESS THEREOF, the PARTIES have hereto, on the dates indicated, entered into this Agreement. The persons executing this Agreement on behalf of the parties hereto represent and warrant that the parties have all legal authority and authorization necessary to enter into this Agreement, and that such persons have been duly authorized to execute this Agreement on their behalf.

NTUA

(GAC SYSTEM MANUFACTURER)

Signature _____

Signature _____

Printed Name _____

Printed Name _____

Title _____

Title _____

Date: _____

Date: _____

Attest: _____

Attest: _____

GAC ADSORPTION EQUIPMENT PERFORMANCE GUARANTEE

PARTIES: Navajo Tribal Utility Authority (NTUA), Ft. Defiance, Arizona, hereinafter referred to as Owner, and

_____, hereinafter referred to as Manufacturer.
(GAC System Manufacturer)

REGARDING: Manufacturer provided GAC Adsorption System Package for TOC removal, hereinafter referred to as GAC System.

WHEREAS: Manufacturer will be furnishing the GAC System as part of the Lower Greasewood Water System Improvements Project. A complete description of the GAC System is contained in specification Section 11825 of the Lower Greasewood Water System Improvements Project, Contract No. 2 documents.

NOW THEREFORE, based on the above and the terms and conditions contained herein, the Manufacturer agrees as follows:

1. Performance Guarantee Period

Upon completion of the 30-day acceptance testing and acceptance by the Owner, the 1-year Performance Guarantee period shall commence.

2. Corrective Action

If, during the Performance Guarantee period, the GAC System fails to meet Performance Requirements, as outlined in specification Section 11825, at any time, the Manufacturer shall be afforded a reasonable time to investigate the cause and perform corrective action at no additional cost to the Owner. Corrective action must be conducted while the GAC System facilities remain in operation and with the authorization of the Owner. After corrective action is completed, the 1-year Performance Guarantee period shall restart. If the GAC System fails to meet Performance Requirements after the Manufacturer has investigated the cause and performed corrective action, the Manufacturer will take responsibility for underperformance of the GAC System and will do whatever is necessary, up to and including replacing some or all of the GAC System equipment, in order to meet the Performance Requirements.

3. Owner's Responsibility

Owner is responsible for correction of underperformance of the GAC System that is caused by failure of Owner to operate system in accordance with the Operations and Maintenance Manual provided by the Manufacturer.

IN WITNESS THEREOF, the Manufacturer has hereto, on the date indicated, entered into this Agreement. The persons executing this Agreement on behalf of the Manufacturer hereto represent and warrant that the parties have all legal authority and authorization necessary to enter into this Agreement, and that such persons have been duly authorized to execute this Agreement on their behalf.

(GAC SYSTEM MANUFACTURER)

Signature _____
(Manufacturer's Agent)

Printed Name _____

Title _____

Date: _____

Attest: _____

NOTARY ATTEST:

STATE OF _____)

COUNTY OF _____)

The foregoing instrument was acknowledged before me this ____ day of _____,
20____.

(Notary Public)

My Commission Expires: _____

****END OF SECTION****

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 11830

PRESSURE FILTERS – IRON AND MANGANESE REMOVAL

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies a vertical pressure filter system utilizing permanent media for oxidation and coagulation/filtration treatment of potable water in removing dissolved iron and manganese from municipal groundwater supplies. Main components are denoted on drawing P-101. Equipment for this specification must be furnished by the same manufacturer as equipment specified in section 11825.

B. TYPE:

Equipment provided under this section includes vertical steel pressure vessels, underdrain systems, inlet distributors/backwash collectors, motor operated valves, rate of flow control valves, differential pressure switches, combination air/vacuum valves, flow meters, backwash reclaim system, sludge mixing/transfer system, control panel, and all necessary and auxiliary equipment to provide a complete system capable of meeting specified performance requirements.

C. EQUIPMENT LIST:

Item	Equipment No.
Pressure Filter Vessel A	FLT-A
Pressure Filter Vessel B	FLT-B
Differential Pressure Switches A	DPS A, DPS B
Combination Air/Vacuum Valves	A/V-A, A/V-B
Filter System Control Valves	V1-A, V1-B V2-A, V2-B V3-A, V3-B V4-A, V4-B V5-A, V5-B
Backwash Sludge Mixing Return Valve	V-7
Backwash Sludge Transfer Valve	V-8

Item	Equipment No.
Backwash Reclaim Return Valve	V-9
Filter System Effluent Flow Meters	FM-1A, FM-1B
Filter System Backwash Flow Meter	FM-2
Backwash Sludge Transfer Flow Meter	FM-3
Backwash Reclaim Flow Meter	FM-4
Filter System Effluent Rate of Flow Control	FCV-1A, FCV-1B
Filter System Backwash Rate of Flow Control	FCV-2
Backwash Sludge Transfer Rate of Flow Control	FCV-3
Backwash Reclaim Rate of Flow Control	FCV-4
Sludge Mixing/Transfer Pump	PMP-101
Backwash Reclaim Pump	PMP-102
Backwash Tank Level Indicating Transmitter	LIT
Filter Control Panel	PLC-2

D. RELATED EQUIPMENT:

The following equipment, specified in other sections, shall be integrated with filter control panel:

Item	Equipment No.
GAC System Control Valves	V1-C, V1-D
	V2-C, V2-D
	V3-C, V3-D
	V4-C, V4-D
	V5-C, V5-D
	V6-C, V6-D
GAC System Backwash Flow Meter	FM-5

Pressure Filters – Iron and Manganese Removal
11830-2

Item	Equipment No.
GAC Differential Pressure Switches	DPS-C, DPS-D
Chlorine Solenoid Valves	SV-1T, SV-1R, SV-2T, SV-2R SV-3T, SV-3R
Chlorine Gas Leak Detector	LAH
Chlorine Booster Pumps	PMP-103, PMP-104
Chlorine Dual –Cylinder Scale Weight Indicating Transmitter	WIT-2
Chlortainer Weight Indicating Transmitter	WIT-1
Chlorine Residual Analyzer/Transmitter	A/T
Chlorine Residual Three-way Selector Valve	SV-5
Nitrogen Solenoid Valve	SV-4
Chlortainer High Pressure Switch	PSH

E. PERFORMANCE AND DESIGN REQUIREMENTS:

1. GENERAL: The filtration equipment provided under this section shall be designed specifically for chemical oxidation, coagulation/filtration, and removal of dissolved iron and manganese in the treatment of potable drinking water from groundwater sources. A fraction of the dissolved iron and manganese may be organically bound rather than in the free ionic form. The iron and manganese removal system shall be designed for operation under specified operating conditions and shall meet specified design and performance requirements. Periodic disinfection of filter components may be required. As such, all immersed filter components shall be suitable for exposure to 12.5 percent sodium hypochlorite or a chlorine solution of 50 mg/l as Cl₂. Operation and control of the pressure filter process shall be fully automated with provision for manual control. The height and internal geometry of the pressure filters shall be determined by the pressure filter manufacturer to ensure that media is properly fluidized during hydraulic washing cycles without any measurable media losses (less than 5 percent per year) or clogging of the underdrain system and inlet distributor/backwash collector.

2. OPERATING CONDITIONS:

Raw water characteristics

Pressure Filters – Iron and Manganese Removal
11830-3

	Dissolved iron, max, mg/L	0.6
	Dissolved manganese, max, mg/L	0.3
	pH	7-9
	Temperature, °C	15-20
	TOC, mg/L	1.5-2.5
	Operating Pressure, psig	130
3.	DESIGN REQUIREMENTS:	
	Pressure vessels	
	Number	2
	Diameter, ft	6.5
	Straight wall height, ft	As required by pressure filter manufacturer to achieve a 40% bed expansion without excessive media loss.
	Working pressure, psig	150 @ 100 °F
	Filter media depth, minimum, ft	2.67
	Support media depth, minimum, ft	1
	Interconnecting System	
	Pipe diameter, inches	4, 6 and 8
	Control Valve type	Butterfly
	Rate of Flow Control Valve type	Globe
	Backwash Reclaim and Sludge Transfer System	
	See drawing P-101	
	Power Requirements	
	3 Phase 480 Volts, 60 Hz	
	and	
	1 Phase 120 Volts, 60 Hz	

4. PERFORMANCE REQUIREMENTS:

Max. treated water iron concentration, mg/L	0.15
Max. treated water manganese concentration, mg/L	0.025
Maximum pressure loss across filter media, psi	11
Maximum raw water feed, per filter, gpm	350
Maximum loading rate, gpm/sq. ft.	10
Backwash rate, maximum, gpm	660
Backwash recovery, minimum, %	98
Minimum time between backwash events, hrs	8
Maximum post filtration chlorine residual, mg/L	1

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASME	Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A36	Structural Steel Bars, Plates, and Shapes Other Than Wide Flange Beams
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM 380	Practice for Cleaning and Descaling Stainless Steel Part,
Pressure Filters – Iron and Manganese Removal	

11830-5

	Equipment, and Systems
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. Through 144 in.
AWWA C504	Rubber-Sealed Butterfly Valves
IBC	International Building Code
NSF 61	ANSI/NSF Standard Drinking Water System Components – Health Effects
SSPC	Paint Application Specification No. 1
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning

B. UNIT RESPONSIBILITY:

The Contractor shall assign unit responsibility as specified in paragraph 11000-1.02 C to the pressure filter manufacturer for the equipment specified in this Section, and for materials specified in Section 11825 PACKAGE GRANULAR ACTIVATED CARBON ADSORPTION SYSTEM FOR DRINKING WATER TREATMENT, Section 13540 ACTIVATED CARBON, and Section 11727 CHLORINE GAS FEED SYSTEM. A Certificate of Unit Responsibility shall be provided.

C. SHIPMENT, PROTECTION AND STORAGE:

Equipment shipment, protection, and storage shall conform to the requirements specified in Section 01605.

D. PERFORMANCE WARRANTY:

In addition to the warranty in the General Conditions, the pressure filter manufacturer shall agree to the Iron and Manganese Removal Equipment Warranty and Service Agreement included as Part 4 of this Section.

E. WELDING PROCEDURES AND QUALIFICATIONS

1. Welding Procedure: Weld procedure used for the qualification of welders shall be witnessed and evaluated by a certified AWS QCI welding inspector from and independent testing laboratory utilizing calibrated equipment.
2. Qualifications of Welders:
 - a. Welders shall be qualified for the welding process and the procedure to be used under ASME Boiler and Pressure Vessel

Code, Section IX, Part QW; or AWS Structural Welding Code, Section 5.

- b. Welders shall have verifiable evidence that their qualification is current and valid under the applicable code.
- c. Welder Qualification Certification shall be witnessed and evaluated by a certified AWS QCI welding inspector from an independent testing laboratory utilizing calibrated equipment.

3. Welding Tests

- a. The owner has the option of requesting tests, as noted below.
- b. Test Methods:
X-ray: Paragraph UW-52, Section VIII, ASME Boiler and Pressure Vessel Code. Other non-destructive tests.
- c. Test Coupons:
In accordance with ASTM E-8. Welded seam shall develop strength of adjacent sheet or plate.
- d. Cost of tests:
Test failure: Cost borne by Contractor including follow-up tests after repair. Test satisfactory: Cost borne by Owner as extra work.

4. Certification of Welders

- a. Certification of welders: Submit verifiable evidence of qualification to the Engineer at least seven days prior to work.
- b. Submit welding procedures with supporting qualification records for approval.

F. GENERAL WELDING PROCEDURES

- 1. Used shielded metal arc welding (SMAW) method, or flux cored arc welding (FCAW) method, unless the Engineer approves another method prior to use.
- 2. Welds shall be fused with metal base, uniform in appearance, free from cracks and reasonably free from irregularities.
- 3. Restart in weld zone on clean and sound metal.

4. Limit porosity and slag inclusions in accordance with Section VIII, ASME Boiler and Pressure Vessel Code.
5. Repair defective welds by chipping, grinding, flame gouging, or air-arc gouging.
6. Do not undercut alongside of finished pass.
7. Use procedures or welding sequences that will minimize eccentric stresses, shear or distortion in the weld.
8. Butt welds shall have complete penetration and fusion.
9. Finished weld bead shall be central to the seam.
10. Artificial or forced cooling of welded joints is not permitted.
11. Low hydrogen electrode storage shall be in accordance with AWS D.1., Article 4.5.
12. Manual welding shall be performed in two layers.
13. Passes shall not exceed ¼ inch in throat dimension.
14. Welds shall be thoroughly cleaned after each pass.

1.03 ENVIRONMENTAL CONDITIONS

The equipment furnished under this section will be located indoors as shown and shall be suitable for the environmental conditions specified in Section 01800.

1.04 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed

written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document control one-line diagrams drawings E-402 and E-403 relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. Conduits and circuits that need to be provided by the Contractor shall be identified and verified on the diagrams. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. Certificate of Unit Responsibility attesting that the Contractor has assigned and that the manufacturer accepts unit responsibility in accordance with the requirements of this Section and paragraph 11000-1.02 C. *No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.*
4. A copy of all related contract schematic, structural, process P-100 through P-103, and mechanical drawings with all piping, foundations, supports, and layout sizes and dimensions required for installation either confirmed by a checkmark (✓) or adjustments marked in red ink.
5. Manufacturer's catalogue, shop drawing and/or other data confirming conformance to specified requirements.
6. Installation requirements, showing clearances required for maintenance purposes.
7. Motor information as specified in Section 11060, as applicable.
8. Structural design calculations per Section 01890.
9. Drawings and catalog information detailing all control devices and instrumentation. Control cabinet information to include overall panel layout, interconnection diagrams, and construction.

10. Manufacturer's recommended maintenance schedule detailing the required maintenance and frequency of maintenance.
11. Certified statement indicating that the manufacturer has a minimum of 10 years of proven experience with greensand filtration of US municipal groundwater for the removal of iron and manganese.
12. Process and instrumentation diagrams.
13. Control panel layout, schematics, and bill of materials.
14. Equipment weight – empty and filled with media and water.
15. Electrical Wiring Diagrams

B. CONTROL PANEL PROGRAMMING:

Submit the following prior to the programming coordination meeting per Spec. 17900-1.01 B and after review of Shop Drawing submittal.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. A copy of specification Section 17900, with addendum updates that apply to the equipment in this section, indicate requested deviations from specification requirements. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Annotated PLC ladder logic printout hardcopy or in .pdf format.
Pressure Filters – Iron and Manganese Removal

4. Color prints of operator interface touchscreen screens.

1.05 CONTROL STRATEGY

The control panel programs shall provide for the following operation:

A. FILTRATION:

1. Automatic control shall be for fully unattended operation including normal filtration, backwashing and purge cycles. Main PLC shall be housed in a NEMA 12 enclosure. System-Manual-Auto-Off-Remote controls to be programmed for the following operation:
 - a. Manual – Allows for backwash step advancement and hold step time operations.
 - b. Auto – Allows for auto sequencing through backwash, filter and purge steps.
 - c. Off – Shuts down the system.
 - d. Remote – Allows for remote operation from telemetry controls.
2. Automatic and Manual Control Strategies shall allow for two operation rates.
 - a. High Flow Rate (2 or more wells in operation)
Both filter vessels operate in parallel.
 - b. Low Flow Rate (1 well in operation)
One filter operates with other filter in standby. Alternate filter operation when operating filter requires backwash.

B. BACKWASH:

1. Backwash is triggered by operation time reaching maximum limit (set by operator), differential pressure reaching maximum limit specified in performance criteria, or by operator command at the PLC.
2. Backwash one filter vessel at a time at fixed loading rate per filter manufacturer recommendation and in accordance with performance criteria. Filter vessel not undergoing backwash may remain in service based on Low Flow Rate operation.

3. Backwash water will be drawn from the finished effluent after GAC treatment and from clean water in the distribution system.

C. FILTER TO WASTE:

At the completion of backwashing the system may automatically purge the filter for approximately one minute (or as adjusted by operator), if the filter is to immediately go back into filtration mode. During the purge mode, flow shall be controlled by a rate of flow control valve and the purge butterfly valve. If the filter is to go to standby mode after backwash, the purge cycle need not be activated until the system has been called back into service.

D. FILTRATION BACKWASH RECLAIM:

Reclaim pump may draw down supernatant in tank and pump to beginning of treatment process. Backwash and reclaim may not occur simultaneously. Reclaim may only begin when at least 3 hours have passed since most recent backwash. Reclaim pumping shall be a constant rate of at least 70 gpm.

E. FILTRATION SLUDGE MIXING AND TRANSFER:

Filtration sludge mixing/and transfer pump circulates sludge from/to bottom of backwash tank; then, transfer the mixed sludge to the sump. Neither sludge mixing or transfer may not occur simultaneously with backwash or reclaim pumping. Sludge transfer must be preceded by sludge mixing. Sludge mixing may only occur after reclaim pumping and when total liquid/sludge level in the tank is less than or equal to 3,800 gallons. Only 3,000 gallons of mixed sludge may be transferred to the sump in any single event. Sludge transfer rate shall be controlled with a rate of flow control valve set to 100 gpm. The frequency of sludge mixing/transfer shall be such that the volume of settled sludge in the backwash tank never exceeds 3,500 gallons.

F. GAC ADSORPTION:

1. GAC operation shall be continuous unless stopped manually by the operator. GAC adsorption can operate at two operation rates.
 - a. High Flow Rate (2 or more wells in operation)
Both adsorption vessels operate in series.
 - b. Low Flow Rate (1 well in operation)
Lead adsorption vessel operates with lag vessel in standby.
Alternate lead/lag when lead adsorption vessel requires backwash.

G. GAC BACKWASH:

1. Backwash is initiated manually by the operator using control valves of the GAC system, and must be preceded by treatment system shutdown. PLC shall display differential pressure across adsorption vessels. At the operator's discretion, based on differential pressure approaching the limit specified in the performance criteria of specification 11825, timing, breakthrough of organic contaminants, or following media replacement, the operator may shut down the treatment system and initiate a backwash of one or both adsorption vessels.
2. Backwash shall occur only for one adsorption vessel at a time at fixed loading rate per manufacturer recommendation and in accordance with performance criteria of specification 11825.
3. Backwash from the adsorption vessels is not reclaimed in the backwash tank, but is discharged directly to the sump to be collected in the evaporation pond.
4. Backwash water will be drawn from the finished effluent after GAC treatment and from clean water in the distribution system.

H. GAC PURGE TO WASTE:

At the completion of backwashing the adsorption vessel may be purged for approximately one minute (or as adjusted by operator), if the filter is to immediately go back into operation mode. During the purge mode, flow shall be controlled by a rate of flow control valve and the purge butterfly valve. If the filter is to go to standby mode after backwash, the purge cycle need not be activated until the system has been called back into service.

PART 2--PRODUCTS

2.01 MANUFACTURERS

- A. The specifications and project drawings depict equipment and materials manufactured by Pureflow Filtration Div. Whittier, CA, 90608-0469, (800) 926-3426 that are deemed suitable based upon past performance and pilot test results, and are intended to constitute a standard for quality and performance suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. Evaluation and approval of "or equals" or substitutes will be in accordance with General and Supplemental Conditions (See 00700-7.04 and 7.05).
- B. Manufacturers shall have a minimum of 10 years of proven experience with pressure filtration of US municipal groundwater for the removal of iron and manganese.

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Filter vessel	ASTM A-516 Gr. 70
Structural Steel	ASTM A-36
Inlet/Distributor Piping	Sch. 80 PVC
Underdrain Piping	316 Stainless Steel Sch. 40
Underdrain nozzles or wedge-wire wrapping	316 Stainless Steel Sch. 40
Filter internal fittings and accessories	316 Stainless Steel
Process piping	Carbon steel, ASTM A53 Grade B
Piping flanges	Carbon steel, ANSI B16.5

2.03 EQUIPMENT

A. PRESSURE VESSEL:

The pressure vessels shall be of welded steel construction and shall be provided with I-beam legs to support the filters. Vessels shall be designed and fabricated in accordance with the ASME code and shall be so stamped and certified. In addition, vessels including support systems and anchors shall be designed and installed in accordance with Section 01900. Structural calculations shall be performed and signed by a structural or civil engineer registered in the State of Arizona.

Vessels shall be provided with one 24-inch elliptical manway complete with manhead, yoke, and gasket at the locations shown in the Drawings. Vessel shall be provided with 6-inch diameter flanged and gasketed hand holes located immediately above the bottom of the filter media. Flanged connections shall be provided for inlet/outlet piping and combination air/vacuum valve. Additional piping connections shall be provided as needed for operation of the filters. Support points for vent lines shall be provided.

B. INLET DISTRIBUTOR/BACKWASH COLLECTOR:

Each filter shall be provided with a properly supported header/lateral type inlet distributor/backwash collector system. The inlet/distributor shall be designed for even distribution of flow over the entire filter bed and for the uniform collection of backwash water

during the backwash cycle. Provision shall be made for field leveling of the inlet/distributor to ensure uniform distribution/collection.

Header/lateral type distributors shall be designed with Sch. 80 PVC pipe and type 316 stainless steel threaded fittings and accessories. Laterals shall terminate in upturned 90° elbows with vertical piping extending from the upturned elbows providing the specified freeboard.

C. UNDERDRAIN SYSTEM:

Each filter tank shall be provided with a header/lateral type underdrain system designed to uniformly distribute backwash water, and for collection of treated water. Mal distribution of any of these flows shall not exceed 5 percent over any part of the underdrain system.

The underdrains shall also be so designed to reduce the water velocity without impeding its flow, thereby preventing channeling in the filter bed. Under no circumstances shall the filter support media be upset during normal backwash procedures. Costs for any repairs or replacement of the underdrain system, filter support gravel, or filter media as a result of poor distribution or support media upset shall be borne solely by the Contractor.

Header/lateral type underdrain system shall be designed with type 316 stainless steel pipe and threaded fittings. Underdrain systems shall be properly supported to prevent damage during media installation or operation. The underdrain systems are to be fitted by the filter manufacturer prior to shipment, shipped loose and installed by the Contractor after vessel concrete is in place.

The underdrain shall require a concrete fill of the tank bottom head plus a section of the tank straight shell up to the bottom of the nozzles or orifice openings, or up to within 2 inches of the laterals if nozzles are not used. All concrete is to be furnished and installed by the Contractor.

D. FILTER MEDIA:

One (1) complete filter media load shall be provided for installation by the contractor. The media load shall include Pureflow PM-200 matrix permanent adsorptive catalytic media or approved equal, along with manufacturer selected support media and anthracite cap. The media shall not be coated and shall not require regeneration.

The media will not be loaded into the filter vessel until all components of the filter system have been completely installed, tested hydraulically and electrically, and confirmed to be operating correctly.

The placement of the media in filter vessel shall be in accordance with, and only under the supervision of the manufacturer or authorized representative. The manufacturer's representative shall witness installation of the filter media, and shall promptly notify the consulting engineer in the event that the contractor deviates from the manufacturer's installation instructions, or should any irregular or unusual events occur during installation of the filter equipment. Upon completion, the manufacturer shall furnish a letter to the engineer stating that

the installation was witnessed by the manufacturer, or an authorized representative, and that the system was installed in accordance with the manufacturer's recommendations.

E. PROCESS PIPING

The Filter system shall include all the process piping and valves required to operate the vessels in parallel, or with either vessel off-line. The piping and valves shall also allow the off-line vessel to be backwashed while the other vessel is in normal operation without interruption. All the features and capabilities indicated on the process drawings in the Project Manual shall be included. All process piping and valves shall be factory-welded and field assembled. All process piping supports shall be provided by the Manufacturer.

All process piping shall be Schedule 40 welded steel with 150 pound flanges at valves and equipment connections. Flanged connections to the process piping shall include influent water to the system, treated water out, and backwash supply and discharge. Steel pipe flanges will conform to American National Standards Institute (ANSI) 16.5.

Flexible couplings shall be provided between filter system face piping and interconnecting piping.

Vent piping shall be a minimum of 1" diameter, Schedule 40.

Media drain shall be 4" diameter, Schedule 40 flanged with blind flange cap provided.

All process piping and fittings shall be fusion bond epoxy coated inside. External surfaces shall be coated as described in Paragraph 2.04.

F. MAGNETIC FLOW METERS

1. The electromagnetic induction flow meters shall generate a voltage linearly proportional to flow for full-scale velocity settings from two to 33 feet per second. Standard accuracy of the pulse output shall be +/- 0.5% of rate +/- 0.01% of full scale (33 ft/sec) for all meters.
2. The meter shall incorporate a high impedance amplifier of 1,012 ohms, or greater, eliminating the need for electrode cleaning systems. The meter shall utilize bi-polar pulsed DC oil excitation with auto-integrated zeroing each half-cycle. Manual zero adjustments shall not be required, even at start-up. Power consumption shall be no more than 15 VA, regardless of meter size. Input power required will be from 85 to 260 VAC, 46-65 Hz, with DC input option available.
3. The magnetic flow meters shall be microprocessor based with integral electronics. Remote-mounted electronics up to 650 feet shall be available where specified. The housing is to be powder coated cast aluminum with a NEMA 4 or 4X rating.

Pressure Filters – Iron and Manganese Removal

11830-16

4. The meter's analog and pulse outputs shall be independently selected by push buttons. The analog output shall be isolated 0/4-20 mA_{dc} into 700 ohms load. The pulse output shall be an open collector output with a maximum frequency of 1000 Hz with configurable pulse width (0.5 to 2 sec). An open collector status output shall indicate either system or process error, or flow direction. An auxiliary input shall be available for positive zero process error, or flow direction. A low flow cutoff will be standard which can be turned on or off by push buttons.
5. A 2-line, 16-digit LCD backlit display shall indicate flow rate and / or total flow. The totalizer value is protected by EEPROM during power outages, and utilizes an overflow counter. The display shall also be capable of indicating error messages such as empty pipe condition, error condition, and low flow cutoff.
6. The meter body shall be capable of temporary submersion to 30 feet of water for up to 48 hours where specified. The meter body shall include grounding and empty pipe electrodes of the same material as the measuring electrodes. Ground probes, rings or straps will not be acceptable.
7. The meter body shall be available flanged.
8. Liner and electrodes shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 5mS/cm.
9. Backwash flow meter (Equipment # FM-2) shall be 6" diameter, installed in the filter backwash inlet line to accurately measure backwash flow rate. The design backwash flow rate shall be 660 gallons per minute (gpm) at 60°F (15°C).
10. Effluent flow meters (Equipment # FM-1 A and B) shall be 6" diameter. The design flow rate shall be 350 gallons per minute (gpm) flow rate per iron and manganese vessel.
11. Flow meters shall be Siemens or equal.
12. Flow meters shall be installed with properly engineered upstream and downstream pipe diameters for undisturbed flow, a minimum of five (5) diameters upstream and three (3) diameters downstream, for each element.

G. RATE OF FLOW CONTROL VALVES

1. Effluent Rate of Flow Control Valves (Solenoid Operated, Electronically Controlled)
 - a. Effluent Rate of Flow control valves shall be 200 lb. class, with brass trim, Y-strainer, position indicator, and speed controls. Valves shall have a flanged (flat face) cast body and cover, conforming to ASTM-A-126-CI-B, epoxy lined in accordance with NSF 61, removable brass seat, o-ring of Buna-N, and brass solenoid control valves. Furnish stainless steel tubing pilot lines with stainless steel fittings and isolation valves.
 - b. Effluent Rate of Flow control shall be based on a maximum flow capacity equal to the treatment design flow of 350 gpm per vessel. Rate of flow control valve shall be 4" diameter manufactured by ClaVal.
2. Backwash Rate of Flow Control Valves (Pilot Operated, Manually Set)
 - a. Flow control valves shall be 200 lb. class, with brass trim, Y-strainer, position indicator, and manual control. Valves shall have a flanged (flat face) cast body and cover, conforming to ASTM-A-126-CI-B, epoxy lined in accordance with NSF 61, removable brass seat, and o-ring of Buna-N. Furnish stainless steel tubing pilot lines with stainless steel fittings and isolation valves.
 - b. Backwash flow control shall be based on a backwash design flow rate of 660 gpm. Backwash rate of flow control valve shall be 6" diameter manufactured by ClaVal.
3. All Rate of Flow Control Valves shall be installed with properly engineered upstream and downstream pipe diameters, per manufacturer recommendations, for undisturbed flow.

H. CONTROL VALVES:

1. Butterfly valves shall be a one piece ductile Iron lug body with lug drilled and tapped to mate to ANSI 125 / 150 flat faced flanges. Valves 14" and smaller shall incorporate a tongue and groove design with reinforcing rings around the primary disc and stem seal. Valves shall conform to the latest revisions of ISO 5752 table 5 for short body, and ISO 5211 for mounting pad and stem dimensions.
2. Pressure rating: 2" through 12" valves are rated 230 psi, tested to 110% of full rating, and shell tested to 150% of full rating, and dead end service rating of 200 psi. Valves 14" through 48" are tested to 150 psi.

3. Materials of construction:
- a. Disc: 316SS, spherically machined and polished
 - b. Seat: EPDM or BunaN, food grade
 - c. Shaft: Type 316 SS through shaft design with octagonal disc drive, type internal SS pin. Blow out proof.
 - d. Bearing: Upper – heavy duty Delrin
Lower – heavy duty bronze
 - e. Stem packing: Nitrile O-ring
 - f. Body Coating: Resin coated (in accordance with NSF 61) with baked finish

I. ELECTRIC VALVE ACTUATORS

- 1. Actuator shall conform to the latest version of AWA C-540 for quarter turn electric motor actuators.
- 2. Enclosure shall conform to IP67, NEMA 4 or 4X, and be able to withstand submersion in water for up to 6 ft. head for thirty minutes.
- 3. Power supply shall be 110v, 1 ph, 60 hz, squirrel cage induction type motor, air cooled, designed for actuator use, (fan motors are unacceptable) motor to be protected by a minimum of two thermo switches. Wiring insulation class to be F according to NEMA MG1.
- 4. Control power to be 110vac / 1ph.
- 5. Motor shall have a minimum duty rating of 70%.
- 6. Actuator shall have a minimum of two torque switches with an option of two additional.
- 7. Actuator shall four limit switches standard with an option of four additional, the switches shall be silver or gold plated. 250 VAC 16A Rated.
- 8. Indication shall be by Continuous Mechanical Positioning.

9. Actuator to have a lever operated declutchable manual override that reengages on return of power.
10. Actuator to have externally adjustable travel stops.
11. Switch and motor compartment to have an anti-condensation heater that is always energized, 20 Watt (24/120/220 VAC and 24 vdc).
12. Actuator gearing to be permanently lubricated with Grease Moly (EP) type, oil bath lubrication is not acceptable.
13. Actuator to have a minimum of two conduit entries $\frac{3}{4}$ " NPT.
14. Actuator gearing to be supported by a carbon steel or ductile iron base, (aluminum is not acceptable), actuator cover can be hard anodized aluminum or steel coated with a dry powder, epoxy baked polyester resin.
15. Gearing shall be worm gear type with carbon steel SS worm gear, and aluminum bronze segment gear. (Aluminum or plastic gears are not permitted).
16. Acceptable actuator manufacturers are Aume Model SG, Limitorque Model LY, and ReMote Control Model RCEL, or equal.

J. MISCELLANEOUS EQUIPMENT, VALVES, GAUGES, AND TUBING

1. An 8-inch static mixer shall be provided by filter equipment supplier to facilitate adequate mixing of chlorine into process influent to meet performance criteria.
2. Pressure filters shall be provided with ANSI Certified combination air/vacuum valves, located at the high point of the vessel or high point of inlet piping, whichever is higher. Combination air/vacuum valves sizing shall be as specified or as required by the pressure filter manufacturer for the service intended. Combination air/vacuum valve shall be as manufactured by Valmatic or equal. Combination air/vacuum valves shall have a removable cover, cast iron body, stainless steel internals and shall be factory tested at 200 Pounds Per Square Inch Gauge (psig). A ball valve shall be provided for isolation between pressure vessels and combination air/vacuum valves.
3. Ball valves shall be bronze port with national pipe thread end connections. The body end cap, ball and stem shall be of bronze with stainless steel ball stem and reinforced Teflon polyethylene seats and stem seals. Ball valves,

up to 1-1/2", shall have a minimum pressure rating of 700 pounds per square inch (psi).

4. The process piping shall be equipped with pressure gauges to indicate the pressure entering and exiting each vessel and to provide information on pressure drop across each filter and the system to the PLC.
 - a. Each vessel shall be provided with an indicating differential pressure switch. The switch shall be rated at 5.0 amps @ 115 volts AC for remote indication as manufactured by United Electric.
 - b. Pressure Gauges shall be 3.5" stainless steel, liquid filled, with 1% accuracy. Pressure gauges shall be supplied for appropriate range of operating pressures.
5. Tube Fittings shall be of the push-to-lock / push-to-unlock type. Any 90° elbows shall be of the swivel type as well as push-to-lock.
6. Isolation Valves shall be placed where any tube fittings are to be in a pipe under liquid or pneumatic flow.

K. BACKWASH TANK ACCESSORIES

1. An 18,000 gal backwash water reclaim tank shall be supplied by the contractor. See Specification Section 13201 for details regarding the tank components.
2. Level Indicating Transmitter and tank internals needed for reclaiming supernatant as well as for sludge removal shall be included as part of the filter system package. Tank internals shall include a floating suction assembly for reclaim capture and supported piping for sludge suction and recirculation. Level Indicating Transmitter shall be Siemens or Endress-Hauser.
3. The floating suction shall be designed and constructed so that the hose connection on the float can swivel through a 180 degrees, to allow the hose to travel from the horizontal to the full vertical position, without causing the float to turn on its side or change the location of the suction invert relative to the water surface. Unit should be self-righting if turned over, and shall be capable of functioning as constructed without the addition of field attached weighing.
4. The float shall be filled with foam so that it cannot fill with water and sink. Further, the floating suction shall be constructed in such a manner

that regardless of water level or hose position, the suction inlet will not break suction, either by turning on its side, pulsating, or vortexing at the suction inlet.

5. The suction inlets shall have SS vortex breakers and will be secured with SS hardware. There shall be a set of SS wire guide-brackets on each side and a tether eyebolt in the top of each float. (In some occasions there is a need to guide the position of the float or to tether it from laying on a tank bottom; this hardware shall be provided). Each float has four SS legs, each is fitted with a rubber or plastic end covering to prevent damage to the tank floor coating.
6. The unit shall be equipped with PVC flange, gasket, Power Lock clamps, PVC hose adaptors and flexible hose (depending upon size of the unit and or tank configuration it may have a combination of a flex and rigid suction line).
7. Internal piping.
8. Stainless steel sludge fluidization nozzles, manufactured and mounted for site adjustment to meet the angle best suited to mix the aged settled sludge.
9. Backwash tank accessories shall be field installed by the Contractor.

L. SLUDGE MIXING/TRANSFER SYSTEM

1. A sludge fluidization and transfer system shall be provided. The sludge fluidization and transfer system shall be capable of converting settled sludge in the backwash water reclaim tank into a homogenous mixture of water and sludge so that it can be easily transferred to the backwash pond. The system shall be capable of drawing down the sludge mixture to within 3" of the tank bottom without drawing air into the suction line.
2. The Sludge Mixing/Transfer system shall include one (1) Sludge Mixing/Transfer Pump, two (2) pressure gauges, one (1) sample cock, two (2) manual isolation valves and one (1) check valve, as well as two (2) motorized control valves, one (1) flow meter, and one (1) rate of flow control valve. The pump, flow meter and motorized control valves shall be integrated with the PLC. Manual isolation valves and motorized control valves shall be butterfly type.
3. Sludge Mixing/Transfer Pump shall be capable of pumping a minimum of 100 gpm at 13ft TDH with efficiency equal to or greater than 50%. Pump shall have cast iron housing and impeller. Pump motor shall be 2 hp

direct-drive with 480 Vac 3-phase power requirement. Acceptable pumps include Flowserve 3MF11A FR3A or equal.

4. Rate of flow control valve (for sludge transfer) shall be 4-inch in size and of the fixed rate, variable orifice type. The flow control valve housing shall be manufactured from ductile Iron. The internal cartridge(s) shall be made of stainless steel, and the flow cartridges shall be passivated. The flow control cartridge and spring are matched to the desired flow of 100 gpm with maximum pressure differential across the valve (including headloss) of 3.5 psi. Future flow rate may be changed by replacing the spring / cartridge combination. The sludge transfer rate of flow control valve shall be manufactured by Griswold.
5. The sludge mixing/transfer system motorized control valves shall be as specified in paragraph 11830 2.03 H and I.
6. The sludge mixing/transfer system flow meter shall as specified in paragraph 11830 2.03 F.
7. Sludge mixing/transfer system shall be field piped and installed by the Contractor.
8. Check valves shall meet requirement of Section 15118.
9. Pressure gauges, sample cock and isolation valves shall be as specified in paragraph 11830 2.03J.
10. Piping between Sludge Mixing/Reclaim System and Backwash Water Reclaim Tank, as well as piping between the Sludge Mixing/Reclaim System and the sump shall be supplied and installed by the Contractor.
11. Manufacturer shall coordinate piping and supports with Contractor.

M. BACKWASH RECLAIM SYSTEM

1. The Backwash Reclaim System shall include one (1) Backwash Reclaim Pump, two (2) pressure gauges, one (1) sample cock, two (2) manual isolation valves, and one (1) check valve, as well as one (1) motorized control valve, one (1) rate of flow control valve, one (1) flow meter and associated piping and fittings. The pump, flow meter and motorized control valve shall be integrated with the PLC. Manual isolation valves and motorized control valves shall be butterfly type.
2. Backwash Reclaim Pump shall be capable of pumping a minimum of 70 gpm at 340 ft TDH with efficiency equal to or greater than 65%. Pump

shall have Stainless Steel housing and impeller. Pump shall be 10 hp direct-drive with 480 Vac 3-phase power requirement. Acceptable pumps include Grundfos CRI 15-6 A-P-I-E HQQE or equal.

3. Rate of flow control valve (for reclaim tank discharge) shall be based on a design flow rate of 70 gpm, shall be 1.5" diameter manufactured by ClaVal, with materials and installation conforming to paragraph 11830 2.03 G 1 and 3.
4. The reclaim system motorized control valve shall as specified in paragraph 11830 2.03 H and I.
5. The reclaim system flow meter shall be as specified in paragraph 11830 2.03 F.
6. Backwash reclaim system shall be field piped and installed by the Contractor. Pipe interior shall be lined with NSF 61 approved fusion bonded epoxy. Pipe exterior coating shall be the same as specified for filter vessel face piping.
7. Check valves shall meet requirement of Section 15118.
8. Pressure gauges, sample cock and isolation valves shall be as specified in paragraph 11830 2.03J.
9. Manufacturer shall coordinate piping and supports with Contractor.

N. INSTRUMENTATION:

All instrument enclosures not elsewhere specified shall be rated NEMA 4.

O. CONTROL PANEL:

The filter manufacturer shall supply an integrated programmable control system capable of automatically controlling the following: Filtration System, GAC System specified in Section 11825, Backwash Reclaim System, the Sludge Mixing/Transfer System., and the Chlorine system. Pump motor starters are specified in Section 16155.

The control panel shall be 120 Vac powered with a NEMA 4 enclosure with 3-point latch with quarter turn handle. The control panel shall provide power to all motor operated valves, instruments, and controls that are included in the Filtration System, and GAC System packages, and chlorination system equipment. The control panel shall have Hand-off-Auto (H-O-A) selector switches for each electric valve. The control panel shall be equipped with a UPS.

PLC inputs and outputs shall be wired to terminal blocks. The PLC shall have one communication port for operator interface communication, and a second port for programming. Provide programming for the control strategy specified in paragraph 1.05, and to interface with the Treatment Telemetry PLC per Section 17900.

The operator interface shall be a color touch-screen, 10” diagonal or larger.

The control panel shall receive the following signals from the Telemetry PLC via Ethernet, refer to Section 17900:

1. Greasewood Tank Level

The control panel shall provide the following dry-contact output signals to the Telemetry PLC, refer to Section 17900:

1. Start/Stop Well 1
2. Start/Stop Well 2
3. Start/Stop Well 3
4. Open/Close System Interconnection Valve
5. Chlorine Gas Leak Alarm
6. Filter System Failure

The control panel shall provide the following signals to the Telemetry PLC via Ethernet, refer to Section 17900:

1. Filter A Flow
2. Filter B Flow
3. Chlortainer scale weight (WIT-1)
4. Backwash Tank Level (LIT)
5. Chlorine Analyzer reading (AIT)

The control panel shall also provide the above discrete signals via Ethernet using Modbus TCP/IP protocol to the Telemetry PLC.

The control panel PLC shall have a software program written specifically for this filter project. The software program shall not be proprietary. The filter manufacturer shall provide an

electronic copy of the software on a CD-ROM to allow the customer to reconfigure the program, if required.

The software provided to the customer shall be the “Noted Version” of the operating program that includes all start-up and on-site changes that were made to the original program

2.04 COATINGS

A. Internal Coating:

1. The filter vessel shall be internally cleaned and epoxy lined with a minimum 12 mil, holiday free, dry film thickness, as herein stipulated.
2. Epoxy lining shall be NSF certified, E-5 per Section 09900 for contact with potable water and suitable for contact with sulfides and the media recommended by the manufacturer.
3. Epoxy shall be applied in accordance with the manufacturer’s standard prepared instructions, and as follows:
 - a. All weld splatter and other projecting irregularities shall be removed by chipping or grinding, resulting in a smooth and continuous surface, free of irregularities, pits, or edges. All sharp corners shall be ground to a 1/8 inch radius, and be free of pinholes and undercuts. All contaminants shall be removed by solvent washing.
 - b. All wetted surfaces shall be sandblasted to a shadow free white metal surface per SSPC-SP-5, and shall have an angular profile of 2 or 4 mils. The white metal shall be a pictorial standard VIS-1.
 - c. The entire surface shall be cleaned of all loose material, such as dust or grit, with a commercial type of vacuum cleaner, or by brushing.
 - d. The first coat shall be spray applied to the properly prepared surface within four hours after completion of blast cleaning at a temperature above 50 degrees F. The thickness of the sprayed wet film shall not exceed the 0.015 inches per coat as checked by an Interchemical Wet Film Thickness Gauge (or equal). The spraying shall be done by the multiple pass method. Each coat shall be cured with adequate ventilation until nearly tack free before application of the succeeding coat. Two coats shall be applied to achieve a finished dry film thickness of 12 to 15 mils, as determined by a non-destructive magnetic gauge (electrometer or

equal). Coating shall extend through all flange necks and across full flange face.

- e. After finished coating is thoroughly cured, the entire surface shall be tested for porosity with a 67 volt holiday detector (Tinker & Razor, or equal). All holidays or irregularities shall be repaired by the applicator.
- f. All carbon steel piping fittings shall be internally cleaned and NSF approved fusion bonded epoxy lined as recommended by the manufacturer.

B. External Coating

- 1. External surfaces shall be commercially sandblasted per SAPC-SP6.
- 2. External surfaces shall be coated with TNEMEC Series 69 Epoxy, 4-6 mils DFT.
- 3. All piping and pressure vessels shall be stretch wrapped to protect equipment before shipping.
- 4. The filter vessel must be lifted by lifting lugs only. Face piping and all loose items must be mounted on pallets, and be protected for shipment in a way that no damage will be done to the equipment and external coating.

2.05 SPARE PARTS

The following spare parts shall be provided:

- 1. 2 – manway gaskets
- 2. 1 – 6-inch butterfly valve
- 3. 1 – 4-inch butterfly valve
- 4. 1 – 2-inch butterfly valve
- 5. 3 – actuators for butterfly valves (1 for each size valve)
- 6. 1 – combination air/vacuum valve
- 7. 1 – backwash flow control valve
- 8. 1 – differential pressure switch
- 9. 2 – pressure gauges (0-150 psig)
- 10. 2 – pressure gauges (-15 – 30 psig)
- 11. 1 – 1 ½ -inch ball valve
- 12. 1 – 1-inch ball valve
- 13. 1 – ½-inch ball valve
- 14. 2 – complete hose fitting assemblies

Pressure Filters – Iron and Manganese Removal
11830-27

15. 100 – LF coiled hose

Spare parts shall be tagged and stored as specified in paragraph 11000-2.12.

2.06 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Operation and maintenance information specified in Section 01730, including final reviewed submittal and as-built drawings.
2. Installation certification Form 11000-A as specified in part 3 of this Section.
3. Training certification Form 11000-B as specified in part 3 of this Section.
4. Certified copies of ASME inspection reports.
5. The Iron and Manganese Removal Equipment Warranty and Service Agreement as specified in Part 4.
6. Copies of the PLC and operator interface touchscreen as-built re-loadable programs on CD-ROM disks. Provide three copies. One additional copy shall be placed in the control panel by the Contractor.

PART 3--EXECUTION

3.01 SHOP ASSEMBLY AND INSPECTION

Filter vessel piping shall be completely assembled in the fabrication shop for inspection and testing before the shipment to project site. Disassembly for shipping shall include the labeling of each piece as shown on a reproducible copy of the assembly drawing. The contractor shall receive the piping in pre-assembled sections, convenient for the purpose of shipping and installation (by others).

A representative of NAVAJO TRIBAL UTILITY AUTHORITY, or their consulting engineer, shall have full access to the manufacturer's shop and design facilities, providing proper notice is given and such access does not interfere with manufacturer's production of other work. The purpose of this access shall be to determine the quality of workmanship, adherence to the agreed schedule, and status of required shop drawings. Final inspection at the manufacturer's facilities will be performed on the equipment, assembled, as it would be in the field. After inspection, the units may be disassembled into subassemblies commensurate with shipping limitations.

3.02 INSTALLATION

The equipment shall be installed (including loading of media) and tested in accordance with the recommendations and supervision of a qualified manufacturer's representative. The installation and initial operation shall be certified on Form 11000-A specified in Section 01999.

3.03 TESTING

The equipment provided under this section shall be subject to performance and operational testing and commissioning as specified in Sections 01660 and 01662. Testing shall be supervised by the manufacturer of the filter system. The Contractor shall provide all necessary temporary piping and valves to convey test flows to waste. Valves or orifice plates shall be used in the temporary piping to cause back pressure similar to that which will be experienced when the system is on line and fully operational.

Following successful commissioning of the filter system, acceptance testing shall begin. Acceptance tests for the pressure filter system shall consist of continuous filter operation for a minimum of 30 days during which time the filters will be operated in accordance with the manufacturer's instructions. Filters shall operate throughout the test at a maximum filtration rate equivalent to that specified in Part 1 of this Section. To achieve the specified production rate per filter, it is acceptable to conduct the acceptance test with less than all filters in operation.

The acceptance test shall be performed by the Contractor and witnessed by the Construction Manager, Owner, and a manufacturer's representative. The Owner will sample filter effluent at least 4 times per day and analyze the samples for iron and manganese concentration. The Contractor will also monitor filtration rates, pressure differential, backwash rate, and elapsed time between backwash cycles, and provide this information to the Construction manager. The equipment performance will be acceptable if the monitored parameters meet conditions specified in Part 1 of this Section.

If the equipment fails the acceptance test, the Manufacturer will be allowed 30 days to modify the equipment and the acceptance test will be repeated.

3.04 TRAINING

A minimum of 16 hours of training conforming to the requirements of Section 01664 shall be provided. Training shall be certified on Form 11000-B specified in Section 01999.

PART 4—EQUIPMENT WARRANTY AND SERVICE AGREEMENT

The following Iron and Manganese Removal Equipment Warranty and Service Agreement is included in this section:

THIS PAGE LEFT INTENTIONALLY BLANK

IRON, MANGANESE REMOVAL EQUIPMENT WARRANTY AND SERVICE AGREEMENT

PARTIES: Navajo Tribal Utility Authority (NTUA), Ft. Defiance, Arizona, hereinafter referred to as Owner, and

_____, hereinafter referred to as Manufacturer.
(Pressure Filter Manufacturer)

REGARDING: Manufacturer provided Pressure Filter System Package for Iron and Manganese Oxidation and Filtration, hereinafter referred to as Pressure Filter System.

WHEREAS: Manufacturer will be furnishing the Pressure Filter System as part of the Lower Greasewood Water System Improvements Project. A complete description of the Pressure Filter System is contained in specification Section 11830 of the Lower Greasewood Water System Improvements Project, Contract No. 2 documents.

NOW THEREFORE, based on the above and the terms and conditions contained herein, the PARTIES agree as follows:

1. Warranty Period

The warranty period shall be for 2 years following successful acceptance testing (but no later than 30 months from shipment) of the equipment.

2. Equipment Warranty

Manufacturer shall furnish and warrant a Pressure Filter System as provided by the manufacturer, free of defects in materials and workmanship, including damages that may have been incurred during shipping. Failed equipment or components shall be replaced at no cost to the Owner. Equipment components provided by the Manufacturer that has been built and supplied by manufacturers other than Manufacturer, shall also be warranted by Manufacturer. Recommended preventive maintenance, as provided by Manufacturer as part of the submittal requirements in Section 11830, will not be included as a repair of component replacement.

This warranty shall include the coatings applied to the Pressure Filter System. During the warranty period, the Manufacturer shall recoat any portion of the pressure filters that exhibit any failure in the coating systems including, but not limited to, peeling, blistering, chalking, rust bleed through, or any other evidence of coating deterioration. Any recoating required as a result of these problems shall be done in accordance with Section 09900 of the Lower Greasewood Water System Improvements Project, Contract No. 2 contract documents.

3. Service During Warranty Period

In the event of an equipment failure during the 2-year warranty period, Manufacturer shall provide the services of a factory-trained technician to trouble-shoot and make necessary warranty repairs. The initial trouble-shooting may be by telephone. However, if in the Owner's opinion, the problem cannot be resolved by telephone, Manufacturer shall provide on-site services of the factory-trained technician at no cost to the Owner. Manufacturer's service technician shall be on-site in Greasewood, Arizona, within 10 calendar days of the Owner's request.

Upon request by Manufacturer, the Owner shall provide Manufacturer with equipment operation and maintenance records.

4. Service Following Warranty Period

For a minimum of 5-years following the 2-year warranty period, Manufacturer shall maintain the capability of providing the services of a factory-trained technician for trouble shooting and service. The cost of the service technician shall be at Manufacturer's standard service rates. A service technician shall be on-site in Greasewood, Arizona, within 10 calendar days of the Owner's request.

IN WITNESS THEREOF, the PARTIES have hereto, on the dates indicated, entered into this Agreement. The persons executing this Agreement on behalf of the parties hereto represent and warrant that the parties have all legal authority and authorization necessary to enter into this Agreement, and that such persons have been duly authorized to execute this Agreement on their behalf.

NTUA

**(PRESSURE FILTER SYSTEM
MANUFACTURER)**

Signature _____

Signature _____

Printed Name _____

Printed Name _____

Title _____

Title _____

Date: _____

Date: _____

Attest: _____

Attest: _____

IRON, MANGANESE REMOVAL EQUIPMENT PERFORMANCE GUARANTEE

PARTIES: Navajo Tribal Utility Authority (NTUA), Ft. Defiance, Arizona, hereinafter referred to as Owner, and

_____, hereinafter referred to as Manufacturer.
(Pressure Filter Manufacturer)

REGARDING: Manufacturer provided Pressure Filter System Package for Iron and Manganese Oxidation and Filtration, hereinafter referred to as Pressure Filter System.

WHEREAS: Manufacturer will be furnishing the Pressure Filter System as part of the Lower Greasewood Water System Improvements Project. A complete description of the Pressure Filter System is contained in specification Section 11830 of the Lower Greasewood Water System Improvements Project, Contract No. 2 documents.

NOW THEREFORE, based on the above and the terms and conditions contained herein, the Manufacturer agrees as follows:

1. Performance Guarantee Period

Upon completion of the 30-day acceptance testing and acceptance by the Owner, the 1-year Performance Guarantee period shall commence.

2. Corrective Action

If, during the Performance Guarantee period, the Pressure Filter System fails to meet Performance Requirements, as outlined in specification Section 11830, at any time, the Manufacturer shall be afforded a reasonable time to investigate the cause and perform corrective action at no additional cost to the Owner. Corrective action must be conducted while the Pressure Filter System facilities remain in operation and with the authorization of the Owner. After corrective action is completed, the 1-year Performance Guarantee period shall restart. If the Pressure Filter System fails to meet Performance Requirements after the Manufacturer has investigated the cause and performed corrective action, the Manufacturer will take responsibility for underperformance of the Pressure Filter System and will do whatever is necessary, up to and including replacing some or all of the Pressure Filter System equipment, in order to meet the Performance Requirements.

3. Owner's Responsibility

Owner is responsible for correction of underperformance of the Pressure Filter System that is caused by failure of Owner to operate system in accordance with the Operations and Maintenance Manual provided by the Manufacturer.

IN WITNESS THEREOF, the Manufacturer has hereto, on the date indicated, entered into this Agreement. The persons executing this Agreement on behalf of the Manufacturer hereto represent and warrant that the parties have all legal authority and authorization necessary to enter into this Agreement, and that such persons have been duly authorized to execute this Agreement on their behalf.

(PRESSURE FILTER SYSTEM MANUFACTURER)

Signature _____
(Manufacturer's Agent)

Printed Name _____

Title _____

Date: _____

Attest: _____

NOTARY ATTEST:

STATE OF _____)

COUNTY OF _____)

The foregoing instrument was acknowledged before me this ____ day of _____,
20____.

(Notary Public)

My Commission Expires: _____

****END OF SECTION****

SECTION 13201

WELDED STEEL BACKWASH WATER STORAGE TANK

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

The Contractor shall be responsible for all labor, materials and equipment necessary for the design, fabrication, construction, painting, and disinfection and testing of a welded steel water storage tank.

Design and construction of the welded steel tank shall conform to all requirements of AWWA D100 Standard for Welded Carbon Steel Tanks for Water Storage, except as modified by the requirements of these Contract Documents.

B. BACKWASH WATER STORAGE TANK DESIGN:

The Backwash Water Storage Tank dimensions shall be as required to provide 18,000 gallons of tank operational volume (Low Water Level to High Water Level) with a maximum tank diameter of 16 feet and a maximum height of 18 feet. Unless otherwise specified, the Backwash Water Storage Tank shall be a ground (concrete pad)-supported steel tank with a sloped internal concrete floor to the center of the tank. It shall have a supported conical roof and shall have a rolled knuckle as specified. Design of the tank shall comply with AWWA D100 and Navajo Tribal Utility Authority (NTUA) standards. The effects of an oscillating water surface in the tank shall also be taken into account. The drawings of the steel reservoir are intended to define general dimensional requirements and tank configuration. Inlet, outlet, and overflow configuration shall be as shown in the drawing. The Contractor shall design the reservoir and all required structural supports and stiffeners in accordance with the requirements contained herein. Design calculations shall be provided in sufficient detail to indicate the procedures used, signed by a structural or civil engineer licensed to practice in the State of Arizona. The reservoir shall be anchored to the concrete pad with stainless steel anchor bolts.

C. DESIGN CRITERIA – BACKWASH WATER STORAGE TANK:

Diameter	16 feet maximum
----------	-----------------

Straight Shell Height	18 feet maximum
-----------------------	-----------------

Welded Steel Backwash Water Storage Tank

13201-1

Roof Knuckle	3 feet radius
Roof Slope	¾ inch per foot
Floor Slope	1/4 inch per foot minimum
Roof Load	25 psf
Roof Snow Load	22 psf
Wind Velocity	90 mph
Exposure category	C
Importance factor	1.15
Winter Design Temperature	15 degrees F
Allowable bearing pressure ¹	1800 psf

Note 1: 1/3 stress increase is allowed for wind and seismic loads.

Annular bottom plates shall be butt welded with a radial width providing at least 24 inches between the inside of the shell and any lap-welded joint in the remainder of the bottom.

D. SEISMIC DESIGN:

The Contractor shall design the tank, foundation and accessories in conformance with AWWA D100, Section 13, modified as specified herein with the following data to determine the minimum strength requirements of the tank for seismic design.

- a. Seismic Design Category B .
- b. Seismic Use Group III.
- c. Seismic Importance Factor, $I_E = 1.50$.
- d. Site Class . D
- e. $S_{DS} = 0.0194g$; $S_{D1} = 0.079g$

Welded Steel Backwash Water Storage Tank
13201-2

Contract 2
Bid Issue

- f. Vertical acceleration: 25 percent of horizontal. Combine with horizontal acceleration. Contractor shall verify.
- g. Freeboard: 2 feet. Contractor to calculate earthquake wave (sloshing) height and adjust height to accommodate design.
- h. Combine hoop stresses by root mean square.
- i. Pressure stability: Do not consider for seismic loading.

E. WIND DESIGN

Design the tank per wind criteria shown on drawing S-1, AWWA D100. Tank shall be designed for maximum wind speed at tank empty condition.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISI	Pocketbook of AISI Standard Steels
ASTM A36/A36M	Structural Steel

Reference	Title
ASTM A283/A283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
ASTM D1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction
AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C504	Rubber Seated Butterfly Valves
AWWA C652	Disinfection of Water Storage Facilities
AWWA D100-05	Welded Steel Tanks for Water Storage
UL 96A	Installation Requirements for Lightning Protection Systems, Ninth Edition
NTUA	Navajo Tribal Utility Authority

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Specification Compliance Statement. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*
2. Qualifications Statements. Provide proof of qualifications in the form of copies of licenses, registrations, and certifications as applicable to the profession of the individual or organization. For Contractor, Contractor's tank design engineer, welders, and independent inspection and testing company, provide name, company name, address, and a description of past experience with work like that to be performed under this contract.
3. List, by product name and number, of standard manufactured items or equipment not fabricated by the tank constructor.
4. Product information, including manufacturer's catalogues, technical data, parts lists, materials lists, operation and maintenance manuals, for standard manufactured items or equipment not fabricated by the tank constructor.
 - a. All tank accessories including access hatches, ladders, vents, hatches, etc.
 - b. Fall protection equipment.
 - c. Piping expansion joints.
 1. Affidavit of compliance with AWWA C221.
 - d. Piping support and seismic restraint system components.
 - e. Electrical system components.
5. Design Information. Design drawings and calculations shall provide information needed for fabrication, layout and erection. Design

Welded Steel Backwash Water Storage Tank

13201-5

calculations shall be in sufficient detail to indicate the procedures used, including the design coefficients, loads and methods. All drawings and calculations shall be sealed by a registered Professional Structural Engineer in the State of Arizona. At a minimum, design drawings shall include the following:

- a. Project location,
- b. Reservoir shape,
- c. Dimensions,
- d. Supports and seismic restraints for the piping,
- e. Locations of all access hatches, doors, and wall penetrations
- f. Location and design of internal ventilation system
- g. Locations and dimensions of all piping and conduits
- h. Electrical and lighting plans
- i. Personnel access door details
- j. Access ladders and fall protection system
- k. Sloped concrete flooring system.
- l. Sacrificial anode cathodic protection system.
- m. Exterior insulation and cladding

At a minimum, design calculations and design standards shall include the following:

- a. Structural calculations for the tank structure and all appurtenances demonstrating compliance with applicable standards
 - b. Component parts and materials of the steel tank and support structure including:
 1. Welded joints,
 2. Accessories,
 3. Piping,
 4. Anti-vortex devices,
 5. Pipe penetrations,
 6. Supports,
 7. Seismic restraints for piping systems,
 8. Pipe connections, and
 9. Electrical lighting and receptacle system.
 10. Sloped concrete flooring system.
 11. Sacrificial anode cathodic protection system.
 12. Exterior insulation and cladding.
6. Schedule of radiographic inspection locations prior to tank construction. A written report of shop and field inspections completed during construction fabrication including weld joint records, radiographic film and test segments shall be delivered to Owner.
7. Construction Schedule: Schedule shall be provided for all component parts, accessories and piping. All components that require extended lead

times shall be identified. At a minimum the schedule shall incorporate the following activities:

- a. Shop fabrication of plate steel components
- b. Shop application of coatings
- c. Foundation construction
- d. Tank and support structure erection
- e. Field coatings
- f. Disinfection and testing
- g. Inspection milestones by tank manufacturer, and Engineer
- h. Weather limitations for field construction

Note that upon construction additional data/inspection information is required for submittal per Section 2.07.

1.04 QUALIFICATION OF MANUFACTURER

The design and construction of the water storage tank shall be completed by a Contractor with a minimum of five years experience with the design and construction of welded steel tanks, depending on the final tank type selected by the Owner. The Contractor must be able to demonstrate experience through the design and construction of at least three similar type and sized water tanks.

1.05 QUALITY CONTROL

- A. **INSPECTION AND TESTING:** Inspection of shop and field welds shall be in accordance with AWWA D100. All inspection shall be performed prior to interior and exterior field painting. Radiographic inspection shall be performed by an independent testing agency with all costs included in the Contractor's bid and paid by the Contractor.

The Owner has the option to provide the services of an Owner's Representative who will review the inspection and testing records and reports, and who may duplicate some of the inspection activities to confirm quality control information. Inspections may be waived only by written notice from the Engineer to the Contractor.

- B. **CONTRACTOR'S ACTIVITIES:** The Contractor will provide the services of an independent commercial inspection and testing company to perform inspections and tests required to demonstrate substantial compliance with specifications for all phases of work, including layout, assembly, welding, erection and water-tightness (leak testing).

1. **WELDING INSPECTION AND TESTING:** Radiographic testing of welds will be used in all cases where feasible. A written report of shop inspections and testing shall be prepared for submittal. The Contractor shall

demonstrate weld quality by obtaining and evaluating radiographs prepared using the X-ray or Gamma Ray method. The basic testing schedule shall be:

- a. Full radiograph of the first 10 feet of each type of joint welded by each welder. Obtain acceptable results before allowing welder to continue work on the project, and submit radiographs and acceptable results to Engineer within 1 week of testing.
 - b. One spot radiograph for:
 1. Each 50 linear feet of shell well subject to primary stress.
 2. Each 100 linear feet of shell well subject to secondary stress.
 3. Thirty percent of weld junctions.
 4. When unacceptable sections of weld are discovered, the Engineer may direct additional radiographs be taken to determine the extent of deficiency and to establish that which joints elsewhere are not deficient. In such situations, additional radiographs will be at no additional compensation.
 - c. Obtain and evaluate radiograph tests uniformly as construction progresses. Review results with the when welding is approximately 25, 50, 75 and 100 percent complete.
 - d. Minimum length of spot radiographs shall be 16 inches.
 - e. Use two penetrometers for each film, placed at end of exposure adjacent and parallel to weld.
 - f. Fluorescent type (calcium tungstate) screens are not acceptable. Use lead screen type.
 - g. Use fine-grain or extra-fine-grain film. Coarse-grain, high-speed film is not acceptable.
 - h. Unsatisfactory radiograph results indicate inferior workmanship that Contractor shall repair at no additional compensation.
 - i. Repaired welds shall be 100 percent radiographed.
 - j. Prepare a shell plate diagram to indicate radiograph locations. Submit diagram and radiograph films to Engineer.
2. LEAK TESTING: Leak testing shall occur after completing assembly, welding and erection of the tank and support structure, and before applying field coatings on the tank. If leaks are discovered, Contractor shall complete weld repairs as specified in AWWA D100 (Section 11.11 and 11.12.2), retest, and repeat as necessary until no leakage exists. Repeated leak testing and repairs shall be completed by the Contractor for no additional compensation.
 3. HYDROSTATIC TESTING: Hydrostatic leak testing shall be conducted on tank weld joints at and below the operating high water level (HWL).

Hydrostatic leak testing shall conform to the requirements of AWWA D100 (Section 11.12.2), as modified in this section.

- a. The Owner will supply the potable water for one tank fill. Subsequent fills will be purchased from the Owner at a cost of \$2.50 per 1,000 gallons.
 - b. The Contractor shall fill the tank to the overflow level and hold for a minimum of 24 hours before searching for leaks.
 - c. The Contractor shall dispose of leak test water in the evaporation pond adjacent to the site and in accordance with State and local regulations. Chlorine residual in the water shall be completely neutralized prior to discharge.
4. **DISINFECTION:** The contractor shall flush and disinfect the tank and all appurtenances in contact with the stored water in accordance with ANSI/AWWA C-652. Chlorine residual in the water shall be completely neutralized prior to discharge.
5. **DEMONSTRATION:** After all work has been completed, all inspection reports and test data are acceptable, and the tank system is otherwise ready for service, the Contractor shall demonstrate tank operation and performance as follows:
- a. With the water level in the tank at overflow elevation, the Contractor shall operate the treatment system to deliver the design backwash waste washwater (BWW) flow rate specified.
 - b. With the water level in the tank at overflow elevation, the Contractor shall open the sludge lines (S) connected to the tank to demonstrate the hydraulic capacity and mixing of the sludge mixing system.
 - c. With the water level in the tank at overflow elevation, the Owner shall open the reclaim water line (RWR) to demonstrate the hydraulic capacity of the return water piping system.
 - d. With the water level in the tank above the overflow elevation, the Contractor shall demonstrate the hydraulic capacity of the overflow piping (OF) system.
 - e. Demonstrate acceptable access to and operation of all ladders, fall protection equipment, doors, manholes, hatches and covers.
 - f. Satisfactorily operate all mechanical accessories, including valves, vents, doors, etc.

- g. Demonstrate that all instrumentation has been installed, calibrated, and is reading correctly.

1.06 TANK DETAILS

The tank shall be all-welded steel construction. All members of structural steel shall be designed to safely withstand the maximum stresses to which they may be subjected during erection and operation.

- A. Tank Operational Capacity. The operational capacity of the tank, from the lower operation water level (LWL) to the upper operation water level (HWL), shall be 18,000 gallons.
- B. Backwash Waste Washwater (BWW):
 - 1. Nominal Pipe Size: 6 inch
 - 2. Capacity: 660 gpm
- C. Overflow (OF):
 - 1. Nominal Pipe Size: 6 inch
 - 2. Capacity: 660 gpm
- D. Reclaimed Water (RWR):
 - 1. Nominal Pipe Size: 2 inch
 - 2. Capacity: 70 gpm
- E. Transfer Sludge (S):
 - 1. Nominal Pipe Size: 3 inch
 - 2. Capacity: 100 gpm
- F. Waste Sludge (S):
 - 1. Nominal Pipe Size: 4 inch
 - 2. Capacity: 100 gpm

1.07 PERMITS AND UTILITIES

Project related permits and licenses required for the construction of the tank and associated work shall be obtained by the Contractor.

The Contractor tank design drawings shall clearly indicate the approximate location of all equipment and material lay down areas. Existing overhead electrical lines, underground utilities and piping are present at the site. Contractor is responsible for protecting existing utilities and relocating utilities if they interfere with the safe construction of the tank and support slab. Contractor shall coordinate all work and any required utility shutdowns with the Owner.

PART 2--PRODUCTS

2.01 GENERAL

Unless otherwise specified, materials and construction shall conform to AWWA D100. Steel plates shall conform to ASTM A283 and structural shapes shall conform to ASTM A36. Submerged bolts shall be Type 304 stainless steel and all other bolts shall be galvanized unless otherwise noted on the drawings.

A. LOADS

1. Seismic Loads – All members of structural steel and reinforced concrete shall be designed to safely withstand the maximum stresses to which they may be subjected as a result of seismic action. See Specification 01900 for seismic design parameters.
2. Wind Loads - Wind pressure shall be determined in accordance with AWWA D100.

2.02 SHELL

Welded Steel Tank: Shell plates shall be cold rolled to the tank radius prior to the removal of mill scale. Horizontal and vertical joints shall be butt welded on each side with full penetration. If structural bracing of the shell is required, these members shall only be placed on the inside of the shell. Shell plates shall include all vertical plates.

Shell shall be insulated with 2-inches of polyisocyanurate foam with 0.024 inches of standard embossed aluminum cladding.

2.03 ROOF, ROOF COLUMNS, RAFTERS, AND GIRDERS

Roof support system members for the welded steel tank shall be provided whose slope and layout facilitates cleaning and preparation for application of protective coatings. Columns shall be circular with section properties not less than those of a 6-inch-diameter standard pipe section. The column baseplate shall not be welded to the floor plates but held in position by angles or other stops welded only to the floor plates at ends of a plate diagonal. Shims shall be provided under baseplate to provide uniform bearing where column baseplate overlaps a lap seam in the floor plates.

2.04 ACCESSORIES

A. SHELL MANHOLES AND HANDHOLES:

Shell manholes shall be 30 inches in diameter, as indicated on the drawings, and shall be hinged to the shell. Manholes shall be gasketed and watertight.

B. PIPE CONNECTIONS:

All pipe and pipe connections shall be constructed to the limits specified. Pipe connections shall be provided per AWWA D100 (Section 13.5). Penetrations of shell shall not be less than 12 inches clear above bottom. Steel pipe supports for piping inside the tank shall be designed and installed per the tank manufacturer's recommendations.

C. OVERFLOW PIPE:

The tank shall have an overflow pipe as specified and shown on the drawings. The overflow pipe shall be designed for a flow rate of 660 gallons per minute. Overflow capacity shall be provided with no more than 3 inches of weir crest height.

D. INTERNAL AND EXTERNAL LADDERS:

The tank shall have one external ladder meeting the requirements of AWWA D100 or AWWA D103. The external ladder shall be provided with a Saf-T-Climb device as manufactured by North Safety Products, or approved equal. The exterior ladder shall be carbon steel, painted, and provided with a gate with locking mechanism and padlock as shown on the drawings. Ladders shall comply with OSHA and NTUA requirements.

E. ROOF HATCH:

The 2' by 2' roof hatch shall be aluminum with steel hinges and locking hasps. The manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The hatch opening shall have a 4-inch high curb and the hatch cover shall lap the curb by 2 inches. Roof hatch shall be lockable and be provided with an intrusion sensor/alarm to NTUA's SCADA system.

F. VENT:

A tank vent shall be provided as shown on the drawings. The vent shall contain removable panels with bronze screen and fiberglass insect mesh.

G. PLATFORM:

The reservoir shall have a landing platform and handrails at the top of the ladder.

H. GAGE BOARD:

The tanks shall have a gage board assembly. Gage board assembly shall be a target-reading type liquid level indicator. Gage board assembly shall have an accuracy of plus or minus 1/10 foot.

The indicator shall have an anodized aluminum gage board graduated in feet and tenths and shall extend from the base of the reservoir to the top of the reservoir wall. Gage board shall have black numbers and marks on a white background. The pointer shall be cast iron, colored red, and shall travel in the same direction as the liquid in the reservoir. Pointer shall have two guide wires. Assembly shall have a guided float with two top and bottom anchors, sheave elbows, guides, clamps, and other appurtenances. Sheave anchors shall have a steel housing, adjustable spring rod with cadmium-plated steel spring. Bottom anchor shall be steel. Float and guide wires, pointer guide wires, and wire fasteners shall be 316 stainless steel. Pipe between elbow sheaves and the tank and indicator board shall be 1-1/2-inch galvanized steel. Top of the indicator board shall have an iron cap with a drilled brass bolt guide for guiding the pointer wire. Brackets shall be steel. Indicator shall be equipped with a Type 304 stainless steel pull chain. Gage board shall be Varec 6700 series, or equal.

I. LEVEL INDICATOR TRANSMITTER:

Provide a 6-inch flange connection on top of the tank for a level indicator transmitter for level measurement (level indicator transmitter details specified in 11830). The flange connection shall be a maximum of 6-inches above the tank roof and within access of the platform and walkway.

J. EXPANSION JOINT FILLER:

Reformed expansion joint filler shall be ASTM D1751, nonextruding, resilient bituminous type, except strips utilizing cork shall not be used. Cane or other cellular fibers uniformly saturated with asphalts shall be provided.

K. BITUMINOUS MASTIC:

Bituminous sealant shall consist of Henry's 204 as manufactured by Henry Company, APCO 100, Marvin, or equal.

L. (NOT USED)

M. DAVIT CRANE (NOT USED)

N. SAFETY:

1. GENERAL: Safety devices shall be as specified in AWWA D100 and OSHA.
2. FALL PROTECTION: All ladders shall be equipped with a fall arrest system meeting OSHA regulations. The system shall be supplied complete with rigid metal climbing column, top and bottom mounting brackets, intermediate brackets, sliding clamps, safety harnesses, locking mechanisms, lanyards and accessories for three persons. Wire or cable climbing columns will not be acceptable. The climbing columns shall be constructed of the same material as the ladder. The sliding clamps shall be constructed of stainless steel.
3. RIGGING: Interior and exterior rigging devices shall be provided for painting, inspection and maintaining the structure and accessories. Pipe couplings with plugs in the roof or other similar features shall be furnished to provide means for attaching rigging and gaining access to the tank interior for painting, cleaning and inspection.

B. PROTECTION AND SECURITY:

1. PADLOCKS: The Contractor will provide padlocks (keyed to the Owner's requirements) for all locking hasps.

C. MISCELLANEOUS:

1. IDENTIFICATION PLATE: A tank identification plate shall be mounted near the personnel door on a bracket that projects approximately 1 inch out from the pedestal shell to allow for coating. The identification plate shall be stainless steel and provide information as follows:
 - a. Name of tank contractor/supplier
 - b. NTUA's project or file number
 - c. Tank capacity
 - d. Height to HWL
 - e. Date completed

2.05 FOUNDATION

The reservoir foundation shall consist of a reinforced concrete pad. Prior to construction, the Contractor shall submit final foundation loads and required tank anchorage criteria for review by the Engineer.

2.06 CATHODIC PROTECTION – SACRIFICIAL ANODE SYSTEM

The Contractor shall provide a cathodic protection system including the design, installation, materials, equipment, and testing for a sacrificial anode cathodic protection system to provide corrosion protection for the interior submerged surface of the tank. The design, materials, installation and testing shall conform to AWWA D-106-10.

2.07 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Structural calculations of the reservoir and accessory items as specified in paragraph 13201-1.01 B.1.
2. Welding data tabulation and details of welded joints.
3. Erection drawings.
4. Mill test reports of all steel materials with a certification of which ASTM or other AWWA D100 required specification each meets.
5. Report of initial radiographs and evaluation for each weld as specified in paragraph 13201-3.02 A.
6. Report certifying the inspection per Section 11.2, AWWA D100 at the conclusion of the work.
7. Certificate of compliance with AWWA D100.

PART 3--EXECUTION

3.01 CONSTRUCTION

A. GENERAL:

Unless otherwise specified, construction shall conform to AWWA D100.

B. ASPHALT-IMPREGNATED SAND CUSHION: (NOT USED)

C. WELDING:

1. Unless otherwise specified, all welding shall comply with AWWA D100.
2. Contractor-certified qualification records of the welders employed for erection shall be reviewed with the Engineer at the start of erection and each time a new welder is employed. The record for each welder shall indicate:
 - a. Date and result of qualification test.
 - b. Contractor conducting tests.
 - c. Identifying mark of welder.
3. All butt joints shall be provided with complete joint penetration welds.
4. Welding is not permitted when the temperature is less than 32 degrees F, nor during rain, snow, high winds, or when ice is on the metal. For plate thicknesses in excess of 1-1/2 inches, preheating is required when the metal temperature is less than 70 degrees F.

D. BOTTOM:

The tank bottom shall be assembled by the lap joint method of construction as specified in AWWA D100 for the welded steel tank.

E. JOINT FILLER, TANK BOTTOM TO CONCRETE FOUNDATION:

As recommended by the tank manufacturer, a preformed expansion joint filler or asphalt impregnated board shall be placed between the concrete foundation and the tank bottom. Expansion joint shall be sealed with bituminous mastic. Material furnished shall comply with ASTM D-994.

F. TANK COATINGS:

1. Welded Steel Tank: The tank shall be prepared and coated as specified in Section 09901. There is to be full containment within the project site of materials used in and resulting from the steel tanks surface preparation and painting.

3.02 WELD TESTING

A. SPOT RADIOGRAPHS:

1. During erection of the tank shell, spot radiographs in the first 10 feet of joint welded by each welder shall be obtained and evaluated. The radiographs and the evaluation shall be submitted to the Engineer within a week after the employment of each welder on the site.
2. A spot radiograph in each 100 feet of shell weld subject to primary stress, and in each 200 feet of shell weld subject to secondary stress, shall be obtained and evaluated. A record of the extent of repair of defective welds and the spot radiographs of repaired joints shall be maintained for review by the Engineer on the site and included in the report (per AWWA D100) at job conclusion. After acceptance of the structure, the radiographs or sectional segments shall become the property of the Owner.

B. VACUUM TEST:

Welded seams of the tank bottom shall be tested for porosity by observation for any bubbles in a soap solution coating with a glass top metal testing box connected to equipment that produces a vacuum of at least 2 psi. Deficient welds shall be corrected.

3.03 TEMPORARY CLOSURE OF TANK OPENINGS

Tank openings that are not fitted with valves, hatches, or manhole covers at the completion of erection shall be provided with temporary covers of metal, 10-gage minimum, or plywood, concrete-form quality, cut to fit. Covers shall be installed using three or more bolts. The covers are intended to exclude dust, animals, and intruders before and after painting and after disinfection.

3.04 DISINFECTION

The Contractor shall schedule disinfection of the reservoir in coordination with the treatment contractor to coincide with water availability and the preparation for startup of the treatment facility and tanks. Disinfection shall not commence until coating is completed, and after the final coat has dried and cured.

The tank shall be disinfected in accordance with AWWA C652 unless otherwise specified. Water for disinfection will be provided by the Owner. The Contractor shall provide chlorine

and the piping, equipment and appurtenances to deliver the water from the point of supply to the tank.

Prior to disinfection, all interior surfaces shall be washed with clean water using a high-pressure water blaster. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the tank in compliance with State and local regulations.

The tank shall be disinfected with chlorine that conforms to AWWA B300 or B301. A chlorine solution having a chlorine content of 300 mg/l to 500 mg/l shall be sprayed on interior surfaces to be in contact with water when the tank is put into service. The used chlorine solution shall not be drained from the tank during the spraying operation. At the completion of disinfection, the tank shall be partially filled with water to a depth of 1 foot and retained for 4 hours minimum. After the 4-hour period, the chlorinated water shall be drained and squeegeed from the tank and the tank rinsed with potable water.

Disposal of chlorinated water may be through the storm drain or other means proposed by the Contractor. All water to be discharged shall be dechlorinated and disposal shall be in accordance with State and local regulations.

3.05 TESTING FOR VOLATILE ORGANIC CONSTITUENTS

Following disinfection of the tank, but prior to filling the tank for bacteriological testing, a 5-day soak test shall be completed to determine the presence of any volatile organic chemicals (VOC) at unacceptable concentrations. The test results shall be approved by the Engineer prior to final acceptance of the project by the Owner.

Testing for volatile organic constituents shall be as follows:

1. Contractor shall fill the tank to the overflow level. Potable water for the first test will be provided by the Owner at no cost to the Contractor.
2. Water shall be allowed to stand for a 5-day soaking period.
3. The Contractor will engage the services of a testing laboratory approved by the Owner to perform a total organic scan.
4. The Owner will obtain water samples from the tank in accordance with the latest procedures and forward the samples to the laboratory for analysis.
5. If levels of the volatile organic contaminants exceed the action levels recommended NTUA, Contractor shall drain the tank, cure and force-ventilate the tank for a minimum of 10 days, disinfect, refill, allow to soak,

and retest at his expense. This process shall continue until the sample passes. No compensation for additional testing will be provided.

3.06 BACTERIOLOGICAL TESTING

After successful VOC testing, bacteriological tests shall be conducted. The reservoir shall be drained, if directed by the resident project representative, and re-filled to capacity with potable water. Contractor shall dechlorinate water to be disposed as required.

After filling tank, but prior to placing tank in service, samples shall be collected by the Owner and delivered to a certified laboratory within 6 hours to obtain a bacteriological quality test to demonstrate the absence of coliform organisms. Initial laboratory testing will be paid by the Owner. If the initial tests fail, water in the tank shall be chlorinated and retested until satisfactory results are obtained. All costs of retesting shall be borne by the Contractor.

3.07 GUARANTEE

- A. The Contractor shall guarantee its work for a period of two years from the completion date defined in the contract documents to the extent that it will repair any defects caused by faulty design, workmanship or material furnished under the specifications. If Contractor is not advised of any defects within 30 days of end of guarantee period, guarantee shall be considered fulfilled and complete. Defects caused by damaging service conditions such as electrolytic, chemical, abrasive or other damaging service conditions are not covered by this guarantee.
- B. All guarantees obtained by the Contractor from the manufacturer or installer of paint, equipment or accessories not manufactured by Contractor shall be obtained for the benefit of the Purchaser.
- C. An inspection of the tank system (including coatings) will be conducted during the month prior to final acceptance of the work by the Owner to determine whether any repair work is necessary. The Owner will establish the inspection date and notify the Contractor. The Owner will drain and wash down the tank. The Contractor shall provide lighting and scaffolding for the tank inspection. Cracking, deformation, misalignments, leakage, rusting, or deterioration of concrete or structural metal shall be considered to be a failure of the elevated tank system. Repairs at failures shall be performed by determining and removing the cause of the failure, and by removing and replacing the failed component or, if authorized by the Owner, correcting the failed component in place by modification and/or reinforcement. Inspection and repairs shall be performed at no additional cost to the Owner.

3.08 LEAKS

If any leaks are detected (moisture on the outside of the tank) during testing, the Contractor shall promptly repair the leaks by cutting out the defective welds, rewelding, and repairing coatings. Coatings shall be repaired to meet all product, application, and testing criteria for the original coatings.

****END OF SECTION****

SECTION 13540

GRANULAR ACTIVATED CARBON

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies granular activated carbon (GAC) for treatment of drinking water from surface water sources.

B. TYPE:

Virgin activated carbon shall be non-impregnated, agglomerated, granular type, specifically manufactured to adsorb, color, taste, odor, and organic compounds from municipal potable water previously treated by sand filtration.

C. OPERATING CONDITIONS:

Maximum flow through vessel, gpm	700
Maximum temperature in vessel, degrees C	22
Minimum empty bed contact time, min	14

1.02 QUALITY ASSURANCE

A. GENERAL:

Activated carbon shall be specifically manufactured for continuous exposure to water containing up to 8 mg/L of organic compounds.

B. MANUFACTURER

The GAC shall be manufactured in the United States by a producer certified for ISO 9001:2000 quality standards and at the specific plant or site holding such certification. A copy of the valid certificate shall be submitted. The manufacturer shall have at least 15 years of experience manufacturing granular activated carbon.

C. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Granular Activated Carbon
13540-1

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASME	Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels
ASTM D2862	Standard Test Method for Particle Size Distribution of Granular Activated Carbon
ASTM D2866	Standard Test Method for Total Ash Content in Activated Carbon
ASTM D2867	Standard Test Methods for Moisture in Activated Carbon
ASTM D4607	Standard Test Method for Determination of Iodine Number of Activated Carbon
AWWA B604-96	Standard for Granular Activated Carbon
NSF 61	ANSI/NSF Standard Drinking Water System Components – Health Effects

1.03 ENVIRONMENTAL CONDITIONS

Environmental conditions are specified in Section 01800.

1.04 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a

Granular Activated Carbon
13540-2

Contract 2
Bid Issue

number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Detailed product information for the activated carbon proposed, including verification of all properties specified in paragraph 13540-2.02, as well as total weight per vessel.
3. ISO certification.
4. Source of coal, location of manufacture of the GAC, and description of the agglomeration/thermal process used in the manufacture of the GAC.
5. Media sample (2 lb) accompanied with certificate of analysis, showing the following parameters:
 - a. Iodine number
 - b. Moisture content
 - c. Effective grain size
 - d. Uniformity coefficient
 - e. Abrasion number
 - f. Trace capacity number
 - g. Mesh size
6. Affidavit of compliance certifying conformance to the manufacturing experience requirement specified in paragraph 13540-1.02 B.

PART 2--PRODUCTS

2.01 MANUFACTURERS

The Owner and Construction Manager believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturers include Calgon Carbon Corporation, Norit Americas, Inc., or equal.

2.02 MATERIALS

The GAC shall comply with AWWA B-604 – 96 and NSF 61 and shall meet the following requirements:

Parameter	Value	Test Method
Specifications		
Substrate	Bituminous coal	--
Iodine Number, min., mg/g	1,000	ASTM D4607
Moisture max., weight %	2	ASTM D2867
Effective size, mm	0.55 – 0.75	ASTM D2862
Uniformity Coefficient, max.	1.9	ASTM D2862
Abrasion No., min.	75	AWWA B604
Trace adsorption capacity, mg/cc	10	AWWA B604, App. B.2
Screen Size (US Sieve), weight %		
Larger than No. 12, max.	5.0	ASTM D2862
Smaller than No. 40, max.	4.0	ASTM D2862
Typical Properties		
Apparent Density, g/cc	0.45 - 0.54	ASTM D2862
Ash	8%	ASTM D2866
Water Soluble Ash	<1%	AWWA B604
Non-Wettable	<1%	AWWA B604

2.03 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. A detailed description of the procedure for installation and commissioning of the activated carbon.

PART 3--EXECUTION

3.01 INSTALLATION

The carbon shall be delivered in enclosed food grade hopper trucks dedicated to hauling granular activated carbon for potable water applications. The delivery vehicles dedicated for transport of potable grade GAC shall have a minimum capacity of 20,000 lb. The trailers shall be lined with a FDA approved lining material for potable water use. The transport vehicle shall be capable of filling and emptying the adsorber tanks via direct connection to the quick-connect fittings provided under Section 11825. The vehicle shall be equipped with hose for conveying

the carbon a distance of approximately 50 feet from the truck loading area to the adsorption tanks.

The carbon shall be installed in strict accordance with manufacturer's recommendations under the direct supervision of the carbon manufacturer's representative. The representative shall have at least 5 years of experience in performing the carbon exchange procedures.

3.02 TESTING

Upon delivery but before installation of the carbon, the Construction Manager will take random samples for testing. Tests to be performed by the Construction Manager may include sieve analysis, iodine number, ash, contact pH, and apparent density. Failure of the samples to meet the specifications shall be cause for rejection and the Contractor shall remove such media from the site and provide media that meets specification.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 14611

MONORAIL AND HOIST

PART 1--GENERAL

1.01 DESCRIPTION

A. This section specifies Crane System Manufacturer's design and installation of a monorail system complete with concrete foundations, support frame, monorail beam, and trolley hoist; for installation at the chlorine processing area in an exterior environment.

B. Hoist: underhung, heavy-duty, manual, chain type, trolley hoist.

1.02 QUALITY ASSURANCE

A. REFERENCES

The following references are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI B30.11	Monorail Systems and Underhung Cranes
ANSI B30.16	Safety Standards for Overhead Hoists
CMAA	Crane Manufacturer's Association of America
HMI	Hoist Manufacturer's Institute

Equipment furnished shall also comply with the requirements of OSHA.

B. RELATED SPECIFICATION SECTIONS

Division 3 Specifications	Concrete
Section 05100	Structural Materials
Section 05501	Anchor Bolts
Section 05910	Hot-Dip Zinc Coating
Section 11000	General Requirements for Equipment

C. MANUFACTURER'S QUALIFICATIONS:

The monorail Crane System Manufacturer shall be a full service company, regularly engaged in the business of designing, supplying, building, and repairing complete monorail systems of the type specified. Monorail system components and appurtenances furnished shall be designed, coordinated, supplied, installed, and tested by a single manufacturer.

Crane System Manufacturer shall provide calculations and shop drawings that are prepared, sealed, and signed by a professional engineer registered in the State of Arizona.

D. PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment provided shall be suitable for Class C, H-3 service as defined by CMAA.

Concrete foundations, support frames, and monorail beam including splices and runway stops, shall be designed and furnished by the Crane System Manufacturer.

Monorail beam vertical live load design deflection shall be limited to less than 1/600 of span including support system. Vertical live load shall include 25% impact at which time deflection shall be limited to 1/360 of span.

E. OPERATING REQUIREMENTS:

Parameter	
Chlorine Cylinder Weight, full, lb	3650
Chlorine Cylinder Weight, empty, lb	1650
Assumed maximum load, tons	2
Rated Capacity, tons	4
Vertical lift and dimensions, feet	**
Environment	Exterior

** Hook approach distances and high hook position shall be as required to lift chlorine cylinders on/off a delivery truck and moved to/from the chlorine containment vessel loader rack. Examine drawings for interferences and obstructions which might impose additional limitations upon the equipment.

** Coordinate with Owner for specific delivery truck and chlorine cylinder configurations, dimensions, building layout, loader rack layout, etc.

F. UNIT RESPONSIBILITY:

The General Contractor shall assign unit responsibility as specified in Section 11000 to the Crane System Manufacturer for equipment and appurtenances specified in this section.

1.03 SUBMITTALS

Provide the following:

1. Certificate of Unit Responsibility attesting that the General Contractor has assigned, and that the Crane System Manufacturer accepts, unit responsibility in accordance with the requirements of this Section and Section 11000. *No other submittal material will be reviewed until the certificate has been received and accepted.*
2. Manufacturer's equipment data sheet confirming rated capacity, and component sizes and dimensions.
3. Operation and maintenance information for equipment.
4. Detail and construction drawings showing components of complete design including concrete reinforcement, proposed concrete mix, structural steel support framing, monorail beam and spreader bar. Shop drawings shall show the exact layout for this project including bracing, anchor bolts, clearances, hook lift range, hook travel range, erection details, etc.
5. Calculations for components of complete design including vertical and lateral loads (vertical live and dead loads, impact load, wind load, and seismic load), concrete reinforcement steel, structural steel support framing, monorail beam and spreader bar. The first page(s) of the calculation set shall provide a summary of design parameters plus a summary of component stress levels under maximum loading with corresponding component deflections.

Calculation submittal shall be a separate submittal for record purpose only and shall include only two copies; only the summary page(s) will be reviewed by the Engineer and the submittal will not be marked approved and will not be returned to the Contractor.

6. Detail drawings, construction drawings, and calculation submittals shall be sealed and signed by the professional engineer responsible for the design.

1.05 PROJECT/SITE CONDITIONS

A. GENERAL:

Under full load conditions, the equipment shall perform without exceeding the above stated deflection limits and the manufacturer's stated tolerances.

B. SEISMIC:

Supports, equipment, and anchorage shall be designed and installed in accordance with local seismic design requirements. Reference specification 01900 Structural Design and drawing S-001 for design criteria.

PART 2--PRODUCTS

2.01 Trolley hoist shall be Harrington Hoists and Cranes "NTH", Yale Lift Tech "Load King LTP2", or equal; modified as necessary to meet the requirements of this section.

2.02 MATERIALS

Component	Material
Monorail beam and support framing	Steel, ASTM A913
Spreader bar	Steel, ASTM A913
Hoist body	Aluminum
Hand and load chain	Zinc coated steel or stainless steel
Bolts including anchor bolts into concrete foundation	Stainless steel
Concrete	Class A - 4000 psi

2.03 EQUIPMENT

A. MONORAIL BEAM:

Monorail beam shall be either a standard "S" shape or a specially fabricated composite beam comprised of top flange, web and hardened steel bottom tee section, continuously welded to the web. End stops shall be fitted with hard rubber cushions to absorb impact. Reference Section 05100. Monorail beam shall either be a clear span design or support from a carry beam.

B. TROLLEY HOIST:

Bearings shall be sealed to exclude dust and moisture and shall be lubricated for life.

Trolley shall be push propelled running on four (4) alloy steel or cast iron wheels with tread surfaces rated at 375 Brinell hardness.

Hoist shall contain a "load brake" designed for long life and positive stopping and shall be applied automatically on lowering and raising of the load and shall be capable of holding 125 percent of the hoist rated load capacity.

Load hook shall be of hardened steel equipped with a safety catch and be mounted on a ball thrust bearing to swivel without twisting the chain.

Load chain shall be manually raised/lowered by operation of a separate hand chain. Excess load chain shall be collected in a chain container basket.

Spreader bar shall be designed to be used specifically for assisting in hoisting and trolleying ton containers of chlorine between delivery truck and loader rack. Spreader bar shall be capable of holding 125 percent of its design rated capacity. Coordinate spreader bar dimensions with chlorine cylinder configurations, trolley hoist dimensions, and loader rack layout.

C. STORAGE GARAGE

During times when hoist is not in use, provide a weather cover to shield the hoist. Crane System Manufacturer shall design and install a fixed aluminum or stainless steel cover of a size which is approximately twice as large as the hoist. Design shall be substantial enough to be maintenance free and withstand years of exposure. Coordinate location of cover with Owner.

D. FINISHES:

Concrete, above grade – Smooth rub finish.

Monorail beam, support framing, and spreader bar – Hot-dip galvanized after fabrication per Section 05910; use type 316 stainless steel bolts including anchor bolts per Section 05501. Each side of the beam web shall be permanently labeled to indicate system rated load capacity.

Trolley hoist – Epoxy paint with visible capacity label.

Load and hand chains – Zinc coated or stainless steel for use in a corrosive environment.

PART 3--EXECUTION

3.01 INSTALLATION

Manufacturer shall test the equipment in accordance with industry standards and federal regulations prior to shipment.

The monorail system shall be installed and field tested by the Crane System Manufacturer.

3.02 TESTING

After completion of installation, the monorail system shall be tested to ensure compliance with the performance requirements as specified. As a minimum, testing shall be by operating the equipment through a complete lift and lowering cycle and through a complete travel of the monorail to determine that the equipment performs smoothly and safely without failure. Plus a static lift test, held for 10 minutes by the hoist load brake alone without movement.

Such tests shall be carried out with the hoisting equipment loaded at the specified capacity. Any defects shall be corrected or replaced immediately by the Crane System Manufacturer at no expense to the Owner. Final OSHA inspection, load tests, all other testing, and certification shall be at the Crane System Manufacturer's expense.

3.03 TRAINING

The Crane System Manufacturer shall provide a representative to train of the Owner's personnel in the proper operation and maintenance of the equipment.

3.04 USE BY CONTRACTOR

Any hoist used by the Contractor shall be repaired, repainted, and otherwise refurbished to like-new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the monorail system has been accepted.

****END OF SECTION****

SECTION 15050

PIPING SYSTEMS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies systems of process piping and general requirements for piping systems. Detailed specifications for the components listed on the Piping System Specification Sheets are found in other sections of Division 15. This section shall be used in conjunction with those sections.

B. DEFINITIONS:

Pressure terms used in Section 15050 and elsewhere in Division 15 are defined as follows:

1. Maximum: The greatest continuous pressure at which the piping system operates.
2. Test: The hydrostatic pressure used to determine system acceptance.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M36/M36M	Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.3	Malleable Iron Threaded Fittings Class 150 and 300
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket Welding and Threaded
ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312/A312M	Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

Reference	Title
ASTM B88	Seamless Copper Water Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C296	Asbestos-Cement Pressure Pipe
ASTM C443-REV A	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2996	Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4174	Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

Reference	Title
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger--Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services--Sizes 4 In. through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C301	Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
AWWA C303	Reinforced Concrete Pressure Pipe--Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water
AWWA M11	Steel Pipe--A Guide for Design and Installation
CISPI 301	Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
FEDSPEC L-C-530B(1)	Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
MIL-H-13528B	Hydrochloric Acid, Inhibited, Rust Removing
MIL-STD-810C	Environmental Test Methods
SAE J1227	Assessing Cleanliness of Hydraulic Fluid Power Components and Systems
UPC	Uniform Plumbing Code
NTUA	Navajo Area Standards & Construction Requirements

B. FITTINGS AND COUPLING COMPATIBILITY:

To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

1.03 SUBMITTALS

Submittals and product data for all piping materials shall be provided in accordance with Section 01300.

Piping layout drawings for all piping (including encased and above ground piping in the WTP) shall be transmitted to the CONSTRUCTION MANAGER a minimum of 2 weeks prior to construction. Drawings shall be original layouts by the CONTRACTOR; photocopies of contract drawings are not acceptable.

1.04 TEMPORARY ABOVEGROUND POTABLE WATER PIPE (HIGH LINE)

High line piping shall be provided where water service is to be maintained and as required by the CONSTRUCTION MANAGER. High line piping and appurtenances shall be furnished, installed, disinfected, connected, maintained, and removed by the CONTRACTOR. Bacteriological sampling and testing shall be performed by a certified testing laboratory approved by the Owner. The Contractor shall coordinate highlining activities with the Construction Manager.

PART 2--PRODUCTS

2.01 PIPING MATERIALS

Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 15.

2.02 PIPING IDENTIFICATION

A. PLASTIC CODING MARKERS:

Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking Services Inc., or equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant to petroleum based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 degrees F to 180 degrees F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

Markers bearing the legends on the background colors specified in the PIPESPEC shall be provided in the following letter heights:

Outside pipe diameter, ^a inches	Letter height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8
Greater than 3	2-1/4

^a Outside pipe diameter shall include insulation and jacketing.

In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. MAGNETIC TRACER TAPE:

Polyethylene magnetic tracer tape shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal. Tape shall be acid and alkali-resistant, 3 inches wide, 0.005 inch thick, and have 1500 psi strength and 140 percent elongation value. The tape shall be colored the same as the background colors as specified in paragraph 15050-3.06 and shall be inscribed with the word "CAUTION--PIPE BURIED BELOW" and the name of the piping system.

2.03 VALVES

Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be nonasbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5. Push-on and mechanical joints shall meet the requirements of AWWA C111. Manual Valve operators are specified in Sections 15184. Motorized Valve operators are specified in Section 11830.

PART 3--EXECUTION

3.01 INSTALLATION

A. LOCATION:

Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. PIPING SIZES:

Where the size of piping is not specified, the CONTRACTOR shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1 inch in diameter) required for services not described by UPC shall be 1/2 inch.

C. PIPE SUPPORT, ANCHORAGE AND SEISMIC BRACING:

1. **GENERAL:** Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/ contraction and for seismic bracing, as well as anchorage details, are shown on the drawings. Minimum spacing shall be as specified for supports and for seismic bracing. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be hot-dip or mechanically galvanized. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

2. **PIPING CONNECTIONS TO MACHINES:** Piping at machine connections shall be aligned in all planes to permit insertion of bolts at bolted connections or coupling screwed connections without using jacks, come-a-longs or other mechanical means to align field piping with the connections at the machines. Bolts shall not be forced into mating flange bolt holes and shall be capable being withdrawn using finger pressure alone. The use of 'dutchmen' mitered sections or similar specials to achieve the required alignment with machine connections is strictly prohibited.

D. ANCHORAGE FOR BURIED PIPING:

All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified.

E. BEDDING AND BACKFILL:

Bedding and backfill for buried piping shall be as specified.

F. EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings as specified in Section 15085 shall be provided between field piping systems and equipment inlet and outlet connections.

G. FLEXIBILITY

Pipe couplings or flexible joints shall be provided as specified.

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified in Section 15085.

3.02 PIPING IDENTIFICATION

A. PIPE CODING:

After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers as specified in paragraph 15050-2.02 A. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50-foot centers.

B. MAGNETIC TRACER TAPE:

Polyethylene magnetic tracer tape shall be buried 12 to 18 inches below ground and shall be above and parallel to buried nonferrous, plastic and reinforced thermosetting resin pipe lines. For pipelines buried 8 feet or greater below final grade, the CONTRACTOR shall provide a second line of tape 2.5 feet above and parallel to the buried pipe.

3.03 VALVE IDENTIFICATION

Stainless steel tags bearing the specified valve number stamped in 1/4-inch high letters shall be installed on valve flanges in a position visible from floor level. Flangeless valves 8 inches in diameter and larger shall have tags attached to the valve body by self-tapping corrosion resistant metal screws. Flangeless valves 6 inches in diameter and smaller shall have tags attached to the valve stem by stainless steel wire. Wire shall be 0.063 inch minimum.

3.04 TESTING

A. GENERAL:

Upon completion of piping, but prior to application of insulation on exposed piping, the CONTRACTOR shall test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the CONTRACTOR shall notify the CONSTRUCTION MANAGER 24 hours prior to each test.

Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

Where testing existing chlorine and sulfur dioxide systems to the nearest isolation valve, CONTRACTOR shall provide a tee in the line adjacent to the valve. The branch outlet on the tee

shall be valved and used for cleaning, pressure testing, draining, and drying the line. Unless otherwise indicated, the existing chlorine or sulfur dioxide system shall not be shut down during testing or connecting the tee and valve. Prior to placing the line in service, the valve on the branch outlet shall be plugged or sealed with a blind flange or threaded plug. CONTRACTOR shall be responsible for all damage to the existing system as a result of this work.

B. GAS, AIR, AND VAPOR SYSTEMS: (NOT USED)

C. LIQUID SYSTEMS:

Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: exposed piping, buried insulated piping, and buried or exposed piping carrying liquid chemicals. Testing procedures for chlorine and sulfur dioxide systems are specified in paragraph 15050-3.04 D. Testing procedures for hydraulic and lube oil systems are specified in paragraph 15050-3.04 E. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallon per hour per inch diameter per 100 feet of buried piping.

D. CHLORINE SYSTEMS:

1. GENERAL: Chlorine systems include chlorine in gaseous and liquid phase under positive and negative pressure. After cleaning, as specified in paragraph 15050-3.05 E, the system shall be pressure tested. Pressure gages, relief valves, automatic control valves, and other components which may be damaged or exceeded by test pressures shall be removed and openings shall be blocked off prior to testing. The Contractor shall not attempt to repair leaks until all pressure has dissipated from the system. The system shall be repaired and retested as necessary until a successful test (zero leakage) is achieved.

For evaporator-supplied systems, Contractor shall disconnect the vent from the discharge side of the pressure relief valve of each evaporator, plug the resultant opening, inspect and secure all joints, close all valves which discharge to atmosphere, and open all in-line valves. Contractor shall open the valve in the bypass line around the pressure reducing valve on the downstream side of each evaporator to provide a through path around this valve. System piping shall then be tested to 150 psig. After testing, Contractor shall replace all equipment previously removed and close all in-line valves. Contractor shall reconnect the vent line to the downstream side of the pressure relief valve of each evaporator and close the valve in the bypass line around the pressure reducing valve on the downstream side of each evaporator.

Steel pipelines shall be hydrostatically tested. However, if drying after hydrostatic testing is impractical or cannot be accomplished, the Contractor may test steel lines with nitrogen gas or dry air providing he takes the necessary safety precautions to safeguard personnel and minimize the risk incurred when performing such a test at high pressures. All PVC pipelines shall be hydrostatically tested. Testing PVC lines with nitrogen or air is not permitted.

2. HYDROSTATIC TESTING: Steel piping lines and PVC solution lines hydrostatically tested shall be tested to 150 psig. PVC vacuum lines shall be hydrostatically tested to 50 psig. After testing, all moisture absorbing gaskets and valve packing shall be replaced.

3. DRYING: Chlorine and sulfur dioxide piping systems shall be dried prior to placing in service. Even if water has not been purposely introduced into the system for hydrostatic testing or cleaning, drying is still required because moisture may enter the system from the atmosphere or other sources.

For steel pipe, drying shall be accomplished by passing steam through the lines from the high end of the system until the lines are thoroughly heated. While steaming, the Contractor shall allow condensate and foreign matter to drain out. The steam supply shall then be disconnected and all pockets and low spots in the line drained. While the line is still warm, dry oil-free air having a dew point of -40 degrees F, or below, shall be blown through the line until the exiting air dew point is the same as the supply air. Valves shall be fixed in the half-open position during drying. Valves removed temporarily from the system during drying operations must be free of moisture before being recoupled to the system piping.

Drying of PVC pipe applies solely to vacuum lines and consists of draining and removing all water and moisture from the system. After draining the line, the Contractor shall first pig the pipe to remove excess water. The Contractor shall then air dry the system in accordance with the requirements for steel pipe. PVC pipe shall not be steamed.

4. NITROGEN OR AIR PRESSURE TESTING: The Contractor may use nitrogen gas or oil-free dry air to test steel lines. Testing consists of gradually introducing nitrogen gas or dry air up to 50 psig and maintaining this pressure while testing the line for leaks with soapy water. When the system is free from leaks at this pressure, the test pressure shall then be increased in increments of 50 psig up to a maximum of 150 psig. At each stepped increase in pressure, the Contractor shall check for leaks and take corrective action as necessary. When the system is free from leaks at the final test pressure, the system shall then be depressurized, the test source disconnected, and the system capped to prevent the entrance of water.

For testing with nitrogen gas, the Contractor shall use cylinders of dry high purity nitrogen gas, nitrogen handling cylinder mounted pressure regulator 0 to 300 psig, and necessary fittings and adapters to complete connection between the source and system header. Pressure regulator shall be self-relieving type which vents to the atmosphere and include a throttling valve.

For testing with air, the Contractor shall provide oil-free air with a relative humidity of zero. All fittings, adapters, and accessories, pressure regulator and throttling valve shall be suitable for pressure testing with air and rated for 300 psig service.

5. SERVICE GAS TESTING: Immediately after the chlorine system has been dried and pressure tested, the service gas shall be gradually introduced and the entire system tested for leaks. Time shall be allowed for the complete replacement of air from the piping with service gas.

The Contractor shall use a liquid ammonia solution or chlorine gas detector to detect for chlorine leaks. The Contractor shall spray the solution at the pipe connections and shall not squirt the liquid on the pipe or fittings. In the event leaks are detected in the piping or the equipment, they shall not be repaired until all gas has been purged from the line. The reaction of the two substances produces a dense white cloud. Upon completion of repairs, the Contractor shall repeat the cleaning and drying process described in paragraphs 15050-3.04 D and 3.05 E and retest the lines with service gas.

The Contractor shall use a commercial electromechanical volt-ammetric sensor for detecting sulfur dioxide leaks. Gas detectors manufactured by Interscan Corporation and Enterra are recommended.

E. HYDRAULIC AND LUBE OIL SYSTEMS: (NOT USED)

F. DRAINS:

Drain systems, other than pumped drain systems, shall be tested in accordance with UPC and the local governing agency.

G. GRAVITY SEWER LINES: NOT USED

3.05 CLEANING AND FLUSHING

A. GENERAL:

Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The CONTRACTOR may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab.

B. TEMPORARY SCREENS:

Upon completion of the cleaning, the CONTRACTOR shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Equipment suction or piping size, inches	Maximum screen opening, inches
0 –1	1/16

Equipment suction or piping size, inches	Maximum screen opening, inches
1-1/4 – 3	1/4
3-1/2 – 6	1/2
Over 6	1

The CONTRACTOR shall maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. The CONTRACTOR shall remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

C. GAS AND AIR SYSTEMS:

Unless otherwise specified, gas and air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6 inches shall be cleaned by having a swab or "pig" drawn through the separate reaches of pipe. After connection to the equipment, it shall then be blown out using the equipment. Upon completion of cleaning, the piping shall be drained and dried with an airstream. Sludge gas, natural gas and propane systems shall be purged with nitrogen and a nitrogen pad maintained at 10 psi until put in service. Chlorine and sulfur dioxide systems shall be cleaned in accordance with paragraph 15050-3.05 E.

D. LIQUID SYSTEMS:

After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens. Liquid chlorine and sulfur dioxide lines shall be cleaned in accordance with paragraph 15050-3.05 E.

E. CHLORINE AND SULFUR DIOXIDE SYSTEMS:

1. GENERAL: All portions of the system shall be cleaned free of oil and grease.
2. STEEL PIPE: All pipe threads shall be washed clean and free from cutting oil. The inside of all pipe sections and fittings shall be cleaned of any pipe dope, oil and grease by drawing a cloth wetted with solvent through each assembly. Valves shall be dismantled, thoroughly cleaned with solvents, and repacked, if necessary. Contractor shall cap or plug all open ends at the end of each work day.

Contractor shall use trichloroethylene. The Contractor shall at all times exercise caution to minimize solvent exposure and shall be responsible for its proper handling and disposal. Solvents containing hydrocarbons or alcohols are unacceptable.

3. PVC PIPE: All solution lines shall be cleaned using water only. Vacuum lines shall be cleaned with a detergent and water and thoroughly rinsed to remove all vestiges of detergent. All lines shall be further purged of water by passing a cleaning ball or swab through the lines as specified in paragraph 15050-3.05 A.

F. STEAM SYSTEMS: (NOT USED)

G. HYDRAULIC AND FLUID POWER OIL SYSTEMS: (NOT USED)

H. POTABLE WATER SYSTEMS:

Potable water piping systems shall be flushed, tested and disinfected in accordance with AWWA C651 and NTUA requirements. Furnish test equipment, chemicals for chlorination, temporary valves, bulkheads and other water equipment control equipment and materials required. Coordinate water acquisition with local water agency.

Indiscriminate onsite disposal or discharge of chlorinated water to sewer systems, storm drains, drainage courses or surface waters is prohibited.

Pipes, fittings, valves and all other components incorporated into tie-ins and connections with the existing system shall be spray disinfected or swabbed with a liquid chlorine solution in accordance with AWWA C651 and as specified herein. Upon connection to the main, the line shall be flushed as directed by the CONSTRUCTION MANAGER. Disinfection by this method is generally limited to assemblies of 20' or less in length. Alternate methods such as "predisinfection" prior to installation in accordance with AWWA C651 may be required at the discretion of the CONSTRUCTION MANAGER.

3.06 PIPING SPECIFICATION SHEETS (PIPESPEC)

Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services (PIPESPEC) is identified by a piping system number. Piping services specified in the PIPESPECS and on the drawings are designated by service symbols as shown in Table A. Table A also indicates the system number, fluid category, and pipe marker background color of each service.

Table A, Piping Services

Symbol	Service	System	Fluid category	Pipe marker color ¹
BW	Backwash Water	7	Water	Green
BWW	Backwash Waste Washwater	9	Water	Green

CLG	Chlorine Gas	20	Chemical	Yellow
CLS	Chlorine Solution	19	Chemical	Yellow
CLV	Chlorine Vacuum	21	Chemical	Yellow
D	Drain	24	Drain/Vent	Green
OF	Over Flow	24	Drain/Vent	Green
PD	Pumped Drainage	12	Wastewater	Green
RWR	Reclaimed Water	9	Water	Green
S	Sludge	14	Sludge	Green
STD	Storm Drain	24	Drain/Vent	Green
TD	Tank Drain	12	Wastewater	Green
V	Vent	24	Drain/Vent	Yellow
WW	Well Water (Raw Water)	7	Water	Blue
1W	Potable Water (City water)	7	Water	Blue
2W	Potable Water (downstream of air gap or backflow preventer)	7	Water	Blue

3.06 PIPING SPECIFICATION SHEET--PIPESPEC

Piping Symbol/Service	1W--Potable Water	System--7
	2W—Potable Water (downstream of air gap or backflow preventer)	
	WW—Well Water	
	BW—Backwash Water	

Test Requirements:

Medium:	Water; ref. spec paragraph 15050-3.04 C.
Pressure:	160 psig
Duration:	120 minutes

Gasket Requirements:

Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	EPDM

Exposed Pipe and Valves:

(See drawings for pipe size and valve type. See Remarks for insulation requirements.)

(3" and smaller)

Pipe:	<u>Copper tube</u> ; ASTM B88, Type L, drawn. <u>Conn</u> ; solder type with threaded or flanged adapters for valves. <u>Ftgs</u> ; wrought copper or bronze, ANSI B16.22. <u>Insulation</u> : See Remarks
-------	---

PVC; ASTM D1784, Class 12454 B, NSF certified, ASTM D1785, Sch. 80. Ref. spec Section 15064.
Conn; plain end; solvent weld.
Ftgs; PVC, Sch. 80, socket type.

Valves:

Ball; Jamesbury Fig. 351, Nibco T-580, or equal.
Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal.

Ball; PVC, true union, socket type, Chemtrol Tru Block TU Series, Asahi/ America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and Viton O-rings.
Diaphragm; PVC body, PTFE diaphragm, Chemtrol Series PD, Posacon 677, Asahi/ America, or equal.

(4" and larger)

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 7 (continued)

Pipe: Steel; ASTM A53, Grade B, black, or AWWA C200 with NSF compliant epoxy lining per AWWA C210 or AWWA C213. Ref. spec Section 15061.
Conn; welded, flanged at valves and equipment.
Ftgs; steel; ends and lining to match pipe.

(3" and larger)

Valves: Butterfly; Ref. spec Section 15103. Substitute Type B on 2-1/2-inch lines.

Buried Pipe and Valves:

(See drawings for pipe size and valve type.)

(3" and smaller)

Pipe: Copper tube; ASTM B88, Type K, annealed or drawn.
Conn; solder type, with threaded or flanged adapters for valves.
Ftgs; wrought copper or bronze, ANSI B16.22.

PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Ref. spec Section 15064.

Conn; plain end; solvent weld.

Ftgs; PVC, Sch. 80, socket type.

(2-1/2" and smaller)

Valves:

Ball; PVC, true union, socket type, Chemtrol Tru Block TU Series, Asahi/ America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and Viton O-rings.

Diaphragm; PVC body, PTFE diaphragm, Chemtrol Series PD, Posacon 677, Asahi/ America, or equal.

(4" to 12")

Pipe:

PVC; per AWWA C900, DR as specified. Ref. spec Section 15064.

Restrained push-on rubber gasket joint. Flanged adapters for valves and fittings.

Ftgs; ductile iron; coating, lining and ends to match pipe.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 7 (continued)

Ductile iron; AWWA C151 with NSF Compliant lining and coating.. Polyethylene encasement per ANSI/AWWA A21.5/C105.

Conn; Restrained mechanical joint pipe. Flanged adapters for valves.

Ftgs; ductile iron;restrained mechanical joint, coating, lining, and ends to match pipe.

Valves: Gate; Resilient Seated. ref. spec Section 15102, with extension stem and valve box.

Encased Pipe:

(See drawings for pipe size and location.)

(4" and larger)

Pipe: Ductile iron; AWWA C151 with NSF Compliant lining and coating.

Conn; restrained mechanical coupling or flanged.

Ftgs; Ductile iron; coating, lining, and ends to match pipe.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Sleeves shall be installed of proper size for all pipes passing through walls as shown on the drawings. Where indicated on the drawings, or required for liquid or gas-tightness, the pipe shall be sealed with mechanical seal by Link Seal as manufactured by Thunderline Corp., Wayne, Michigan, or equal.
3. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
4. System 7 piping installed in areas and locations subject to freezing (including ceiling areas which are not heated) shall be insulated.
5. Water lines installed over suspended or other type ceilings shall be insulated for condensation control.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 7 (continued)

6. Systems shall be disinfected per NTUA requirements.
7. Tape shall be spirally wrapped with a 55 percent overlap and sufficient tension and pressure to provide continuous adhesion without stretching the tape. Edges of tape must be continuously smoothed and sealed by hand during wrapping. On vertical application, contractor shall begin at bottom and proceed upward creating a weather board overlap.

Smooth contours shall have a minimum thickness of 50 mils while nuts, bolts, and sharp projections shall be 100 mils.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:

System--9

BWW--Backwash Waste Washwater
RWR--Reclaimed Water

Test Requirements:

Medium: Water; ref. spec paragraph 15050-3.04 C.
Pressure: 125 psig
Duration: 60 minutes

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar)
and neoprene binder
Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(3" and smaller)

Pipe: Steel; ASTM A53, galvanized. Ref. spec Section 15061.
Conn; taper threaded, ANSI B1.20.1. Flanged adapters for
2-1/2 inch, 3 inch valves.
Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150,
galvanized.

(2" and smaller)

Valves: Ball; Jamesbury Fig. 351, Nibco T-580, or equal.
Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or
equal.
Swing check; Crane 137, Lunkenheimer 230, or equal.

(4" thru 8")

Pipe: Steel; ASTM A53, ERW, Grade B, black or AWWA C200,
3/16 inch thick, with cement mortar lining. Ref. spec Section
15061.
Conn; grooved mech pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel, per spec Section
15061; ends and lining to match pipe.

(2 1/2" thru 8")

Valves: Butterfly; Ref. spec Section 15103. Substitute Type B on
2-1/2-inch lines.
Swing check; spring loaded per spec Section 15118.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 9 (continued)

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Sleeves shall be installed of proper size for all pipes passing through walls as shown on the drawings. Where indicated on the drawings, or required for liquid or gas-tightness, the pipe shall be sealed with mechanical seal by Link Seal as manufactured by Thunderline Corp., Wayne, Michigan, or equal.
3. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
4. For buried piping see Civil Site Piping Plan.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: PD--Pumped Drainage System--12
TD--Tank Drain

Test Requirements:

Medium: Water; ref. spec paragraph 15050-3.04 C.
Pressure: 125 psig
Duration: 120 minutes

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(2" and smaller)

Pipe: Steel; ASTM A53, galvanized. Ref. spec Section 15061.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

Valves: Eccentric plug; per spec Section 15110. Install valve with seat upstream.
Swing check; Lunkenheimer 230, Crane 137, or equal.

(2 1/2" thru 8")

Pipe: Steel; ASTM A53 ERW, Grade B, black, no lining. Ref. spec Section 15061.
Conn; butt weld, grooved mech pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel per spec Section 15061; ends to match pipe.

Valves: Eccentric plug; per spec Section 15110. Install valve with seat upstream.
Swing check; spring loaded per spec Section 15118.

Buried and Encased Pipe and Valves:

(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3" and smaller)

Pipe: PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Ref. spec Section 15064. Provide magnetic tracer tape.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 12 (continued)

Conn; plain end; solvent weld with threaded or flanged adapters for valves.

Ftgs; PVC, Sch. 80, socket weld.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating per spec Section 09900.

(4" thru 12")
Pipe:

Ductile iron; AWWA C151. Ref. spec Section 15062.

Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.

Ftgs; ductile iron, per spec Section 15062; coating, lining and ends to match pipe.

Valves: Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09900.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.
2. Valves for tank drain lines shall be provided where indicated on the drawings.
3. Testing for tank drains shall be in accordance with the Uniform Plumbing Code or NTUA standards as applicable.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: S—Sludge System--14

Test Requirements:

Medium: Water; ref. spec paragraph 15050-3.04 C.
Pressure: 125 psig
Duration: 120 minutes

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(2" and smaller)

Pipe: Steel; ASTM A53, galvanized. Ref. spec Section 15061.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; malleable iron, ASTM A197, ANSIB16.3, Class 150, galvanized.

Valves: Eccentric plug; per spec Section 15110. Install valve with seat upstream.
Swing check; Lunkenheimer 230, Crane 137, or equal.

(2 1/2" thru 8")

Pipe: Steel; ASTM A53, ERW, Grade B, black, no lining. Ref. spec Section 15061.
Conn; butt weld, grooved mechanical pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel per spec Section 15061; ends to match pipe.

(2 1/2" thru 12")

Valves: Eccentric plug; per spec Section 15110. Install valve with seat upstream.
Swing check; spring loaded per spec Section 15118.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline.

2. Sleeves shall be installed of proper size for all pipes passing through walls as shown on the drawings. Where indicated on the drawings, or required for liquid or gas-tightness, the pipe shall be sealed with mechanical seal by Link Seal as manufactured by Thunderline Corp., Wayne, Michigan, or equal.
3. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
4. For buried piping see Civil Site Piping Plan.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: CLS--Chlorine Solution System--19

Test Requirements:

Medium: Water; ref. spec paragraph 15050-3.04 C.
Pressure: 300 psig
Duration: 120 minutes

Gasket Requirements:

Flange: PTFE bonded EPDM, full-face gaskets, ANSI B16.1.
Push-on/Mech Cpl: N/A

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(All sizes)

Pipe: CPVC; Sch 80 (valves and fittings to match) NSF certified, Pipe and fittings exposed to sunlight shall be painted. Ref. spec Section 15064.
Conn; plain end, solvent weld, flanged for valves 3 inch and larger.
Ftgs; PVC, Sch. 80, solvent weld.

(4" and less)

Valves: Ball; Sch 80 CPVC Chemtrol Tru Bloc TU Series, Asahi/America Duo Bloc TU Series, GSR TU Series, or equal, with PTFE seats and EPDM O-rings.
Diaphragm; CPVC body, Chemtrol Series PD, Posacon 677, Asahi/America, or equal with EPDM or PTFE diaphragm.
Ball check; CPVC body, Chemtrol Series BC, Asahi/America, or equal with EPDM or PTFE seats/seals.

Remarks:

1. Valves shall be provided with certification for use with chlorine by the Chlorine Institute, Inc.
2. Valves shall be cleaned for chlorine service by the valve manufacturer prior to delivery to the job site.
3. Following test completion, piping, valves, and fittings shall be dried as specified in paragraph 15050-3.04 D.
4. Sleeves shall be installed of proper size for all pipes passing through walls as shown on the drawings. Where indicated on the drawings, or required for liquid or gas-tightness, the pipe shall be sealed with mechanical seal by Link Seal as manufactured by Thunderline Corp., Wayne, Michigan, or equal.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping System: 19 (continued)

5. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
6. All pipe, valves, fittings and appurtenances for this system shall be rated for continuous service at 250 psi, minimum.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: CLG--Chlorine Gas System--20

Test Requirements:

Medium: Ref. spec paragraph 15050-3.04 D.
Pressure: 150 psig
Duration: 120 minutes

Gasket Requirements:

Flange: Gylon gasketing, Garlock Style 3500 or 3510
Push-on/Mech Cpl: N/A

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(1-1/2" and smaller)

Pipe: Steel; ASTM A106, seamless, Grade B, black, Sch. 80, no lining, pickled. Ref. spec Section 15061.
Conn; socket weld; forged steel, Class 3000, ANSI B16.5, flanged for valves. Ref. spec Section 15085.
Ftgs; forged steel, ASTM A105, ANSI B16.11, pressure Class 3000, pickled, ends to match pipe.

Valves: Ball; Jamesbury 530S-C31-2271MT, ITT Cam-Tite 3058-2-4, or equal.

Remarks:

1. The cleaning (pickling) solution used shall comply with Mil-H-13528B. Immediately following pickling and rinsing procedures, steel pipe and fittings shall be coated inside and outside with a rust and corrosion preventative system, and the ends sealed to prevent the entry of dirt. Corrosion preventive coating shall not interfere with cleaning operations specified in paragraph 15050-3.05 E.
2. Valves shall be provided with certification for use with chlorine by the Chlorine Institute, Inc.
3. Valves shall be cleaned for chlorine service by the valve manufacturer prior to delivery to the job site.
4. Following test completion, piping, valves, and fittings shall be dried as specified in paragraph 15050-3.04 D.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service: CLV--Chlorine Vacuum System--21

Test Requirements:

Medium: Water; ref. spec paragraph 15050-3.04 D.
Pressure: 50 psig
Duration: 1440 minutes

Gasket Requirements:

Flange: PTFE bonded EPDM, full-face gaskets, ANSI B16.1.
Push-on/Mech Cpl: N/A

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(All sizes)

Pipe: PVC; ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Piping and fittings exposed to sunlight shall be painted. Ref. spec Section 15064.
Conn; plain end, solvent weld, flanged for valves 3 inches and larger.
Ftgs; PVC, Sch. 80, solvent weld.

Valves: Ball; PVC, Asahi/America Duo Bloc TU Series, Chemtrol Tru Bloc TU Series, GSR TU Series, or equal, with PTFE seats and Viton O-rings.

Remarks:

1. Valves shall be provided with certification for use with chlorine by the Chlorine Institute, Inc.
2. Valves shall be cleaned for chlorine service by the valve manufacturer prior to delivery to the job site.
3. Following test completion, piping, valves, and fittings shall be dried as specified in paragraph 15050-3.04 D.

3.06 PIPING SPECIFICATION SHEETS--PIPESPEC

Piping Symbol/Service:	D--Drain STD--Storm Drain V--Vent	System--24
------------------------	---	------------

Test Requirements:	
Medium:	In accordance with Section 712, Uniform Plumbing Code.
Pressure:	In accordance with Section 712, Uniform Plumbing Code.
Duration:	In accordance with Section 712, Uniform Plumbing Code.

Gasket Requirements:	
Flange:	Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl:	Nitrile or neoprene

Exposed Pipe and Valves:
(See drawings for pipe size.)

(3" and smaller)	
Pipe:	<u>Steel</u> ; ASTM A53, galvanized. Ref. spec Section 15061. <u>Conn</u> ; taper threaded, ANSI B1.20.1. <u>Ftgs</u> ; cast iron, threaded drainage fittings, ASTM A126, ANSI B16.12, galvanized.

Valves:	None
---------	------

(4" thru 12")	
Pipe:	<u>Cast iron soil pipe (CISP)</u> ; ASTM A74. <u>Conn</u> ; service hub and spigot compression type or hubless cast iron sanitary system per CISPI 301. <u>Ftgs</u> ; CISP, ASTM A74, joint options to match pipe.

Valves:	None
---------	------

Buried and Encased Pipe and Valves Under and 5 Feet Outside Building
(See drawings for pipe size.)

(12" and smaller)	
Pipe:	<u>Cast iron soil pipe (CISP)</u> ; same as exposed.

Valves:	None
---------	------

Buried and Encased Pipe and Valves Beyond 5 Feet Outside Building
(See drawings for pipe size.)

(3" and smaller)

Pipe:

PVC; ASTM D1784, Class 12454-B, ASTM D2665, Sch. 40.
Ref. spec Section 15064. Provide magnetic tracer tape.

Conn; plain end, solvent weld.

Ftgs; PVC, socket type, DWV, ASTM D2665.

Valves:

None

(4" thru 12")

Pipe:

PVC; ASTM D3034, SDR 35. Provide magnetic tracer tape.

Conn; Push-on with nitrile gasket.

Ftgs; PVC or IPS cast iron; ends to match pipe.

Valves:

None

Remarks:

1. HVAC equipment condensate drains shall be copper tube; ASTM B88, Type M, drawn. Fittings shall be wrought copper or bronze, ANSI B16.22. Connections shall be solder type with threaded adapters for equipment connections where required. Products and fabrication shall be as specified in Section 15066.

****END OF SECTION****

SECTION 15061

STEEL PIPE

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies steel pipe and fittings.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASTM A36/A36M	Structural Steel
ASTM A47	Ferritic Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106 REV A	Seamless Carbon Steel Pipe for High-Temperature Service

Reference	Title
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A283/A283M REV A	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A572/A572M REV B	High Strength Low Alloy Columbium-Vanadium Steels of Structural Quality
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger-- Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services--Sizes 4 In. Through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA M11	Steel Pipe--A Guide for Design and Installation
SSPC-SP10	Near-White Blast Cleaning

B. TESTING:

Factory testing shall conform to the requirements of ASTM A53, ASTM A106, or AWWA C200 as applicable.

PART 2--PRODUCTS

2.01 PIPE MATERIALS

Steel Pipe
15061-2

Contract 2
Bid Issue

Steel pipe and fittings shall be provided in accordance with ASTM A53, ASTM A106, or AWWA C200 as specified in Section 15050, Piping Systems.

Steel for pipe fabricated to meet requirements of AWWA C200 shall conform to the requirements of ASTM A36, ASTM A572, Grade 42, ASTM A570, Grades 33 and 36, or ASTM A283, Grade D. Steel for ASTM A53 and ASTM A106 pipe shall be Grade B.

2.02 PIPE MANUFACTURE

Unless otherwise specified, ASTM A53 pipe shall be Type E, electric resistance welded or Type S, seamless pipe as specified in Section 15050. The minimum wall thickness for ASTM A53 or ASTM A106 pipe shall be Schedule 40 for pipe 10 inch diameter and less and 3/8 inch for pipe 12 inch through 24 inch diameter. Increased shell thickness shall be provided where specified.

AWWA C200 pipe shall be straight or spiral seam. The minimum wall thickness shall be 7 gage for pipe 6 inch through 24 inch diameter and 1/4 inch for pipe 26 inch diameter and larger. Increased shell thickness shall be provided where specified.

2.03 CONNECTIONS

Connections shall be as specified in Section 15050 and shall conform to Section 15085. Coating for buried connections shall be as specified in paragraph 15085-2.06.

2.04 FITTINGS AND APPURTENANCES

Malleable iron threaded fittings and appurtenances shall conform to the requirements of ASTM A47 or ASTM A197, ANSI B16.3.

Unless otherwise specified, steel fittings and appurtenances shall conform to the requirements of ASTM A234, ASTM A105, or ANSI B16.11; and fabricated steel fittings and appurtenances shall conform to AWWA C208.

Fittings for grooved end piping systems shall be full flow cast fittings, steel fittings, or segmentally welded fittings with grooves or shoulders designed to accept grooved end couplings. Cast fittings shall be cast of ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47. Standard steel fittings, including large size elbows, shall be forged steel conforming to ASTM A106. Standard segmentally welded fittings shall be fabricated of Schedule 40 carbon steel pipe.

Unless otherwise specified, all fittings shall be rated for pressure and loadings equal to the pipe.

2.05 PIPE LINING

A. EPOXY:

Unless otherwise specified, pipe and fittings shall be lined with a liquid epoxy as specified in AWWA C210 with the following exceptions:

1. No coal tar products shall be incorporated in the liquid epoxy.
2. The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.

The lining shall be applied to a minimum thickness of 16 mils in not less than two coats.

B. CEMENT MORTAR:

Where specified, pipe and fittings shall be lined with cement mortar as specified in AWWA C205. Fittings and specials larger than 24 inches, not fabricated from centrifugally lined straight sections, shall require 2-inch by 4-inch by 13-gage self-furring wire mesh reinforcement for hand-applied lining.

C. HIGH TEMPERATURE SERVICE EPOXY: (NOT USED)

D. GLASS LINING: (NOT USED)

2.06 PIPE COATING

A. EPOXY:

Unless otherwise specified, pipe and fittings shall be coated with a liquid epoxy as specified in AWWA C210 with the following exceptions:

1. No coal tar products shall be incorporated in the liquid epoxy.
2. The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.

The coating shall be applied to a minimum thickness of 16 mils in not less than two coats.

B. POLYETHYLENE TAPE:

Where specified, pipe and fittings shall be coated and wrapped with prefabricated multilayer cold applied polyethylene tape coating in accordance with AWWA C214. The coating application shall be a continuous step operation in conformance with AWWA C214, Section 3. The total

coating thickness shall be not less than 50 mils for pipe 24 inches and smaller and not less than 80 mils for pipe 26 inches and larger.

2.07 FUSION EPOXY COATING AND LINING

Where specified, steel pipe and fittings shall be fusion epoxy coated and lined. The fusion epoxy coating shall be 3M Scotchkote 203, or equal. Surface preparation shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. The application method shall be by the fluidized bed method and shall attain 12 mils minimum dry film thickness.

Field welds, connections and otherwise damaged areas shall be coated and patched according to the manufacturer's instructions with 3M Scotchkote 306.

2.08 JOINT GASKETS

Joint gaskets shall be as specified in Section 15075.

2.09 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Affidavits of Compliance with AWWA C200, ASTM A53, or ASTM A106 as applicable.
2. Contractor's layout drawings as specified in paragraph 15050-2.04.

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL:

Pipe shall be installed in accordance with AWWA M11, Chapter 16. Welded joints shall be in accordance with AWWA C206 and Section 15085.

Sleeve-type mechanical pipe couplings shall be provided in accordance with AWWA M11 and paragraph 15085-2.02 A.

Pipe lining and coatings at field joints shall be applied as specified in paragraphs 15061-2.05 and 2.06.

Unless otherwise specified, buried mechanical couplings and valves shall be field coated as specified in paragraph 15085-2.06.

B. ANCHORAGE:

Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01300.

3.02 TESTING

Hydrostatic testing shall be in accordance with Section 4 of AWWA C600 except that test pressures and allowable leakage shall be as listed in Section 15050.

****END OF SECTION****

SECTION 15062

DUCTILE IRON PIPE

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies ductile iron pipe, ductile fittings and gaskets.

B. DEFINITION:

Where cast iron pipe is specified, the term and symbol shall mean ductile iron pipe.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A21.14	Ductile-Iron Fittings 3 In. Through 24 In., for Gas
ANSI A21.52	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for Gas
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A716	Ductile-Iron Culvert Pipe

Reference	Title
ASTM C150	Portland Cement
AWWA C104 (ANSI A21.4)	Cement-Mortar Lining for Ductile- Iron and Gray-Iron Pipe and Fittings for Water
AWWA C110 (ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111 (ANSI A21.11)	Rubber-Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115 (ANSI A21.15)	Flanged Ductile-Iron and Gray-Iron Pipe With Threaded Flanges
AWWA C150 (ANSI A21.50)	Thickness Design of Ductile-Iron Pipe
AWWA C151 (ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153 (ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 12 In. for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints
NTUA	Navajo Area Standards & Construction Requirements

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The CONSTRUCTION MANAGER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any*

requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration .

2. Shop fabrication drawings showing details of materials, piping, fittings, couplings, dielectric connections, joint locations and details, types and locations of supports.
3. CONTRACTOR's layout drawings as specified in paragraph 15050-1.03.
4. Certifications specified in the following documents:

ANSI A21.14, paragraph 14-4.2
ANSI A21.52, paragraph 52-4.2
ASTM A716, paragraph 4.2
AWWA C110, paragraph 10-5.3
AWWA C111, paragraph 11-7.1
AWWA C115, paragraph 15-4.2
AWWA C151, paragraph 51-5.2
AWWA C153, paragraph 53-6.3
AWWA C606, paragraph 4.1.1.1
5. Other data necessary to show conformance of the complete piping system to these specifications.

PART 2--PRODUCTS

2.01 GENERAL

Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150
Manufacturing requirements	
Water or other liquid	AWWA C151
Gas	ANSI A21.52
Gravity service pipe	ASTM A716
Joints	
Rubber gasket	AWWA C111
Threaded flange	AWWA C115

Ductile Iron Pipe
15062-3

Item	Document
Fittings	
Water or other liquid	AWWA C110/AWWA C153
Gas	ANSI A21.14
Cement mortar lining	AWWA C104

2.02 PIPE

Unless otherwise specified, ductile iron pipe shall be Class 50 and have nominal laying lengths of 18 or 20 feet. For grooved-end pipe, wall thickness shall be minimum Class 53 except where the specified pressure requires heavier pipe.

2.03 GASKETS

Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50 percent by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

2.04 FITTINGS

Unless otherwise specified, fittings shall conform to AWWA C110. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified. The AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings unless otherwise specified. Long-radius elbows shall be provided where specified. Grooved end fittings shall comply with paragraph 15050-1.02 B.

2.05 JOINTS

A. UNRESTRAINED JOINTS:

1. **PUSH-ON JOINTS:** Unrestrained joints, where specified, shall be the rubber ring compression, push-on type joint suitable for buried service. Unrestrained joints shall be the Fastite Joint as manufactured by American Cast Iron Pipe Company, the Tyton Joint as manufactured by U.S. Pipe, or equal. This joint is not permitted on fittings or specials, unless otherwise specified. Unless otherwise specified, joints shall have an allowable deflection up to 5 degrees at specified pressures. Joint assembly and field cut joints shall be made in strict conformance with AWWA C600 and manufacturer's recommendations.

2. **MECHANICAL JOINTS:** Where specified, mechanical joints for above or below ground service shall meet the requirements of ANSI/AWWA A21.10/C110 and

ANSI/AWWA A21.11/C111. Gaskets and bolts and nuts shall comply with paragraphs 15062-2.03 and 2.05 D, respectively.

B. RESTRAINED JOINTS:

1. **GENERAL:** Unless otherwise specified, restrained joints are required for all exposed and buried piping. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and restrained push-on for buried service.

2. **PUSH-ON JOINTS:** Restrained push-on joints shall be as specified in paragraph 15062-2.05 A.1., modified for restraint. Joints shall be the Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company, TR Flex Joint as manufactured by US Pipe, or equal. Restrained joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the CONSTRUCTION MANAGER.

3. **FLANGE ASSEMBLIES:** Unless otherwise specified, flanges shall be ductile iron and shall be threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110. Flanges shall be adequate for 250 psi working pressure. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges. Where specified, flanges shall be threaded-on or cast-on flanges conforming to ANSI B16.1, Class 250.

Unless otherwise specified, bolts and nuts for flange assemblies shall conform with paragraph 15085-2.01 C. Gaskets shall be as specified in paragraph 15085-2.01 B.

4. **MECHANICAL JOINTS:** Where specified, restrained mechanical joints shall be the positive restraint type. Mechanical joints with retainer glands are not acceptable.

Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.

C. BALL AND SOCKET FLEXIBLE JOINT PIPE:

Ball and socket flexible joint pipe shall be the boltless type and shall allow a maximum joint deflection of 15 degrees. Each joint shall be provided with a retainer lock to prevent rotation after assembly. Joints shall be the Flex-Lok Joint as manufactured by American Cast Iron Pipe Company, USIflex as manufactured by U.S. Pipe, or equal.

D. BOLTS AND NUTS:

Corrosion-resistant bolts and nuts for use with ductile iron joints shall be high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.

2.06 PIPE COATING

Unless otherwise specified, pipe and fittings shall be coated with asphaltic material as specified in AWWA C151.

2.07 PIPE LINING

A. ASPHALTIC LINING:

Unless otherwise specified, pipe and fittings shall be lined with asphaltic material as specified in AWWA C151.

B. CEMENT MORTAR LINING:

Where specified, interior surfaces of pipe and fittings shall be cement mortar lined in accordance with AWWA C104. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalies.

C. GLASS LINING: (NOT USED)

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL:

Piping runs specified on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01300.

Pipe shall be installed in accordance with AWWA C600.

Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work, cutting and shaping. Concrete mortar shaping within any structure and manhole shall be as specified.

B. INSULATING SECTIONS:

Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided as specified in paragraph 15085-3.05.

C. ANCHORAGE:

Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01300.

3.02 ACCEPTANCE TESTING

Hydrostatic pressure tests shall be conducted in accordance with Section 4 of AWWA C600 except that test pressures and allowable leakage shall be as listed in Section 15050.

The CONTRACTOR shall conduct the tests in the presence of the CONSTRUCTION MANAGER.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15064

PLASTIC PIPE

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies polyvinylchloride, chlorinated polyvinylchloride, polyethylene, and polypropylene pipe and fittings. High density polyethylene (HDPE) piping for trenchless installation shall be per specification Section 15065.

The Contractor shall provide all necessary labor, materials, appurtenances, equipment, and services for a complete, in-place pipeline.

B. PIPE DESIGNATIONS:

For use in the Piping System Specification Sheets (PIPESPEC) in Section 15050 and in this section, the following plastic pipe designations are defined:

Designation	Definition
PVC	Polyvinylchloride
CPVC	Chlorinated polyvinylchloride
PE	Polyethylene
PP	Polypropylene

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents

issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2464	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D2657	Heat-Joining Polyolefin Pipe and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F402	Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings
ASTM F437	Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

Reference	Title
ASTM F493	Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
NTUA	Navajo Area Standards & Construction Requirements

B. MANUFACTURER INSPECTION AND TESTS:

1. Unless otherwise specified, all pipe manufacturing materials, pipe and fittings provided shall be tested in accordance with the applicable referenced standards.
 - a. Perform material tests at no additional cost to the Owner.
 - b. In addition to those tests specifically required, Construction Manager may request additional samples of any material for testing by Construction Manager. Additional samples and testing shall be furnished at no additional cost to Owner.
2. Like pipe and fittings provided shall be furnished by a single manufacturer.

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The CONSTRUCTION MANAGER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Shop fabrication drawings showing details of materials, piping, fittings, couplings, mechanical restraint devices, dielectric connections, joint locations and details, types and locations of supports.
3. CONTRACTOR's layout drawings as specified in paragraph 15050-1.03. Contractor shall provide restraint calculations including required length for mechanical restraint, placement and/or sizing of thrust blocks, based on provided layout and Section 3.03. Calculations shall be stamped by a Registered Professional Engineer in the State of Arizona.
4. Manufacturer's certificates of compliance with the specified standards.
5. Procedures for safe handling, transport and storage of HDPE piping, including maximum pipe stacking height to maintain the round pipe shape.
6. Other data necessary to show conformance of the complete piping system to these specifications.

PART 2--PRODUCTS

2.01 PVC PIPE

A. PRESSURE PIPE:

PVC material for pipe and fittings shall conform to ASTM D1784, Class 12454-B with an established hydrostatic design basis (HDB) equal to or greater than 4000 psi at 73.4 degrees F.

Pressure pipe for water lines 4 through 12-inches shall be manufactured in accordance with AWWA C900. Pressure pipe 14- through 48-inches shall be manufactured in accordance with AWWA C905. Minimum Dimension ratio shall be as specified on the plans. Where not specified on plans, use DR18.

Where specified, pipe and fittings shall be in accordance with ASTM D1785 or shall conform to ASTM D2241 for standard dimension ratios: 160 psi pipe--SDR 26; 200 psi pipe--SDR 21; 250 psi--SDR 17. Pressure rating for pipe shall be in excess of test pressure specified in Section 15050. Neoprene gaskets with push-on joints shall conform to ASTM F477.

Where specified, Schedule 80 PVC socket type fittings shall conform to ASTM D2467. Schedule 40 PVC fittings shall conform to ASTM D2466. PVC solvent weld cement for socket connections shall meet the requirements of ASTM D2564. Schedule 80 PVC threaded fittings shall conform to ASTM D2464. Fittings for gasketed pipe shall be ductile iron or steel push-on IPS-sized pressure fittings rated for use with the specified class of PVC pipe. Unless otherwise specified, fittings shall be lined and coated in accordance with Section 15061 or Section 15062 as applicable.

B. NONPRESSURE PIPE:

1. GRAVITY SEWER PIPE: PVC material for sewer pipe and fittings shall conform to Class 12454-B, as defined in ASTM D1784. Pipe and fittings shall meet the requirements of ASTM D3034 for SDR 35. Neoprene gaskets with push-on joints shall conform to ASTM F477.
3. DRAIN, WASTE AND VENT PIPE: PVC material for drain waste and vent (DWV) pipe and fittings shall conform to Class 12454-B, ASTM D1784. Pipe and fittings shall conform to ASTM D2665. Unless otherwise specified, connections shall be solvent weld. Connections to traps, closet flanges, and nonplastic pipe shall be with approved adapter type fittings designed for intended use. Solvent weld cement for socket connections shall meet requirements of ASTM D2564.

C. FITTINGS FOR PVC PRESSURE PIPE

Fittings for PVC water lines shall be ductile-iron conforming to AWWA C110 or AWWA C153 with a minimum rated working pressure greater or equal to the provided pressure pipe. The fittings shall have restrained mechanical or push on joints manufactured specifically for the PVC pipe to be used with the fitting. Fittings with repaired defects are not acceptable and will be rejected.

Bolts and nuts for mechanical joints, or flanged ends will be of high strength corrosion resistant low-alloy steel and shall conform to AWWA C111. Flange bolts and nuts for above ground installation shall conform to Appendix A of AWWA C115. Flange bolts and nuts for below ground installation shall be 316 stainless steel. All fittings shall be fusion bonded epoxy lined and coated and lined unless stainless steel is used.

Couplings shall meet the requirements of AWWA C900 and/or C905 as applicable, and be suitable for the working pressure. Deflection shall not exceed 50% of the manufacturer's written maximum recommendation unless otherwise specified.

2.02 CPVC PIPE

CPVC material for pipe and fittings shall conform to ASTM D1784, Class 23447-B. Pipe and fittings shall be in accordance with ASTM F441. Neoprene gaskets with push-on joints shall conform to ASTM F477.

Schedule 80 CPVC socket type fittings shall conform to ASTM F439. Schedule 40 CPVC socket type fittings shall conform to ASTM F438. CPVC solvent weld cement for socket connections shall meet the requirements of ASTM F493. Schedule 80 CPVC threaded type fittings shall conform to ASTM F437.

2.03 PE PIPE

PE pipe shall meet the requirements of ASTM D1248, Type III, Grade P 34, Class C, 100 psi or as specified in Section 15050, whichever is higher. Fittings shall be of the same material, molded socket fusion for sizes 4 inch diameter and smaller and molded or fabricated butt fusion for sizes 6 inch and larger. Fittings shall be 125 psi or as specified in Section 15050, whichever is higher. Heat fusion welding shall be in conformance with ASTM D2657.

2.04 PP PIPE

A. PRESSURE PIPE:

PP pipe and fittings shall be formulated of polypropylene conforming to ASTM D4101, SDR 11, butt fusion type. Pipe shall be 150 psi rated in all sizes. Heat fusion welding shall be in conformance with manufacturer's recommendation.

B. DRAIN, WASTE AND VENT PIPE:

PP drain, waste and vent (DWV) pipe and fittings shall be made from flame retardant, Schedule 40, polypropylene (PPFR) plastic as defined in ASTM D4101. Pipe and fittings used for buried piping and in concealed locations shall be joined by electrical fusion coils energized by a variable low-voltage power supply to completely fuse the interface between the pipe and socket and form a completely homogenous structure. Unless otherwise specified, mechanical joint fittings may be used under bench or in exposed locations where future disassembly is desired. The mechanical method shall be in conformance with the manufacturer's recommendation.

PART 3--EXECUTION

3.01 STORAGE AND HANDLING

Pipe shall be stored and handled in accordance with AWWA M23 and the manufacturer's recommendations. PVC pipe that has been gouged, scratched, or otherwise damaged shall be subject to rejection at the discretion of the Construction Manager. Rejected pipe shall be removed from the site and replaced at no additional cost to the Owner.

Cover stored PVC pipe with an opaque material to protect it from the sun's ultraviolet radiation. PVC pipe that has been subjected to excess ultraviolet radiation as identified by color fading or chalking shall not be used. The determination as to the acceptability of PVC pipe shall rest solely with the Construction Manager.

PVC pipe that has been contaminated in any way with petroleum products (on the inside or outside of the pipe) shall not be used.

3.02 INSTALLATION

PVC pipe 3 inches in diameter and smaller shall be joined by means of socket fittings and solvent welding in conformance with ASTM F402. Solvent-cemented joints shall be made in strict compliance with the manufacturer's/supplier's instructions and recommended procedures. Unless otherwise specified, PVC pipe 4 inches in diameter and greater shall be joined by means of gasketed push-on joints and steel or ductile iron push-on or mechanical joint fittings. Fittings that are not plastic or stainless steel shall be lined and coated. Linings shall meet or exceed AWWA C-116 or AWWA C-210 and fully compliant with NSF requirements for potable water service, Ceramapure PL90 ceramic epoxy, or equal. Coatings shall be asphaltic material as specified in AWWA C151. Unless otherwise specified, PVC and CPVC piping exposed to sunlight shall be painted with an approved Latex coatings Tnemec Series 1028 or 1029, Sherwin Williams, Sher Cryl HPA, or equal.

Connections to different types of pipe shall be by means of flanges, specified adapters or transition fittings. Where sleeve type couplings are used, both shall be uniformly torqued in accordance with pipe manufacturer's recommendation. Foreign material shall be removed from the pipe interior prior to assembly.

Unless otherwise specified, PE pipe and fittings 4 inch diameter and smaller shall be joined by means of thermal socket fusion and pipe 6 inch and larger by thermal butt fusion. Butt-fusion joining of the pipes and fittings shall be performed with special joining equipment in accordance with procedures recommended by pipe manufacturer. Tensile strength at yield of butt-fusion joints shall not be less than pipe. Flanged adapters shall be provided for connection to valves and where specified.

3.03 SUPPORTS, THRUST AND ANCHOR BOLTS

All plugs, caps, tees and horizontal and vertical alignment changes greater than or equal to 11 ¼ degrees and as specified in buried pressure piping systems shall be anchored by means of reaction backing thrust blocks or mechanically restrained joints.

Concrete support blocks shall be provided for all ductile-iron fittings and valves to prevent the fitting or valve weight from being carried by the PVC pipe.

3.04 TESTING

Testing of plastic piping shall be in accordance with the NTUA Standards, AWWA C651, and as specified in Section 15050.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15065

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 -- GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies high density polyethylene (HDPE) pipe for trenchless installation by Horizontal Directional Drilling in accordance with specification Section 02160.

B. CHARACTERISTICS:

Provided HDPE pipe shall conform to the following minimum requirements:

Dimension Ratio (DR)	11
Material Designation	PE-4710
Pipe Sizing System per AWWA C906 & ASTM F714	DPS
Pressure Class in accordance with AWWA C906	202 psig

C. REFERENCES:

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. References shall be made to the latest edition of said standards unless otherwise called for.

References	Title
ANSI/AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
ASTM D2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2657	Heat Joining Polyolefin Pipe and Fittings
ASTM D3350	Polyethylene Plastics Pipe and Fittings Material
PPI TR 31	Underground Installation of Polyolefin Piping

1.02 QUALITY ASSURANCE

High Density Polyethylene (HDPE) Pipe
15065-1

Contract 2
Bid Issue

A. INSPECTION AND TESTING:

All HDPE materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C906.

B. AFFIDAVIT OF COMPLIANCE:

The manufacturer shall furnish an affidavit of compliance conforming to the requirements of AWWA C906, Section 1.5, affirming that the piping components comply with the requirements of AWWA C906 and this section.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300.

Submit the following prior to commencement of the Work:

- A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- B. Detail drawings which show the type and location of all fittings, joints, and connections to other pipe materials.
- C. Design calculations demonstrating that the pipe is capable of sustaining service conditions and the maximum loads to be imposed during installation. For HDPE installed by directional drilling, this submittal may be made as part of Section 02160 Horizontal Directional Drilling.
- D. Affidavit of Compliance specified in paragraph 15065 1.02 C.

- E. A report containing a copy of all manufacturer's test results for all tests conducted in accordance with paragraph 15065-1.02 B.

1.04 DESIGN REQUIREMENTS

The design and layout of pipe shall meet the service and installation conditions and the criteria specified in this Section and as shown on the Plans are the responsibility of the Contractor. This design shall be performed by or under the supervision of a Professional Engineer licensed by the State of Arizona. The Contractor shall submit design calculations for pipe with wall thickness and pressure class demonstrating that the pipe is capable of sustaining the maximum stresses to be imposed during installation and service.

The calculations shall take into account ground loads, live loads such as traffic and railroad, and any other installation loads which may be reasonably anticipated.

PART 2 -- PRODUCTS

2.01 GENERAL

HDPE materials, pipe and fittings shall be manufactured, marked, inspected, sampled and tested in accordance with the requirements of AWWA C906 and this section.

The color of the pipe shall be black with a blue stripe designating potable water.

2.02 MATERIALS

HDPE piping components shall as a minimum be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE 4710 and that conform to the requirements of ASTM D3350 for a cell classification of PE 445474C.

2.03 PIPE

Pipe shall have the nominal pipe diameter shown, with the inside diameter based on the DR and pipe sizing system shown. Dimensions and tolerances shall be as specified in AWWA C906.

2.04 FITTINGS

Fittings shall meet the pressure requirements of the specified pipe. Fittings shall conform to the applicable requirements of AWWA C906 for the joining methods specified in paragraph 15065-3.02 B.

Increase wall thickness to next nominal pressure rating/next lower DR for mitered bends. Mitered bends shall be segmented according to the following table:

High Density Polyethylene (HDPE) Pipe
15065-3

Contract 2
Bid Issue

Degree of bend	Minimum number of miter segments
45 or less	2
Greater than 45	4

2.05 FLANGE ENDS:

Flange End assemblies shall consist of HDPE stub end flange adapter and back up ring.

Furnish beveled flange adapters for disk clearance on connections to butterfly valves.

Stub end flange adapters shall be furnished with concentric ring convolutions on the flange face and radiused or chamfered outer diameter transition from pipe wall to stub end.

Back up ring shall be ductile iron encapsulated in polypropylene for non corrosive applications or 316L stainless steel for corrosive applications as called for on the Plans. Drilled for ANSI B 16.5, Class 150 or AWWA C207. Flange ring bore shall be chamfered or radiused to match transition on stub end flange adapter. Improved Piping products - PPDI, or approved equal.

2.06. BOLTS:

Bolts and nuts for buried mechanical joining components such as flanges shall be made of noncorrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any protective coating.

Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.

PART 3 -- EXECUTION

3.01 PIPE HANDLING AND STORAGE

The Contractor shall use care in handling and storage of the pipe. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The handling of the pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

Sections of pipe with cuts, gouges, or scratches on the outside diameter (OD) surface that exceed 10-percent of the wall thickness of the pipe shall be removed completely and the ends of the pipeline rejoined. The inside diameter (ID) surface shall be free of cuts, gouges, and/or scratches.

3.02 INSTALLATION

A. GENERAL:

Unless otherwise specified, the piping system shall be installed in accordance with ASTM D2321, ASTM F1962, AWWA C906 and the manufacturer's recommendations.

B. JOINING:

Pipe and fittings shall be joined into continuous lengths on the job site above ground. Unless otherwise specified, joining shall be by the butt-fusion method performed in accordance with the pipe manufacturer's recommendations and ASTM D2657. Socket fusion, extrusion welding and hot gas welding shall not be used.

The pipe supplier shall be consulted to obtain machinery and expertise for the joining by butt-fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe.

Flanged joining, or other mechanical joining methods specified, may be used to make connections to differing piping materials, to equipment, valves and other appurtenances, and where specified.

Internal beads formed at joints during butt fusion shall be removed from pipes that convey solids-bearing liquids. Joints shall be debeaded on all buried pipes where the beading interferes with the deflection testing specified in paragraph 15065-3.03.C

C. INSTALLATION:

Horizontal directional drilling shall be per Section 02160. Trench excavation and backfill where required shall be per Section 02200.

D. LOCATION AND ALIGNMENT:

Pipe and fittings shall be placed in the trench with the invert conforming to the elevations, slopes, and alignments shown.

E. BEDDING AND BACKFILL:

Materials used for bedding and backfill shall be as specified in Section 02200 and as shown.

Place materials by methods that will not disturb or damage the pipe. All HDPE pipe shall be at the temperature of the surrounding soil at the time it is backfilled and compacted. Work in

and tamp the bedding material in the area under the pipe and up to the spring line before placing and compacting the remainder of the embedment. Blocking under the pipe shall not be permitted.

Use compaction equipment and techniques that are compatible with materials specified and location in the trench. Before using heavy compaction or construction equipment directly over the pipe, place sufficient backfill to prevent damage, excessive deflections, or other disturbances of the pipe.

3.03 TESTING

A. HYDROSTATIC PRESSURE TESTING:

HDPE piping systems shall be fully pressure tested prior to placing the line into service. Water shall be the test medium for hydrostatically testing the pipe. Test procedures shall be as specified in Section 15050 and the following. In case of conflict, the following procedures shall apply.

Cover the pipe at intervals and/or at curves if necessary to hold the pipe in place during testing. Connections shall be left exposed for visual leak inspection.

After all free air is removed from the test section, the pressure in the pipe shall be raised at a steady rate to the required pressure. The pressure in the section shall be measured at the lowest point of the test section. Test pressure shall be as specified in Section 15050. The initial pressure shall be applied and allowed to stand without makeup pressure for 2-3 hours to allow for diametric expansion or pipe stretching to stabilize. After the equilibrium period, the test section shall be returned to the required test pressure and held for 3 hours. Amounts of makeup water allowable for expansion during the pressure test shall be as listed in the Plastic Pipe Institute Technical Report TR 31-88. No visual leaks or pressure drops shall be observed during the final test period.

B. DEFLECTION TESTING:

1. GENERAL: Deflection testing shall be performed on the entire length of installed pipe no sooner than 30 days after completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe and fittings in the installed pipeline under external loads shall not exceed the maximum deflection specified in paragraph 15065-1.01 B. Either of the following devices and procedures may be used to measure deflection.

2. PULL-THROUGH DEFLECTION TESTING: The Contractor shall determine whether the allowable deflection has been exceeded by use of a pull-through device.

a. PULL-THROUGH DEVICE: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular

sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:

- (1) A diameter, or minor diameter as applicable, equal to the average inside diameter of the pipe minus the dimension equivalent of the maximum installed deflection specified in paragraph 15065-1.01 B. A tolerance of plus 0.5 percent in the diameter of the test device will be permitted.
- (2) A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
- (3) Center bored and through bolted with a 1/4-inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.
- (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. **PULL-THROUGH DEVICE PROCEDURE:** Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

3. **DEFLECTION DEVICE:** The Contractor shall determine whether the allowable deflection has been exceeded by use of a deflection measuring device.

a. **DEFLECTION MEASURING DEVICE:** This device shall be sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. The deflection measuring device shall be approved by the Construction Manager prior to use.

b. **DEFLECTION MEASURING DEVICE PROCEDURE:** Measure deflections through each run of installed pipe. If deflection readings in excess of the maximum allowable specified in paragraph 15065-1.01 B are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of the allowable, remove pipe which has excessive deflection, replace with new pipe, and completely retest in the same manner and under the same conditions.

3.05 DISINFECTION

A. Disinfection of HDPE piping shall be in accordance with the Navajo Area Standards & Construction Requirements, AWWA C651, and as specified in Section 15050.

**** END OF SECTION ****

SECTION 15066

COPPER PIPING

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies copper piping, tubing, couplings and fittings.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASTM B32	Solder Metal
ASTM B88	Seamless Copper Water Tube

PART 2--PRODUCTS

2.01 COPPER TUBING

Copper tubing shall be seamless copper, conforming to ASTM B88. Unless otherwise specified, copper tubing shall be Type L, drawn, where used in exposed service and Type K, annealed or drawn for buried service.

2.02 COUPLINGS AND FITTINGS FOR COPPER TUBING

Unless otherwise specified, couplings and fittings for copper tubing 1/2 inch and smaller nominal diameter shall be compression type, brass or bronze, capable of holding the full bursting strength of the tubing; shall meet the requirements of ANSI B16.26; and shall be Swagelok, Gyrolok, or equal.

Couplings and fittings for copper tubing larger than 1/2-inch nominal diameter shall be wrought copper or bronze, solder joint pressure fittings and shall conform to ANSI B16.22.

2.03 SOLDER

Solder to be used in copper piping shall be ASTM B32, Alloy Grade Sn95 or Silvabrite 100.

2.04 PRODUCT DATA

Contractor's layout drawings and catalog data demonstrating compliance with this specification and giving full description of the copper piping shall be provided in accordance with Section 01300.

PART 3--EXECUTION

3.01 FABRICATION

A. SOLDER JOINTS:

All pipe and fittings to be jointed with solder shall be free from all burrs and wire brushed or steel wool cleaned. After cleaning, a paste flux shall be evenly and sparingly applied to the surfaces to be joined. Solder shall then be applied and flame passed toward the center of the fitting until the solder disappears. All excess solder shall be removed while it is still plastic. Absolutely no acid flux or acid wipe shall be used in making solder joints.

B. TAKEDOWN COUPLINGS:

Takedown couplings shall be screw union type and shall be provided in accordance with paragraph 15085-3.01 C.

C. DIELECTRIC PROTECTION:

Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel, or other steel at any location. Electrical checks shall be made to assure no contact is made between copper tubing and steel elements. Wherever electrical contact is demonstrated by such tests, the Contractor shall provide dielectric protection as specified in paragraph 15085-3.01 E.

3.02 INSTALLATION, CLEANING, DISINFECTION, AND TESTING

The installation, cleaning, disinfection, and testing of copper piping shall be as specified in Section 15050.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15075

JOINT GASKETS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies rubber gaskets for push-on compression type joints used with fabricated steel pipe, steel pipe, reinforced concrete pipe, concrete cylinder pipe, and cement mortar lined and coated steel pipe.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D395	Rubber Property--Compression Set, Test for
ASTM D412	Rubber Properties in Tension, Test for
ASTM D471	Rubber Property--Effect of Liquids, Test for
ASTM D573	Rubber--Deterioration in an Air Oven, Test for
ASTM D1149	Rubber Deterioration--Surface Ozone Cracking in a Chamber (Flat Specimens), Test for
ASTM D2240	Rubber Property--Durometer Hardness, Test for

B. TESTING:

Certified copies of test reports indicating that the gasket material has been tested and that the results of the tests comply with the requirements specified in paragraph 15075-2.02 shall be provided as product data.

1.03 SUBMITTALS

Manufacturer's product data shall be provided in accordance with Section 01300.

In accordance with Section 01300, the CONTRACTOR shall provide certified copies of test reports specified in paragraph 15075-1.02 B.

PART 2--PRODUCTS

2.01 MATERIALS

Gasket stock shall be a synthetic rubber compound in which the elastomer is neoprene. The compound shall contain no less than 50 percent by volume neoprene and shall be free from factice, reclaimed rubber and other deleterious substances.

2.02 PHYSICAL REQUIREMENTS

The compound shall meet the following physical requirements when tested in accordance with the specified ASTM standards.

A. TENSILE (ASTM D412):

The tensile strength shall be 1500 psi minimum and the ultimate elongation shall be 350 percent minimum.

B. HARDNESS (ASTM D2240, TYPE A DUROMETER):

The compound shall have a hardness in the range of 35 to 50 for concrete spigots and 50 to 65 for steel spigots.

C. COMPRESSION SET (ASTM D395):

The compression set shall not exceed 20 percent when compressed for 22 hours at 70 degrees C.

The test specimens shall be circular discs cut from the gaskets. Test specimens shall be 0.500 ($\pm 0.005 - 0.025$) inches in height. The diameter of the test specimen shall be that of the gasket but not to exceed 1.129 ± 0.010 inches in diameter.

D. AGING (ASTM D573):

The test specimen deterioration shall be less than 20 percent reduction in tensile strength, 40 percent reduction in ultimate elongation, and 15 points increase in hardness.

E. EFFECT OF LIQUIDS (ASTM D471):

The maximum volume change in oil and in water shall be as follows:

1. Oil: 100 percent in ASTM oil No. 3.
2. Water: 15 percent.

The test specimens shall have a thickness of 0.080 ± 0.005 inches and shall be circular discs cut from the gasket.

F. OZONE CRACKING (ASTM D1149):

The test specimen shall be a gasket loop mounted to give at least 20 percent elongation. There shall be no cracking visible at two times magnification of the gasket after 100 hours exposure to 1 mg/l ozone at 40 degrees C.

PART 3--EXECUTION

The gaskets shall be installed in accordance with the manufacturer's recommendations.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15085

PIPING CONNECTIONS

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies the following methods of connecting metallic piping: flanges, threading, mechanical couplings, equipment connection fittings, dielectric unions, and welding.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Qualifications
ASTM B98	Copper-Silicon Alloy Rod, Bar and Shapes

Reference	Title
ASTM F37	Standard Test Methods for Sealability of Gasket Materials
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. through 144 in.
AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe-A Guide for Design and Installation
NSF 61	Drinking Water System Components - Health Effects

1.03 SUBMITTALS

In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01300:

1. For Equipment Connection Fittings used in pumping applications submit thrust rod stretch calculations in accordance with paragraph 2.01D. and dimensional layout data.

PART 2--PRODUCTS

2.01 FLANGE ASSEMBLIES

A. FLANGES:

1. GENERAL: Flanges shall either be flat flanges or convoluted ring flanges as specified in the following paragraphs.

2. FLAT FLANGES: Cast iron flanges shall be faced in accordance with ANSI B16.1. Where companion flanges are used, the flanges on pipe shall be refaced to be flush with the companion flange face. Class 150 and Class 300 forged steel flanges shall be raised face conforming to ANSI B16.5. Lightweight slip-on flanges shall be plain face conforming to AWWA C207, Class B and ANSI B16.5. Unless otherwise specified, steel flanges shall be ANSI B16.5, Class 150 or AWWA C207, Class D. Class E AWWA flanges shall be provided where test pressure exceeds 175 psi. Plain faced flanges shall not be bolted to raised face flanges.

3. CONVOLUTED RING FLANGES: Convoluted ring flanges shall be ductile iron, forged steel or cast stainless steel, designed to bear on hubs welded to the pipe and shall be as manufactured by Improved Piping Products. The Construction Manager knows of no equal. The flange joints shall be rated for not less than 150 percent of the test pressures listed in Section 15050 and shall conform to the requirements of ANSI B 16.5 and AWWA C207. The flange manufacturer shall be prepared to demonstrate, by certified pressure test that the flanges will meet these requirements.

B. GASKETS:

Gasket material shall be as specified in paragraph 15085-2.03.

Gaskets for plain faced flanges shall be the full face type. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16 inch thick for pipe 3-1/2 inches and less in diameter and 1/8 inch thick for pipe 4 inches and larger.

C. BOLTS:

Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.

Unless otherwise specified, bolts shall be carbon steel machined bolts with hot pressed hexagon nuts. Bolts for submerged service shall be made of Type 316 stainless steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy bronze conforming to ASTM B98, alloy C65100, designation H04 or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

2.02 MECHANICAL COUPLINGS

A. SLEEVE-TYPE COUPLINGS:

Unless otherwise specified, sleeve-type mechanical pipe couplings shall be Smith-Blair Type 411, Dresser Style 38, or equal, with the stop removed from the middle ring. Reducing couplings shall be Smith-Blair Type 415, Dresser Style 62, or equal. Sleeve-type flanged coupling adapters shall be Smith-Blair Type 913, Dresser Style 128, or equal. Insulating couplings shall be Smith-Blair Type 416, Dresser Style 39, or equal.

Bolts for submerged service shall be made of Type 316 stainless steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy

bronze conforming to ASTM B98, alloy C65100, designation H04, or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

Gaskets shall be as specified in paragraph 15085-2.03 and AWWA C111.

B. PLAIN END COUPLINGS:

Plain end pipe couplings for pipe sizes 6 inches and smaller shall be Gustin-Bacon 200, Victaulic Style 99, or equal for Schedule 80 pipe and Gustin-Bacon 205, Victaulic Style 90, or equal for lighter weight pipe. Plain end couplings for pipe sizes 8 inches and larger shall be Gustin-Bacon 200, Victaulic Style 99, or equal. Unless otherwise specified, bolts and nuts shall comply with AWWA C606.

Gaskets shall be as specified in paragraph 15085-2.03 and AWWA C606.

C. GROOVED END COUPLINGS:

Grooved end flexible-type couplings shall be Gustin-Bacon 100, Victaulic Style 77, or equal. Grooved end rigid-type couplings shall be Gustin-Bacon 120 Rigi-Grip, Victaulic Style 07 Zero-Flex, or equal. Flexible-type couplings shall be used for all piping greater than 12 inches in diameter; for pipe 12 inches in diameter and less in rack-mounted tunnel piping applications; and for grooved joints adjacent to pump or blower suction and discharge where grooved couplings are used for noise and vibration control. All other applications for piping 12 inches in diameter and less shall utilize rigid-type couplings. Grooved end flanged coupling adapters shall be either Gustin-Bacon 154, Victaulic Style 741, or equal. Snap-joint grooved end couplings shall be Gustin-Bacon 115, Victaulic Style 78, or equal. Cut grooves are not permitted on fabricated or lightwall pipe.

Unless otherwise specified, bolts and nuts shall comply with AWWA C606. Bolts for submerged service shall be Type 316 stainless steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy bronze conforming to ASTM B98, alloy C65100, designation H04 or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

Gaskets shall be as specified in paragraph 15085-2.03 and AWWA C 606.

D. EQUIPMENT CONNECTION FITTINGS

Equipment connection fittings shall provide both lateral and angular misalignment adjustment between equipment connection flanges and the connection to field piping systems by providing individually adjustable flexible joints at each connection. In addition, equipment

connection fittings shall provide full pressure thrust restraint between the field piping connection and equipment connection flanges.

Equipment connection fittings shall consist of two flanged coupling adapters, a plain end section of pipe and thrust restraint rods and associated fittings designed to transmit thrust without transmitting shear to the thrust restraint rods and without compromising provisions for accommodating angular and parallel misalignment. Materials and features shall conform to the requirements established in this paragraph. Standard “dismantling joints” incorporate only one flanged coupling adapter and are not acceptable substitutes. Equipment connection fittings shall be Romac ECF Series, or Baker Coupling Company, Los Angeles or equal, modified as specified to provide the required features.

Equipment connection fittings shall each consist of a single sleeve of plain end piping conforming to the requirements of the specified piping system of sufficient length to span the gap between the connection at the equipment and the connection at the field piping with gasketed flange adapters at each end. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and male rod nuts and female washers that are rounded to provide a ball-joint type self aligning feature. All threaded restraint rod shall project through flange and mating flange coupling adapter bolt holes or through holes in restraint lug plates that extend above the flanges and are secured to the flanges with a minimum of two flange bolts. Where the all threaded rods project through flange bolt holes, ball joint type nut and washer combinations and lock washers shall be provided at each face, each end. Where restraint lug plates are employed, ball joint type nuts and washers shall be provided only on the outside faces of the plates and the nuts shall have a self locking feature that prevents nut movement due to vibration or other operational or environmental causes. Double nutting with non-locking nuts shall not be an acceptable method of providing the self locking feature. Thrust rod diameter and material shall be selected to provide sufficient freedom of movement through all bolt holes to allow unrestricted maximum adjustment of equipment connection fittings to accommodate piping misalignment without transmitting any shear to the thrust rods and also to permit full development of thrust restraint at all thrust rod tension take-ups. Design of equipment connection fittings shall conform to AWWA C219.

Thrust rods, restraint lug plates, nuts, washers and lock washers shall be Type 316 stainless steel, all selected to develop full rated piping system pressure thrust forces. Equipment connection fittings for pump applications shall have thrust rod number and diameter selected such that thrust rod stretch under piping system operating pressure does not exceed 2 mils. Calculations shall be submitted. Dry film molybdenum di-sulfide anti-galling compound shall be factory applied to ends of thrust rods, covering all threads subject to nut travel and tightening. Gaskets shall be as specified in paragraph 15085-2.03. Flange gaskets shall be full face type. Follower gaskets shall be compression wedge type.

Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

E. DISMANTLING JOINTS

Dismantling joints may be used as takedown couplings in accordance with paragraph 15085-3.03. Dismantling joints shall fully restrained double flange fittings consisting of a flange coupling adapter and flanged spool piece that allows for longitudinal adjustment. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and secured to the flanges with a minimum of two flange bolts. Design of equipment connection fittings shall conform to AWWA C219. Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. Dismantling joints shall be Romac DJ-400, Smith Blair 975, or Crane-Viking Johnson Dismantling Joint.

F. SLEEVE BAND COUPLINGS

Sleeve band couplings shall be Victaulic Depend-O-Lock. Unless otherwise noted, couplings for liquid service shall be Model F x F Type 2 fully restrained, shouldered high deflection couplings with standard width band. Couplings shall comply with AWWA C-219. Couplings for use with air systems shall be Airmaster restrained Depend-O-Lock couplings in conformance with AWWA C-606. Sleeve band couplings are acceptable wherever sleeve type couplings are used (paragraph 15085-2.02 A.)

G. FLEXIJJOINT

Where specified Flexijoint couplings shall be Flanged Romac Flexijoint couplings. The Flexijoint is a flexible, ductile iron joint that can accommodate expansion, contraction, rotation and bending and is rated at 350 psi working pressure. The joint can accommodate 15 to 20 degree deflection depending on size. Body shall be ductile iron, lock rings Type 410 stainless steel, and ring gasket, casing, ball and cover shall be EPDM molded watertight construction. All metal portions of Flexijoint coupling including the stainless steel lock rings shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. For buried installations, install with polyethylene baggy cover in accordance with the manufacturer's instructions.

2.03 GASKETS

Gaskets designated in Section 15050 shall be as follows:

1. EPDM: ethylene-propylene-diene-terpolymer.
2. Neoprene: neoprene.
3. Nitrile: nitrile (Buna N).

4. Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder; ASTM F104 (F712400), 2500 psi (ASTM F152), 0.2 ML/HR LEAKAGE FUEL A (ASTM F37).
5. Compressed gasketing consisting of organic fibers (Kevlar) and SBR binder; ASTM F104 (F712400), 2500 PSI (ASTM F152), 0.1 ml/hr leakage Fuel A (ASTM F37).
6. Gylon gasketing, Garlock Style 3500, 2000 psi (ASTM F152), 0.22 ml/hr Fuel A (ASTM F37).
7. Gylon gasketing, Garlock Style 3510, 2000 psi (ASTM F152), 0.04 ml/hr Fuel A (ASTM F37).
8. Gylon gasketing, Garlock Style 3504, 2000 psi (ASTM F152), 0.12 ml/hr Fuel A (ASTM F37).
9. TFE: noncreeping tetrafluoroethylene (TFE) with insert filler.
10. PTFE bonded EPDM: PTFE bonded to EPDM in full-face gasket having concentric-convex molded rings; Garlock Stress Saver 370 or equal.

2.04 THREAD

Pipe thread dimensions and size limits shall conform to ANSI B1.20.1.

2.05 DIELECTRIC UNIONS

Dielectric unions shall be EPCO, Capitol Manufacturing, or equal.

2.06 COATINGS

Unless otherwise specified, flange assemblies and mechanical type couplings for buried installation shall be field coated with System M-1 as specified in Section 09900.

2.07 PRODUCT DATA

In accordance with Section 01300, the Contractor shall provide for each welder, a welder qualification certificate indicating the welder is certified for pipe welding in accordance with ASME Boiler and Pressure Vessel, Section IX. Each welder's certificate shall be provided to the Construction Manager prior to that welder working on the job.

PART 3--EXECUTION

3.01 PIPE CUTTING, THREADING AND JOINTING

Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1.

3.02 PIPE WELDING

Pipe shall be welded by ASME-certified welders using shielded metal arc, gas shielded arc or submerged arc welding methods. Welds shall be made in accordance with the requirements of ANSI B31.1 for piping Systems 8, 26, and 28 specified in Section 15050. Welds shall be made in accordance with the requirements of ANSI B31.3 for piping System 20 specified in Section 15050. Welds for piping systems not specified above shall be made in accordance with AWWA C206.

3.03 TAKEDOWN COUPLINGS

Takedown couplings shall be screw unions, flanged or grooved end mechanical coupling type joints and shall be provided as specified. Flanged or grooved end joints shall be employed on pipelines 2-1/2 inches in diameter and larger. Where piping passes through walls, takedown couplings shall be provided within 3 feet of the wall, unless specified otherwise.

A union or flanged connection shall be provided within 2 feet of each threaded end valve.

3.04 FLEXIBILITY

Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints (or a single Flexijoint) as specified on the buried pipe within 2 feet of the structure for 2-inch through 6-inch diameter pipe; within 3 feet of the structure for 8-inch through 24-inch diameter pipe; and within one and one-half pipe diameters of the structure for larger pipe. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with Chapter 13 of AWWA M11, including Tables 13-4, 13-5 and 13-5A, and Figure 13-20.

3.05 DIELECTRIC CONNECTIONS

Where a copper pipe is connected to steel or cast iron pipe, an insulating section of rubber or plastic pipe shall be provided. The insulating section shall have a minimum length of 12 pipe diameters. Dielectric unions as specified in paragraph 15085-2.05 may be used instead of the specified insulating sections. Where copper pipe is supported from hangers, it shall be insulated from the hangers, or copper-plated hangers shall be used.

3.06 EQUIPMENT CONNECTION FITTINGS

Where shown, equipment connection fittings shall be provided between field piping systems and equipment inlet and outlet connections.

**** END OF SECTION****

Piping Connections
15085-8

Contract 2
Bid Issue

SECTION 15096

PIPE HANGERS AND SUPPORTS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies hangers and supports for all piping systems specified in Section 15050. This section does not include pipe supports for fire sprinkler systems, pipe anchors, guides or seismic restraints.

B. OPERATING CONDITIONS:

The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:

1. Hot Systems

- A - 1. 120 degrees F to 450 degrees F
- A - 2. 451 degrees F to 750 degrees F
- A - 3. Over 750 degrees F

2. Ambient Systems

- B. 60 degrees F to 119 degrees F

3. Cold Systems

- C - 1. 33 degrees F to 59 degrees F
- C - 2. -20 degrees F to 32 degrees F

C. HANGER AND SUPPORT SELECTION:

The CONTRACTOR shall select pipe hangers and supports as specified in the project manual. Selections shall be based upon the pipe support classifications specified in this section, the piping insulation thickness specified in Section 15250, and any special requirements which may be specified in the project manual.

The CONTRACTOR shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:

1. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
2. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
3. Reaction forces due to the operation of safety or relief valves.
4. Wind, snow or ice loadings on outdoor piping.

Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.

Where negligible movement occurs at hanger locations, rod hangers shall be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members shall be used.

Hangers for the suspension of size 2 1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.

The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.

Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.

There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

Unless otherwise specified, pipe support components shall not be attached to pressure vessels.

Stock hanger and support components shall be used wherever practical.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Ed.
FEDSPEC WW-H-171e-78	Hangers and Supports, Pipe
MFMA-2-91	Metal Framing Standards Publication
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application
MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture

1.03 SUBMITTALS

Hanger and support locations and components shall be indicated on the piping layout drawings required by paragraph 15050-1.03.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or equal. Pipe support components shall conform to the requirements of MSS SP-69 and FEDSPEC WW-H-

Pipe Hangers and Supports
15096-3

171e. Pipe support materials shall conform to the requirements of MSS SP-58. Metal framing system components shall conform to the metal framing manufacturers' Association Standard MFMA-2.

2.02 MATERIALS

A. GENERAL:

Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories shall be hot-dip or mechanically galvanized after fabrication. Nuts, bolts and washers may be zinc-plated except for those subject to moisture or corrosive atmosphere, as specified in paragraph 16000-1.05 B, which shall be type 304 stainless steel.

B. PIPE HANGERS AND SUPPORTS:

1. TYPE 1 - CLEVIS PIPE HANGER: Clevis hangers shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 1.

- a. Steel pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal, with insulation shield.
- b. Steel pipe (uninsulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal.
- c. Cast and ductile iron pipe - shall be B-Line B3102, Grinnell Fig. 590, or equal.
- d. Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Fig. CT-65, or equal.
- e. Copper pipe (insulated) - shall be B-Line B3100, Grinnell Fig. 260, or equal, with insulation shield.
- f. Plastic pipe - shall be B-Line B3100 C, Carpenter & Patterson Fig. 100PVC, or equal.

2. TYPE 2 - "J" PIPE HANGER: Hangers shall be carbon steel with configuration and components equivalent to MSS Type 5.

- a. Steel pipe - shall be B-Line B3690, Grinnell Fig. 67, Michigan model 418, or equal.
- b. Copper and plastic pipe - shall be Michigan model 419, Unistrut J 1205N series, or equal.

3. TYPE 3 - DOUBLE BOLT PIPE CLAMP: Pipe clamp shall be carbon steel, with configuration and components equivalent to MSS and FEDSPEC Type 3.

- a. Steel pipe (insulated) - shall be B-Line B3144, Grinnell Fig. 295, or equal, with insulation shield. Insulation shield is optional for hot and ambient systems.
- b. Steel pipe (uninsulated) - shall be B-Line B3144, Grinnell Fig. 295, or equal.
- c. Copper pipe (insulated only) - shall be B-Line B3144, Grinnell Fig. 295, or equal, with insulation shield.

4. TYPE 4 - ADJUSTABLE ROLLER HANGER: Rollers shall be cast iron, yoke and cross bolt shall be carbon steel. Configuration and components shall be equivalent to MSS Type 43 and FEDSPEC Type 44.

- a. Steel pipe (insulated) - shall be B-Line B3110, Grinnell Fig. 181, or equal, with insulation shield.
- b. Steel pipe (uninsulated) - shall be B-Line B3110, Grinnell Fig. 181, or equal.
- c. Copper pipe (insulated only) - shall be B-Line B3110, Grinnell Fig. 181, or equal, with insulation shield.
- d. Plastic pipe - shall be B-Line B3110, Grinnell Fig. 181, or equal.

5. TYPE 5 - SINGLE PIPE ROLL: Rollers and sockets shall be cast iron, cross rod shall be steel. Configuration and components shall be equivalent to MSS Type 41 and FEDSPEC Type 42.

- a. Steel pipe (insulated) - shall be B-Line B3114, Grinnell Fig. 171, or equal, with insulation shield.
- b. Steel pipe (uninsulated) - shall be B-Line B3114, Grinnell Fig. 171, or equal.
- c. Plastic pipe - shall be B-Line B3114, Grinnell Fig. 171, or equal.

6. TYPE 6 - FRAMING CHANNEL PIPE CLAMP: Pipe clamps shall be steel with galvanized finish and material thickness as listed below:

- a. Steel pipe (uninsulated) - Pipe size 3/8 inch and 1/2 inch shall be 16 gage; 3/4 inch through 1 1/4 inches shall be 14 gage; 1 1/2 inches

through 3 inches shall be 12 gage; 3 1/2 inches through 5 inches shall be 11 gage; 6 and 8 inches shall be 10 gage; Michigan model 431, Powerstrut PS 1100, Unistrut P 1109 series, or equal.

- b. Steel pipe (insulated) - Pipe clamp shall be as described in paragraph 15096-2.02 B.6.a with insulation shield.
- c. Copper (uninsulated) and plastic pipe - Pipe size 3/8 inch and 1 inch shall be 16 gage; 1-1/4 inches and 1-1/2 inches shall be 14 gage; 2 inches through 3 inches shall be 12 gage; 4 inches shall be 11 gage; clamp shall be copper-plated, plastic coated or lined with dielectric material; Michigan model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or equal.
- d. Copper pipe (insulated) - Pipe clamp shall be as described in paragraph 15096-2.02 B.6.a with insulation shield.

7. TYPE 7 - U-BOLT: U-bolts shall be carbon steel with configuration equivalent to MSS and FEDSPEC Type 24.

- a. Steel pipe (uninsulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal.
- b. Steel pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.
- c. Cast and ductile iron pipe - shall be Grinnell Fig. 137, B-Line B3188, or equal.
- d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 222 CT, B-Line B3501 CT, Grinnell Fig. 137C, or equal.
- e. Copper pipe (insulated) - shall be Grinnell Fig. 137, B-Line B3188, or equal, with insulation shield.
- f. Plastic pipe - shall be Grinnell Fig. 137C, Michigan model 151, B-Line B3188 C, or equal.

8. TYPE 8 - ADJUSTABLE DOUBLE ROLLER SUPPORT: Rollers shall be non-metallic with hot-dip galvanized sockets and stainless steel hardware.

- a. Stainless Steel pipe - shall be B-Line B3122ANM adjustable double roller guide, or equal.

9. TYPE 9 - WELDED PIPE STANCHION: Minimum material thickness shall be standard schedule carbon steel pipe, cut to match contour of the pipe elbow. Use of this support shall be limited to ambient systems only.

10. TYPE 10 - PIPE STANCHION SADDLE: Saddles and yokes shall be carbon steel and comply with MSS Type 37 and FEDSPEC Type 38.

- a. Steel pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
- b. Steel pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.
- c. Cast and ductile iron pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090 NS, or equal.
- d. Copper pipe (uninsulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield or lined with dielectric material.
- e. Copper pipe (insulated) - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal, with insulation shield.
- f. Plastic pipe - shall be Carpenter & Patterson Fig. 125, B-Line B3090, or equal.

11. TYPE 11 - OFFSET PIPE CLAMP: Pipe clamp shall be carbon steel with configuration and components as specified and shall be of standard design manufactured by a pipe hanger component manufacturer.

- a. Steel pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.
- b. Steel pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal.
- c. Cast and ductile iron pipe - shall be B-Line B3148 NS, Grinnell Fig. 103, or equal.
- d. Copper pipe (insulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, with insulation shield.
- e. Copper pipe (uninsulated) - shall be B-Line B3148, Grinnell Fig. 103, or equal, lined with dielectric material.

- f. Plastic pipe - shall be B-Line B3148, Grinnell Fig. 103, or equal.

Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe.

12. TYPE 12 - RISER CLAMP: Riser clamp shall be carbon steel with configuration and components equivalent to MSS and FEDSPEC Type 8.

- a. Steel pipe (insulated) - shall be B-Line B3373, Grinnell Fig. 261, or equal.
- b. Steel pipe (uninsulated) - shall be B-Line B3373, Grinnell Fig. 261, or equal.
- c. Cast and ductile iron pipe - shall be B-Line B3373, Grinnell Fig. 261, or equal.
- d. Copper pipe (insulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Michigan model 511, or equal.
- e. Copper pipe (uninsulated) - shall be B-Line B3373 CT, Grinnell Fig. CT-121, Michigan model 511, or equal.
- f. Plastic pipe - shall be B-Line B3373, Grinnell Fig. 261c, or equal.

13. TYPE 13 - FRAMING CHANNEL PIPE STRAP: Pipe strap shall be carbon steel, with configuration equivalent to MSS Type 26.

- a. Steel pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.
- b. Steel pipe (insulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.
- c. Copper pipe (uninsulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield or lined with dielectric material.
- d. Copper pipe (insulated) - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.
- e. Plastic pipe - shall be Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.

C. RACK AND TRAPEZE SUPPORTS:

1. GENERAL: Unless otherwise specified, trapeze and pipe rack components shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.

2. TYPE 20 - TRAPEZE PIPE SUPPORT: Trapeze pipe support cross members shall be framing channel as specified in paragraph 15096-2.02 E.5. Flat plate fittings shall be 1 5/8-inch square carbon steel of standard design manufactured by framing channel manufacturer, Unistrut P2471, B-Line B202-2, or equal.

3. TYPE 21 - PIPE RACK SUPPORT: Post and cross members shall be framing channel as specified in paragraph 15096-2.02 E.5. Pipe rack fittings shall be carbon steel, of standard design manufactured by framing channel manufacturer. 90-degree fittings shall be gusseted Unistrut P2484, B-Line B844, or equal. Post base fittings shall be as specified in paragraph 15096-2.02 D.5.

D. STRUCTURAL ATTACHMENTS:

1. TYPE A - MALLEABLE IRON CONCRETE INSERT: Concrete inserts shall be malleable iron and comply with MSS and FEDSPEC Type 18. Grinnell Fig. 282, Carpenter & Patterson Fig. 108, or equal.

2. TYPE B - SIDE BEAM BRACKET: Bracket shall be malleable iron and comply with MSS Type 34 and FEDSPEC Type 35. Grinnell Fig. 202, B-Line B3062, or equal.

3. TYPE C - MALLEABLE BEAM CLAMP WITH EXTENSION PIECE: Clamp and extension piece shall be malleable iron, tie rod shall be steel. Beam clamp shall comply with MSS and FEDSPEC Type 30. Grinnell Fig. 218 with Fig. 157 extension piece, B-Line B3054, or equal.

4. TYPE D - STEEL BEAM CLAMP WITH EYE NUT: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.

5. TYPE E - FRAMING CHANNEL POST BASE: Post bases shall be carbon steel, of standard design manufactured by framing channel manufacturer. Single channel: Unistrut P2072A, B-Line B280, or equal. Double channel: Unistrut P2073A, B-Line B281, or equal.

6. TYPE F - WELDED BEAM ATTACHMENT: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.

7. TYPE G - WELDED STEEL BRACKET: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.

8. TYPE H - CAST IRON BRACKET: Bracket shall be cast iron, Carpenter & Patterson Fig. 340, or equal.

9. TYPE J - ADJUSTABLE BEAM ATTACHMENT: Beam attachment shall be carbon steel, Carpenter & Patterson Fig. 151, B-Line B3082, or equal.

10. TYPE K - DOUBLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in paragraph 15096-2.02 E.5. Cantilever bracket shall be a carbon steel double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or equal.

11. TYPE L - SINGLE CHANNEL BRACKET: Wall channel shall be single channel framing channel as specified in paragraph 15096-2.02 E.5. Cantilever bracket shall be a carbon steel single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or equal.

12. TYPE M - WALL MOUNTED CHANNEL: Wall channel shall be single channel framing channel as specified in paragraph 15096-2.02 E.5.

13. TYPE N - PIPE STANCHION FLOOR ATTACHMENT: Baseplate shall be carbon steel with 1/2 inch minimum thickness. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with nonshrink grout.

E. ACCESSORIES:

1. HANGER RODS: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.

2. WELDLESS EYE NUT: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B3200, or equal.

3. WELDED EYE ROD: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B3211, or equal.

4. TURNBUCKLE: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 13. Turnbuckle shall be Grinnell Fig. 230, B-Line B3202, or equal.

5. FRAMING CHANNEL: Framing channel shall be 1 5/8 inches square, roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Single channel: Unistrut P1000, B-Line B22, or equal. Double channel: Unistrut P1001, B-Line B22A, or equal. Triple channel: Unistrut P1004A, B-Line B22X, or equal.

2.03 THERMAL PIPE HANGER SHIELD

Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. The thermal shield shall be the same thickness as the piping system insulation specified in Section 15250. The standard shield shall be used for hot systems and the vapor barrier shield shall be used for cold systems. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.

A. STANDARD SHIELD:

1. INSULATION:

- a. Hydrous calcium silicate, high density, waterproof
- b. Compressive strength: 100 psi average
- c. Flexural strength: 75 psi average
- d. K factor: 0.38 at 100 degrees F mean
- e. Temperature range: 20 degrees F to 500 degrees F

2. STEEL JACKET: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.

3. CONNECTION: Shield shall have butt connection to pipe insulation. Steel jacket and insulation shall be flush with end.

B. VAPOR BARRIER SHIELD:

1. INSULATION:

- a. Hydrous calcium silicate, high density, waterproof
- b. Compressive strength: 100 psi average
- c. Flexural strength: 75 psi average
- d. K factor: 0.38 at 100 degrees F mean
- e. Temperature range: 20 degrees F to 500 degrees F

2. STEEL JACKET: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.

3. CONNECTION: Shield shall have butt connection to pipe insulation. Insulation shall extend 1 inch each side of steel jacket for vaportight connection to pipe insulation vapor barrier.

PART 3--EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

The CONTRACTOR shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project manual to support continuous pipeline runs unaffected by concentrated loads.

At least one hanger or support shall be located within 2 feet from a pipe change in direction.

The CONTRACTOR shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.

Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.02 INSTALLATION

Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.

Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

The CONTRACTOR shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.

The CONTRACTOR shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.

Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

Rollers shall roll freely without binding.

Finished floor beneath Type N structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.

Baseplates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.03 ADJUSTMENTS

The CONTRACTOR shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their baseplates.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15097

SEISMIC RESTRAINTS FOR PIPING

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies seismic restraints for bracing all piping systems specified in Section 15050. This section does not include seismic restraints for fire sprinkler systems.

B. DEFINITIONS:

Longitudinal direction--direction parallel to the pipe axis.

Lateral direction--direction perpendicular to the pipe axis.

C. OPERATING CONDITIONS:

The seismic restraints specified in this section are provided to resist pipe movements and loads occurring as a result of an earthquake or other seismic event.

Unless otherwise specified, all piping shall have bracing to resist seismic loading caused by forces applied at the individual pipe's center of gravity. Seismic loading shall be per Section 01990.

D. RESTRAINT SELECTION:

Unless otherwise specified, the CONTRACTOR shall select, locate and provide seismic restraints for piping in accordance with the project manual.

The CONTRACTOR shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the restraint to be used at each point.

Seismic restraints may be omitted from the following installations:

1. Gas piping less than 1-inch inside diameter.
2. Piping in boiler and mechanical rooms less than 1 1/4-inch inside diameter.
3. All other piping less than 2 1/2-inch inside diameter.
4. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support for the hanger.

Piping systems shall not be braced to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.

There shall be no contact between a pipe and restraint component of dissimilar metals. The CONTRACTOR shall prevent contact between dissimilar metals when restraining copper tubing by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.

Branch lines shall not be used to brace main lines.

Seismic bracing shall not limit the expansion and contraction of the piping system.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASCE 7-05	Minimum Design Loads for Buildings and Other Structures
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 13th Edition
FEDSPEC WW-H-171e-78	Hangers and Supports, Pipe
MFMA-2-91	Metal Framing Standards Publication

Seismic Restraints for Piping
15097-2

Contract 2
Bid Issue

MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application
SMACNA, PPIC	Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems

B. APPROVAL:

Seismic restraint load calculations specified in paragraph 15097-3.01 shall be reviewed and signed by a structural engineer registered in the State of Arizona.

1.03 SUBMITTALS

The following information shall be provided as specified in Section 01300:

1. Seismic restraint locations and legend as specified in paragraph 15097-3.01.
2. Load calculations as specified in paragraph 15097-1.02 B.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Standard pipe restraints and components shall be manufactured by Carpenter & Patterson, B-Line, Kin-Line, ITT Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or equal. Pipe restraint materials shall conform to the requirements of MSS SP-58 and MFMA-1.

2.02 MATERIALS

A. GENERAL:

Unless otherwise specified, restraints, including braces, pipe and structural attachments, shall be hot-dip galvanized after fabrication. Nuts, bolts and washers, fittings and accessories, may be mechanically zinc-coated except for those subject to moisture or corrosive atmosphere, which shall be type 304 stainless steel.

B. PIPE ATTACHMENTS:

1. **TYPE 1s: CLEVIS RESTRAINT ATTACHMENT:** Clevis attachment shall be Type 1, clevis pipe hanger, as specified in paragraph 15096-2.02 B.
2. **TYPE 3s: DOUBLE BOLT RESTRAINT CLAMP:** Restraint clamp shall be Type 3, double bolt pipe clamp, as specified in paragraph 15096-2.02 B.

3. TYPE 4s: ROLLER RESTRAINT ATTACHMENT: Roller attachment shall be Type 4, adjustable roller hanger, as specified in paragraph 15096-2.02 B. Hold down strap shall be carbon steel and sized as follows: pipe size 1 inch through 2 inch shall be 1 inch by 1/8 inch thick, pipe sizes 2 1/2-inch through 4 inch shall be 1 1/4-inch by 3/16 inch thick, 6 inch pipe shall be 2 inch by 3/16 inch thick, 8 inch pipe shall be 2 1/2-inch by 3/16 inch thick, 10-inch through 16-inch pipe shall be 2 1/2-inch by 1/4 inch thick, 20-inch pipe shall be 3 inch by 1/4 inch thick, and 24-inch pipe shall be 3 inch by 3/8 inch thick.

4. TYPE 7s: U-BOLT RESTRAINT: U-bolt restraint shall be Type 7, U-bolt, as specified in paragraph 15096-2.02 B.

5. TYPE 13s: FRAMING CHANNEL STRAP RESTRAINT: Strap restraint shall be Type 13, framing channel pipe strap, as specified in paragraph 15096-2.02 B.

6. TYPE 14s: PIPE CLAMP RESTRAINT: Pipe clamp shall be carbon steel, with configuration and components equivalent to MSS and FEDSPEC Type 4. Rod attachment and longitudinal brace connection stud shall be carbon steel, fabricated and welded by the manufacturer.

- a. Steel pipe (insulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
- b. Steel pipe (uninsulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.
- c. Cast and ductile iron pipe--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.
- d. Copper pipe (insulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
- e. Copper pipe (uninsulated)--shall be Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield or dielectric lining.
- f. Plastic pipe--shall be Superstrut No. S-720, Kin-Line No. S475, or equal.

C. TRAPEZE RESTRAINTS:

1. GENERAL: Unless otherwise specified, trapeze members shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.

2. TYPE 20s: SINGLE CHANNEL LATERAL RESTRAINT: Trapeze restraint cross member shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal. Pipe attachments shall be Type 13s or Type 7s specified in

paragraph 15097-2.02 B. Rod stiffeners and lateral brace shall be as specified in paragraph 15097-2.02 D.

3. TYPE 21s: DOUBLE CHANNEL LATERAL RESTRAINT: Trapeze restraint cross member shall be a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal. Pipe attachments shall be Type 13s or Type 7s specified in paragraph 15097-2.02 B. Rod stiffeners and lateral brace shall be as specified in paragraph 15097-2.02 D.

4. TYPE 22s: DOUBLE CHANNEL LONGITUDINAL RESTRAINT: Trapeze restraint cross member shall be a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal. Pipe attachments shall be Type 13s or Type 7s specified in paragraph 15097-2.02 B. Rod stiffeners, longitudinal and lateral braces shall be as specified in paragraph 15097-2.02 D.

D. BRACES AND FITTINGS:

1. SEISMIC BRACE FITTING: Seismic brace fitting shall be manufactured for use with industry standard framing channel. The fitting shall be carbon steel, welded construction, two-piece linked fitting. A means to reduce noise and vibration transmission between the linked fitting parts shall be provided. Seismic brace fittings shall be Superstrut C-749N series seismic brace, Kin-Line No. 633 seismic connector fitting, or equal.

2. HANGER ROD STIFFENER ASSEMBLY: Rod stiffener channel shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal. Rod stiffener clamps shall be complete with channel nut and shall be Superstrut ES-142, Kin-Line No. 635, or equal.

3. TYPE A1 SEISMIC BRACE: Seismic brace shall be 1 5/8-inch square carbon steel framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, Kin-Line No. 4112, or equal.

4. TYPE A2 SEISMIC BRACE: Seismic brace shall be 1 5/8-inch wide by 3 1/4-inch deep carbon steel framing channel, Unistrut P5000, B-Line B11, Superstrut H-1200, Kin-Line No. 8212, or equal.

E. STRUCTURAL ATTACHMENTS:

1. GENERAL: Unless otherwise specified, hanger rod structural attachments shall be as specified in Section 15096. Structural attachments for longitudinal and lateral seismic braces shall be as specified in paragraph 15097-2.02 E.

2. TYPE SA-1 ATTACHMENT: Brace fitting shall be as specified in paragraph 15097-2.02 D. Concrete anchors shall be as specified in Section 05501 with embedment and location dimensions as specified.

3. TYPE SA-2 ATTACHMENT: Brace fitting shall be as specified in paragraph 15097-2.02 D. Concrete anchors shall be as specified in Section 05501 with embedment and location dimensions as specified. Framing channel shall be as specified in paragraph 15097-2.02 F.

4. TYPE SA-3 ATTACHMENT: Brace fitting shall be as specified in paragraph 15097-2.02 D. Cap screw, lockwasher and hex nut materials and finish shall be compatible with structural steel material.

5. TYPE SA-4 ATTACHMENT: Brace fitting shall be as specified in paragraph 15097-2.02 D.

6. TYPE SA-5 ATTACHMENT: Brace fitting shall be as specified in paragraph 15097-2.02 D. Four-inch x 3-inch x 3/8-inch angle shall be carbon steel.

F. ACCESSORIES:

1. HANGER RODS: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.

2. FRAMING CHANNEL: Framing channel shall conform to the Metal Framing Manufacturers Association standard MFMA-1. Framing channel shall be roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Channel shall be Unistrut P1000 series, B-Line B22 series, Superstrut A-1200 series, or equal.

3. ROD COUPLING: Rod coupling shall be carbon steel, with sight hole in center of coupling body, Grinnell Fig. 135, Superstrut H-119, or equal.

2.03 THERMAL PIPE HANGER SHIELD

Thermal shields shall be provided at seismic restraint locations on pipe requiring insulation. Thermal pipe hanger shields shall be as specified in paragraph 15096-2.03. Stainless steel band clamps shall be provided on thermal shields at longitudinal pipe restraint locations.

PART 3--EXECUTION

3.01 PIPE RESTRAINT LOCATIONS

The first seismic restraint on a piping system shall be located not more than 10 feet from the main riser, entrance to a building or piece of equipment.

Cast iron pipe shall be braced on each side of a change in direction of 90 degrees or more. Joints in risers shall be braced or stabilized between floors.

No-hub and bell and spigot cast iron soil pipe shall be braced longitudinally every 20 feet and laterally every 10 feet.

Lateral bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24 inches of the elbow or tee of the same size.

Seismic restraint locations and components shall be indicated on the piping layout drawings required by paragraph 15050-1.03. The CONTRACTOR shall provide a legend giving load information and restraint component selection at each restraint location.

3.02 INSTALLATION

Rod stiffener assemblies shall be used at seismic restraints for hanger rods over 6 inches in length. A minimum of two rod stiffener clamps shall be used on any rod stiffener assembly.

Lateral and longitudinal bracing shall be installed between 45 degrees above and 45 degrees below horizontal, inclusive, relative to the horizontal centerline of the pipe.

Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. There shall be no drilling or burning of holes in the building structural steel without approval of the CONSTRUCTION MANAGER.

Embedded anchor bolts shall be used instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submerging.

The CONTRACTOR shall install thermal pipe hanger shields on insulated piping at required locations during restraint installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.

Restraint components in contact with plastic pipe shall be free of burrs and sharp edges.

Rollers shall roll freely without binding.

Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15102

RESILIENT-SEATED GATE VALVES

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies iron-body, resilient-seated gate valves.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI B16.1-89	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ASTM A126-84	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
AWWA C-111-85	Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C-509-87	Resilient-Seated Gate Valves for Water and Sewerage Systems
NTUA	Navajo Area Standards & Construction Requirements

PART 2--PRODUCTS

2.01 GATE VALVES FOR WATER MAINS

Gate valves 3 through 12 inches in size shall comply with AWWA C509, including applicable hydrostatic testing. The seal shall be drop-tight. All internal and external surfaces of the valve including the interior of the gate shall be coated with a two part epoxy coating in accordance with AWWA C550.

Valve working pressure rating shall be the greater of 235 psi minimum or equal to or greater than the rated pressure of the waterline on which the valve is installed.

Gate valves shall be supplied by a single manufacturer.

2.02 MATERIALS

The body of the valve shall be cast iron, with a full round port opening equal to or exceeding the diameter of the corresponding pipe. The body shall have integrally cast guides to insure the gate is properly guided through complete travel, and shall be free of pockets and bridges in the valve bottom.

The sealing mechanism shall consist of a free draining bi-directional compression seating gate, which ensures a 100 percent bubble tight seal in the closed position against the line flow. The gate shall be constructed with a rubber seal mechanically retained between two epoxy coated gate halves which are securely fastened with stainless steel recessed capscrews.

Gate valves shall be of the nonrising stem type. The stem shall be 400 series stainless steel and shall be independent of the bronze stem nut. A four bolt bonnet cover shall contain a grit and dust cap protecting two O-ring stem seals and the nylon bushing located above the stem collar. A teflon washer shall be located between the stem collar and bonnet as an antifriction device.

End connections shall be furnished as specified in Section 15050 and shown on the drawings. Mechanical joints are to be per ANSI/AWWA C111/A21.11; flanged joints shall conform to ANSI standard B16.1, Class 150. End connections shall be restrained.

2.03. MANUAL OPERATORS:

Gate valves shall be provided with counter clockwise opening geared operators.

Exposed valves shall be supplied with an enclosed bevel gear and handwheel to permit side operation.

Buried valves shall be provided with enclosed spur gears and 2" square operating nuts to permit operation through a valve box from above.

2.04 VALVE BOXES

Valve boxes shall be installed on all buried valves and shall be 5-1/4-inch Nominal diameter shaft, two-piece adjustable screw type equal to Tyler no. 6850 series. The length of the box shall be sufficient to permit access to the valve at the specified depth of bury. Tyler series extensions will be utilized to extend the valve box when required. The word "water" shall be cast onto the Lid.

2.05 SUBMITTAL DATA

The following information shall be provided in accordance with Contractor submittal requirements:

1. Full product submittal including manufacturer's cut sheets, details of construction, and product information.

PART 3--EXECUTION

3.01 VALVE INSTALLATION

Gate valves shall be installed in the closed position.

Before installing the valve, care shall be taken to see that all foreign material and objects are removed from the interior of the valve. The valve shall be opened and closed to see that all moving parts are in working order.

All valves shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connecting ends furnished. All valves shall be set in and tied to poured in-place concrete support blocks as per the HIS Standard Detail.

Valves and valve boxes shall be set plumb and valves boxes shall be placed over the valve in such a manner that the valve box does not transmit shock or stress to the valve. The cast iron valve box cover shall be set flush with, or slightly above, the finished grade. A 2-foot by 2-foot by 4-inch reinforced concrete pad shall be poured around each valve box. Before the concrete has hardened, the Contractor shall neatly scribe in the concrete pad the valve size and a line representing the direction of flow of water through the valve.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15103

BUTTERFLY VALVES

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies butterfly valves for water service.

1. TYPE A: Valves used in the following piping systems for sizes 3 inches and larger shall be designated Type A.

Piping systems

7

9

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A48	Gray Iron Castings

Butterfly Valves
15103-1

Contract 2
Bid Issue

Reference	Title
ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A216/A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C504	Rubber-Seated Butterfly Valves
NTUA	Navajo Area Standards & Construction Requirements

PART 2--PRODUCTS

2.01 MATERIALS

A. TYPE A:

Type A valves are specified according to size as follows:

1. TYPE A, SIZE 2 THROUGH 24 INCHES: Type A valves from 2 through 24 inches in size shall be constructed of the following materials unless otherwise specified:

Component	Material
Shaft	Stainless steel, ASTM A276, Type 304 Carbon steel, ASTM A108, with stainless steel journals
Disc	Ductile iron, ASTM A536, or cast iron, ASTM A436, type 1 (Ni-Resist); or ASTM A48, Class 40, or ASTM A126, Class B
Seat mating surface	Stainless steel, ASTM A276, Type 304, mounted in body or on disc edge; or Ni-Chrome on the disc edge
Seat sealing surface	Neoprene, EPDM or Buna N
Body	Cast iron, ASTM A126, Class B

2.02 MANUFACTURE

A. GENERAL:

Valves shall be flanged. Wafer type valves are not acceptable. Unless otherwise specified, valve flange drilling shall be per ANSI B16.1, Class 125.

B. TYPE A:

Type A valves shall be designed in accordance with AWWA C504. Shafts shall be turned, ground and polished. Shaft dimensions and operator torque shall be chosen for the pressure specified in Section 15050 and Class B as specified in AWWA C504. When carbon steel shafts and stainless steel journals are used, static seals shall be provided to isolate the interior of the disc and the shaft from the process fluid.

Type A valves shall have seats that are vulcanized, bonded, mechanically secured, or clamped to the body or disc.

2.03 MANUAL OPERATORS

A. GENERAL:

Manual operators shall be designed in accordance with AWWA C504 and shall have a disc position indicator designating the opened and closed position of the valve.

B. TYPE A:

Operators for valves 6 inches in diameter and smaller shall be latch lock levers. Valves shall be capable of being locked in at least five intermediate positions between fully open and fully closed.

Manual operators larger than 6 inches shall be of the traveling nut, rack and pinion, or worm gear type. Operators shall be equipped with adjustable mechanical stop-limiting devices to prevent overtravel of the disc in the open and closed positions and shall be self-locking and designed to hold the valve in any intermediate position between full open and full closed. Valve operator components shall withstand an input torque of 300 ft-lbs at the extreme operator positions without damage.

Operator for buried service shall include an AWWA operating nut and shall be gasketed and grease packed for submerged operation at water pressures to 10 psig. Operators for exposed service shall include a handwheel and be gasketed for weatherproof service.

2.04 PRODUCT DATA

Affidavits of compliance with AWWA C504 for Type A valves shall be provided in accordance with Section 01300.

PART 3--EXECUTION

Valves shall be installed in accordance with the manufacturer's recommendations.

****END OF SECTION****

SECTION 15110

ECCENTRIC PLUG VALVES

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies eccentric plug valves.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C504	Rubber Seated Butterfly Valves

B. PROOF OF DESIGN TESTS:

The Contractor shall furnish the Construction Manager three certified copies of a report from an independent testing laboratory certifying successful completion of proof-of-design testing conducted in accordance with AWWA C504, Section 5.2, except that where the word "disc" appears in the standard, it is understood to mean "plug." In lieu of testing the valves at an independent testing laboratory, proof-of-design testing may be performed at the valve manufacturer's laboratory, but must be witnessed by a representative of a qualified independent testing laboratory, and all test reports must be certified by the laboratory representative. Proof-of-design testing shall have been performed on not less than three 6-inch diameter valves, with all three test units demonstrating full compliance with the test standards. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.

PART 2--PRODUCTS

2.01 MATERIALS

Materials of construction shall be as follows:

Component	Material
Body	Cast iron, ASTM A126, Class B
Plug	Cast iron, ASTM A126, Class B, or cast iron ASTM A436 (Ni-resist), or ductile iron, ASTM A536
Plug facing	Neoprene or Buna-N
Body seats	
Less than 3 inches	Cast iron, ASTM A126, Class B
3 inches and larger	Stainless steel, ASTM A276, Type 304 or nickel
Packing	Buna V-flex or TFE

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.02 MANUFACTURE

A. GENERAL:

Valves shall be straight-flow nonlubricated resilient plug type suitable for driptight, bi-directional shutoff at the specified valve design pressure. Valves shall be full port.. Valve body seats consisting of nickel for valves 3 inches and larger shall be constructed of a welded-in overlay

of not less than 90 percent pure nickel. Upper and lower journal bearings shall be replaceable, sleeve-type, corrosion resistant, and permanently lubricated. Packing shall be self-adjusting chevron type replaceable without disassembling the valve.

Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

Size, inches	Design pressure, psig
12 and smaller	175
14 through 36	150
42 through 54	125

B. END CONNECTIONS:

Valves 3 inches and smaller shall have threaded ends. Valve flange drilling for valves larger than 3 inches shall be per ANSI B16.1, Class 125. Grooved-end valves may be provided with grooved-end piping systems.

C. MANUAL OPERATORS:

Unless otherwise specified, valves 4 inches and smaller shall be provided with a lever type manual operator. Valves larger than 4 inches shall be provided with totally enclosed worm gear operators. Where specified, manual operators shall have an adjustable stop. All operator components shall be sized for the valve design pressure in accordance with AWWA C504, Section 4.5. Operators shall comply with applicable portions of Section 15184.

2.03 SUBMITTAL DATA

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's product data.

PART 3--EXECUTION

Unless otherwise specified, valves shall be provided with the seat downstream away from flow. Valves at tank connections shall be installed with seat away from tank. Valves on pump discharge lines shall be installed with seat adjacent to the pump.

****END OF SECTION****

SECTION 15118

SPRING-LOADED SWING CHECK VALVES

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies spring-loaded swing check valves.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A536	Ductile Iron Castings
ASTM B148	Aluminum-Bronze Sand Castings
AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS

PART 2--PRODUCTS

2.01 MANUFACTURERS

Candidate manufacturers include Golden Anderson, APCO or equal.

Spring-Loaded Swing Check Valves
15118-1

Contract 2
Bid Issue

2.02 MATERIALS

Materials of construction shall be as follows:

Component	Material
Body, cover	Cast iron, ASTM A126, Class B
Disc	Ductile iron, ASTM A536
Seat rings	Aluminum bronze, ASTM B148 or Stainless steel, ASTM A276, Type 316
Hinge shafts and hinge pins	Stainless steel, ASTM A276, Type 301 or 304
Shaft bushings	Bronze, AWWA C508

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 MANUFACTURE

Disc, disc arm, shaft, keyways, lever and spring shall be capable of closing within .05 seconds of pump stoppage and fluid moving at velocity of 8 feet per second. Spring tension shall be adjustable. The valve design shall permit mounting levers and springs on either side of the valve. The design of the spring attachment shall permit adjustment of closing force by tensioning the spring or replacement with different active length springs.

Valves shall be provided with a clear opening equal to or greater than the connecting piping, with no raised seating surface. Seats shall be threaded onto the body or fitted with an O-ring seal and locked in place with stainless steel screws or pins and shall be replaceable. Shafts shall be provided with stuffing box and packing or O-ring seals at each end. Seals shall be externally replaceable. Minimum shaft diameters shall be as follows:

Valve Inlet Connection Size, inches	Shaft diameter, inches
3	0.75
4	0.825
6	1.0

The pivot arm shall be secured to the disc with either twin bolted connections with lockwashers or a pinned nut. In either instance, the connection shall be designed to prevent disc movement relative to the arm. Shaft bearings shall extend the entire length of the shaft other than the section required for the disc arm attachment. Disc and lever arms shall be keyed to the shaft and

Spring-Loaded Swing Check Valves

15118-2

Contract 2
Bid Issue

retained by bushings or pins.

Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

Size, inches	Working pressure, pressure, psig	Hydrostatic test
2 through 12	175	350

Check valves wetted parts shall be coated with fusion bonded epoxy.

2.04 SUBMITTAL DATA

Manufacturer's catalog information including dimensions, cross-sectional views, details of construction and materials list shall be provided in accordance with Section 01300.

PART 3--EXECUTION

Spring loaded swing check valves shall be installed in accordance with the manufacturer's recommendations.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15125

STEEL PIPE CASING

PART 1 GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies steel pipe casings to be installed by directional drilling or open excavation. The Contractor shall make a complete submittal of the installation methods and materials for review and acceptance prior to the commencement of work and shall be responsible to coordinate permit requirements, casing spacers, carrier pipe, restraint systems, end seals and testing to provide a complete and properly installed carrier pipe and casing.

The Contractor shall obtain insurance and permits as required by the utility, railroads or roadways where casings are specified and include in the bid price all associated insurance and permits costs necessary to complete the work.

B. DEFINITIONS:

1. CARRIER PIPE: Pipe installed within the casing pipe.

C. REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. References shall be made to the latest edition of said standards unless otherwise called for.

Reference	Title
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
AWWA C200	Standard for Steel Water Pipe 6 Inches and Larger.
AWWA C206	Standard for Field Welding of Steel Water Pipe.
AWS D1.1	Structural Welding Code.
IHS	Standard Drawing No. W-24
IHS	Standard Drawing No. W-35

1.02 QUALITY ASSURANCE

A. LINE AND GRADE

The Contractor shall be responsible to obtain the required line and grade for the carrier pipe. The carrier pipe shall be fully supported by casing spacers and not contact or rest on the casing.

B. WELDING REQUIREMENTS

All welding shall be performed by qualified welding operators in accordance with the requirements of ANSI/AWWA C206 and ANSI/AWS D1.1.

All welding procedures shall be either pre-qualified in accordance with ANSI/AWS D 1.1 for full penetration welds, or qualified by testing, as required.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300.

Submit the following prior to commencement of the Work:

- A. Pipe casing; diameter, thickness, materials, class of steel per ASTM standard, design calculations, linings or coatings and welding procedures and details.
- B. Installation plan detailing the length and placement of the casing, installation procedures, lubricants, schedule, equipment, safety plan and contingency plan.
- C. Record copies of potholes performed
- D. Product data for carrier pipe, carrier pipe restraint systems, casing spacers, and end seals
- E. Record copies of required permits

1.04 DESIGN REQUIREMENTS

The Contractor shall submit structural and deflection calculations for provided steel casings. Design calculations shall demonstrate adequacy of the steel grade and thickness to withstand service loading (earth, live and hydrostatic loads), buckling and installation forces. Pipe shall be capable of withstanding the forces imposed by the process of installation, as well as the final in-place loading conditions. Design calculations shall be signed and stamped by a Licensed Professional Engineer of the State of Arizona.

The minimum wall thickness shall not be less than specified or less than required by the agency having jurisdiction over the road, railroad or utility.

The minimum length of the casing shall be the greater of the length shown, extents shown on Standard Drawing No W-35 or per the minimum length per approved permit.

PART 2 -- MATERIALS

2.01 PIPE CASINGS

- A. Pipe shall be steel, plain end, have minimum yield point strength of 35,000 psi and conform to ASTM A 283/A 283M, Grade D unless otherwise specified. Permaolok steel casing pipe and other steel grades may be used upon review and acceptance by the Construction Manager. Provide Permalok casing pipe as manufactured by Permalok Corporation, 472 Paul Avenue, St. Louis, MO 63135 (800-280-5511), or equal.
- B. The ends of the pipe shall be perpendicular to the longitudinal axis of the pipe with a maximum deviation of no more than 1/16 inch per foot of pipe diameter, with a maximum of ¼ inch, measured with a square and a straight edge across the end of the pipe.
- C. Pipe ends shall be square and smooth so that installation loads are evenly distributed against the pipe end faces without point loads when the pipe is installed.
- D. The exterior of the casing pipe shall be coated with coal tar epoxy or bituminous asphalt.

2.02 CASING SPACERS

Wood skids shall be provided per Standard Drawing No. W-24. At the Contractor's option, manufactured casing spacers may be stainless steel, centered-restrained position type with PVC liner and non-metallic anti-friction runners.

2.03 CASING END SEALS

Unless otherwise specified, casing end seals shall be synthetic rubber, conical shape, pull-on or wrap-around style, minimum ¼" thick with Type 304 stainless steel bands.

2.04 WARNING/IDENTIFICATION TAPE

Where casings are installed in open cut excavations, Warning/Identification Tape materials shall be provided.

PART 3 -- EXECUTION

3.01 GENERAL

Proper care shall be used to prevent damage in handling, moving and placing casing pipe. All pipe shall be lowered into the trench in a manner that prevents damage and shall not be dropped, dragged or handled in a manner that will cause dents, cracks, or other damage.

3.02 PROTECTION OF EXISTING UTILITIES AND FACILITIES

The Contractor shall be responsible for the care and protection of all existing utilities, facilities, and structures in or near the area of the work.

The Contractor shall pothole existing utilities within and adjacent to proposed location of casings. Coordinate potholing and casing installation with the utility owners.

3.03 CARRIER PIPE INSTALLATION

Upstream and downstream elevations of the casing and the required line and grade of the carrier pipe shall be field verified prior to installing the carrier pipe.

Carrier pipe shall be pushed into the casing incorporating the use of casing spacers. PVC carrier pipe joints shall be mechanically restrained. The annular space between the carrier pipe and casing shall be not be backfilled.

The portion of carrier pipe installed within a casing shall be tested prior to installation of the end seals or backfill of the annular space.

3.04 CASING SPACERS

Skids or spacers shall be used to prevent the carrier pipe bell from touching the casing and to maintain a uniform space between the carrier pipe and casing interior. Wooden skids shall be installed per Standard Drawing No. W-24. Casing spacers shall be installed on the carrier pipe at intervals per the manufacturer's recommendations with a minimum of three spacers per pipe section equally spaced.

3.05 CASING END SEALS

Casing end seals shall be provided for all casings and shall be installed in accordance with the manufacturer's recommendations.

****END OF SECTION****

SECTION 15150

AIR RELEASE AND VACUUM VALVES FOR CLEAN WATER SERVICE

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies air release valves, air and vacuum valves, and combination air valves for clean water service, pumping, and storage applications.

B. TYPES:

1. **AIR RELEASE VALVES:** Air release valves (ARV) shall have a small venting orifice to vent the accumulation of air and other gases with the line or system under pressure. Size and capacity shall be as specified.

2. **AIR AND VACUUM VALVES:** Air and vacuum valves (AVV) shall have a large venting orifice to permit the release of air as the line is filling or relieve the vacuum as the line is draining or is under negative pressure. Size and capacity shall be as specified.

3. **COMBINATION AIR VALVES:** Combination air valves (CAV) shall have operating features of both the air and vacuum valve and the air release valve. They include both single- and dual-body construction. Size and capacity shall be as specified.

4. **AIR VALVES FOR VERTICAL TURBINE PUMPS:** Air valves for vertical turbine pumps (ATP) shall consist of an air and vacuum valve with throttling device for sizes 3-inch and less, and a dual body construction combination air valve mounted on top of a surge check for sizes 4-inch and larger. Size and capacity shall be as specified.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents

issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A240	Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Air release and vacuum valves shall be APCO as manufactured by Valve and Primer Corporation, Crispin as manufactured by Multiplex Manufacturing Company, or equal, modified to provide the specified features and to meet the specified operating conditions.

2.02 MATERIALS

Component	Material
Body, cover	Cast iron, ASTM A126, Grade B
Float	Type 316 SS, ASTM A240
Seat	Buna-N or Type 316 SS
Trim	Type 316 SS, ASTM A240

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 CONSTRUCTION

Air release valves shall be float operated, compound lever type, except air release valves less than 1-inch may be simple lever type.

Air and vacuum valves shall be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The seat shall be

fastened into the valve cover, and shall be easily removed if necessary. The float shall be center or peripheral guided for positive shutoff into the seat.

Combination air valves, unless otherwise specified, shall be single-body construction in sizes 1- through 6-inch and dual-body construction in sizes 8-inch and larger. Single-body construction shall be designed to provide all functions within one housing. The body inlet shall be baffled to protect the float and the large and small orifices shall be designed so that during large orifice closure, the small air release orifice will open to allow small amounts of air to escape. Dual-body construction shall combine one air and vacuum valve and one air release valve with interconnecting piping and gate valve. All combination air valves shall be 1-inch in size.

Air valves for vertical turbine pumps (sizes 3-inch and less) shall be designed and constructed as specified for air and vacuum valves except the discharge orifice shall be fitted with a throttling device to regulate and restrict air venting and establish a pressure loading on the rising column of water on pump start. Unless otherwise specified, air valves, 4-inch and larger, shall be dual body combination air valves except the inlet shall be fitted with a surge check to prevent water column entering the valve on pump start.

Valves shall be suitable for pressures up to 150 psi.

2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Manufacturer's product data.
2. Applicable O&M instruction manuals per Section 01730.

PART 3--EXECUTION

Air release and vacuum valves shall be installed in accordance with the manufacturer's recommendations. Unless otherwise specified, isolation valves per Section 15050 shall be provided below each air valve. Piping from air release and vacuum valves shall be provided to equipment drains or floor drains, located in the Water Treatment Plant and Well Pump Houses for the disposal of nuisance water releases.

****END OF SECTION****

SECTION 15154

PRESSURE RELIEF VALVES

PART 1--DESCRIPTION

1.01 DESCRIPTION

A. SCOPE:

This section specifies pressure relief valves.

B. TYPE:

Pressure relief valves furnished under this specification shall control high pressures and power failure surges by bypassing system pressure that exceeds the high pressure control setting.

C. EQUIPMENT LIST:

Item	Equipment No.
Well Water High Pressure Relief Valve	HPRV-1
Finished Water High Pressure Relief Valve	HPRV-2
System Interconnection High Pressure Relief Valve	HPRV-3

D. PERFORMANCE AND DESIGN REQUIREMENTS:

1. GENERAL: The equipment specified in this section shall be suitable for continuous duty service and for exposure to fluids containing small quantities of suspended solids.

2. OPERATING REQUIREMENTS: Surge relief design operating requirements and characteristics shall be as follows:

	HPRV-1	HPRV-2	HPRV-3
a. Maximum line-flow, gpm	700	1045	250
b. Diameter, inches	3	3	3
c. Pressure relief setting, psig	140	140	140

The fluid for the HPRV-1 relief valve will be raw groundwater which may contain small amounts of particulate matter. The fluid for the HPRV-2 and 3 will be finished potable water and may contain up to 4 mg/l chlorine.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM A36	Structural Steel
ASTM A48	Grey Iron Castings
ASTM A536	Ductile Iron Castings
ASTM B62	Bronze Castings
NSF/ANSI 61	Drinking Water System Components

PART 2--PRODUCTS

2.01 MATERIALS

The pressure relief valves shall be constructed of the following materials:

Component	Material
Body and cover	Ductile iron, ASTM A48
Disc Retainer & Diaphragm Washer	Cast Iron, A48
Trim: Disc Guide, Seat & Cover Bearing	Stainless steel, ASTM A36
Disc	Buna-N Rubber
Diaphragm	Nylon Reinforced Buna-N Rubber
Stem, Nut, and Spring	Stainless steel, ASTM A36
Tubes and Fittings	Stainless steel, ASTM A36
Pilot Controls	Bronze, ASTM B62

2.02 EQUIPMENT

Valves shall be equipped with ANSI 150# flanged ends. Valves shall be epoxy lined and coated in accordance with NSF/ANSI 61 requirements. Valves shall include an inlet pressure gauge and a valve position indicator. Valves shall be Cla-Val #50-01 PVKC or approved equal.

2.03 PRODUCT DATA

The following information shall be provided in accordance with paragraph 00710-4.02:

1. Manufacturer's product data.
2. Operation and maintenance data as specified in Section 01730, items 1, 4, 5, 6, 7, and 8.

PART 3--EXECUTION

3.01 INSTALLATION

The valves shall be installed in the locations shown and in accordance with manufacturer's recommendations.

3.02 TESTING

The valves shall be field-tested to prove compliance with capacity and pressure drop requirements.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15184

MANUAL VALVE AND GATE OPERATORS AND OPERATOR APPURTENANCES

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies manual operators for valves and operator appurtenances.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AWWA C500	Gate Valves 3 through 48 inch NPS, for Water and Sewage Systems
NTUA	Navajo Area Standards & Construction Requirements

PART 2--PRODUCTS

2.01 GENERAL

Except as specified in valve specification sections, manual operators shall be as specified herein. Operators shall be mounted on the valve and provided as a unit. Each valve body or operator shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

2.02 OPERATORS

A. GENERAL:

Manual operators shall have operating torques less than 80 foot-pounds. Unless specified otherwise, each manual operator shall be provided with an operating wheel. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

B. WRENCH NUTS:

Wrench nuts shall comply with Section 3.15 of AWWA C500. A minimum of two operating keys, but no less than one key per every ten valves, shall be provided for operation of the wrench nut operated valves.

C. CHAIN WHEELS:

Chain wheels shall be ductile iron. Operating chains shall be galvanized.

2.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized.

B. FLOOR BOXES:

Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key.

C. ADJUSTABLE SHAFT VALVE BOXES:

Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W." Gas line covers shall be impressed with the letter "G."

2.04 PRODUCT DATA

Manufacturer's catalog information and other data confirming conformance to design and material requirements shall be provided in accordance with Section 01300.

PART 3--EXECUTION

3.01 GENERAL

Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 OPERATORS

A. GENERAL:

Valves shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48 inches and 60 inches above the floor or a permanent work platform.

B. WRENCH NUTS:

Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6 inches of the valve box cover.

C. CHAIN WHEELS:

Unless otherwise specified, valves with centerlines more than 7 feet, 6 inches above the specified operating level shall be provided with chain wheels and operating chains. Chain wheel operated valves shall be provided with a chain guide. Operating chains shall be looped to extend within 4 feet of the specified operating level below the valve. For plug-type valves 8 inches and larger, the operator shall be provided with a hammer blow wheel. Hooks shall be provided for chain storage where the chain may hang in a walkway.

3.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes extending to finished surfaces shall be provided for buried valves.

B. FLOOR BOXES:

Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 15632

ELECTRIC UNIT HEATERS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies electric unit heaters for indoor space heating applications.

B. TYPE:

Unit heaters shall be fan-forced, horizontal or vertical discharge type designed for continuous operation.

C. EQUIPMENT LIST:

Item	Equipment No.
Main Process Room Unit Heater 1	EUH-1
Main Process Room Unit Heater 2	EUH-2
Main Process Room Unit Heater 3	EUH-3
Chlorine Room Unit Heater	EUH-4

D. OPERATING REQUIREMENTS:

Equipment No.	Type	CFM	Heating, kW	Voltage and phase	Fan motor HP	Fan motor rpm
EUH-1	Horizontal, Washdown/Corrosion Resistant	1450	15	480/3	1/2	1725
EUH-2	Horizontal, Washdown/Corrosion Resistant	1450	15	480/3	1/2	1725
EUH-3	Horizontal, Washdown/Corrosion Resistant	1450	15	480/3	1/2	1725
EUH-4	Horizontal, Washdown/Corrosion	700	5	240/1	1/2	1725

Electric Unit Heaters
15632-1

Contract 2
Bid Issue

Equipment No.	Type	CFM	Heating, kW	Voltage and phase	Fan motor HP	Fan motor rpm
	Resistant					

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NFPA	National Electrical Code (NEC)
UL 823	Electric Heaters for Use in Hazardous (Classified) Locations
UL 1025	Electric Air Heaters

B. APPROVAL AND CONFORMANCE:

Unit heaters shall bear the UL label and conform to NEC requirements.

PART 2--PRODUCTS

2.01 MATERIALS

Component	Material
Fan	Aluminum
Cabinet	Stainless Steel

Electric Unit Heaters
15632-2

Contract 2
Bid Issue

Component	Material
Heating element	304 Stainless Steel
Hardware	Stainless steel

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.02 STANDARD UNIT HEATERS

A. ACCEPTABLE PRODUCTS:

Unit heaters shall be Indeco or equal, modified to meet specified requirements.

B. EQUIPMENT FEATURES:

1. **CABINET:** Unit heater cabinet shall be heavy 16 gauge stainless steel shroud. Adjustable stainless steel discharge louvers shall be mounted horizontally across the cabinet discharge opening. The cabinet construction shall incorporate a means for mounting the unit heater by either suspension rods or mounting brackets. A stainless steel swivel mounting bracket which can be used for either wall or ceiling mount.

2. **MOTOR:** The fan motor shall be permanently lubricated and thermally protected. Motor voltage and phase shall be as specified in paragraph 15632-1.01 D. The fan motor assembly shall be totally enclosed, UL recognized, factory wired to NEMA 4X enclosure.

3. **HEATING COIL:** The heating coil shall be composed of tubular finned heating elements in a shock proof mounting and enclosed within the unit heater cabinet. The heating coil shall be overheat protected.

C. CONTROLS:

The controls shall be line voltage up to 24 volts. Integral contactors and transformer shall be provided on each unit heater using control voltage other than line voltage.

Unless otherwise specified, a remote, single stage thermostat shall be provided for each unit heater.

2.03 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

Electric Unit Heaters
15632-3

Contract 2
Bid Issue

1. Applicable operating and maintenance information specified in Section 01730.
2. Control wiring diagram.
3. Manufacturer's catalog data confirming conformance to specified design, material and equipment requirements.

PART 3--EXECUTION

Unit heaters shall be installed where specified and in accordance with the manufacturer's recommended clearances from combustibles.

****END OF SECTION****

SECTION 15863

PROPELLER WALL FANS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies wall-mounted fans complete with fans, motors, dampers and accessories required for ventilation systems.

B. EQUIPMENT LIST:

Item	Equipment No.
Main Process Room Wall Exhaust Fan 1	EXF-1
Main Process Room Wall Exhaust Fan 2	EXF-2
Chlorine Room Exhaust Fan	EXF-3

C. OPERATING REQUIREMENTS:

Fan motors shall be nonoverloading on all points of the operating curve. Fans shall be designed for continuous duty service and to comply with the following:

Equipment No.	Capacity, scfm ¹	Static pressure, in., w.c.	Maximum fan speed, rpm	Motor HP	Drive type	Operating voltage/phase
EXF-1	2,500	0.75	1750	0.75	Direct	120/1
EXF-2	2,500	0.75	1750	0.75	Direct	120/1
EXF-3	200	0.25	1650	0.375	Direct	120/1

Notes:

1. Fans performance shall be derated for the elevation at the site.

D. SOUND AND VIBRATION:

Fans specified in this section shall operate at noise levels below 30 sones, as defined by AMCA Standard 300, and at tip speeds below 10,000 fpm.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AMCA Standard 210	Laboratory Methods of Testing Fans for Rating
AMCA Standard 300	Test Code for Sound Rating

B. CERTIFICATION:

Fans shall bear the AMCA rating seal.

1.03 SUBMITTALS

The following information shall be provided in accordance with the requirements of section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be

sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of the contract document HVAC Drawings and Drawings M-100 and E-403 relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "*no changes required*". Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
3. Fan performance curves for the specified operating conditions.
4. Motor data form 11060-A as required in Section 11060.

1.04 ENVIRONMENTAL CONDITIONS

The environmental conditions are specified in section 01300.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Fans shall be the wall mounted, V-belt or direct driven propeller type. Fans shall be manufactured by Aerovent, Greenheck, Penn Ventilator, or equal, modified to provide the specified features and to meet the specified operating conditions.

2.02 MATERIALS

Component	Material
Propeller	Aluminum
Venturi	Steel
Wall panel	Steel
Fan propeller shaft	Steel
Fasteners	Stainless steel
Pillow blocks	Cast iron
Sheaves	Cast iron

Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations.

However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.03 EQUIPMENT

A. FAN:

The fan shall be V-belt or direct driven as specified in paragraph 15863-1.01 C. The fan shaft, on belt-driven fans, shall be mounted in heavy-duty ball bearing pillow blocks with grease fittings. Bearings shall be rated for a minimum AFBMA L-10 bearing life of 50,000 hours.

Belt-driven fans shall be furnished with adjustable pitch sheaves and adjustable motor bases suitable for a plus or minus 5 percent adjustment in operating speed. The V-belt drive shall be as specified in paragraph 11000-2.03.

B. MOTOR:

Unless otherwise specified, motors shall operate at 1750 rpm and shall be TEFC or TENV. Motors 1 HP and larger shall be the high efficiency type. Motors 1/12 HP and smaller shall be the fan manufacturer's standard motor.

C. FAN PANEL:

Each fan panel shall have a spun venturi to direct air smoothly to the propeller blades. The fan, drive motor and fan guard shall be securely attached to the fan panel by means of a four-legged angle or tubular frame and mounting pads. The fan panel, frame, and mounting pads shall receive the manufacturer's standard enamel coating unless otherwise specified.

D. ACCESSORIES:

The fan shall be provided with a steel mounting collar, and a spring-loaded aluminum backdraft damper where specified. Mounting collars shall be protected with a baked epoxy finish. Fans shall be provided with inlet guards constructed of steel wire with lacquer finish. Inlet guards shall conform to OSHA standards and shall be removable to provide motor access.

Where the motor and drive assembly are specified to be installed in a weather-exposed location, such as the exterior side of an exterior wall, a sheet metal shroud or weather hood shall be provided for the fan. This shroud shall protect the fan and drive assembly from direct exposure to the elements without restricting airflow to the fan. A bird screen shall be provided with the shroud.

2.04 SPARE PARTS

One set of V-belts shall be provided for each belt-driven fan.

2.05 PRODUCT DATA

The following information shall be provided in accordance with Section 01300:

1. Certification that the units have been tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Ratings Program.
2. Applicable operating and maintenance data in accordance with Section 01730, including final reviewed submittal.

PART 3--EXECUTION

3.01 INSTALLATION

Each fan shall be installed as specified and in accordance with manufacturer's recommendations.

3.02 FIELD TESTING

Each fan shall be completely field tested in accordance with Section 15990 to guarantee compliance with the project manual.

****END OF SECTION****

SECTION 15944

LOUVERS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies intake and exhaust air louvers and accessories.

B. PERFORMANCE AND DESIGN REQUIREMENTS:

1. GENERAL: Louver shall be suitable for air supply or discharge service and shall be sized as specified.

Equipment Description	Louver dimension, inches			Minimum free area, sq ft	Airflow, cfm	Remarks
	Width	Height	Depth			
Main Process Room Exhaust Fan 1	32	32	6	3.5	2,500	Exhaust for EXF-1, adjustable
Main Process Room Exhaust Fan 2	32	32	6	3.5	2,500	Exhaust for EXF-2, adjustable
Main Process Room Intake Louver 1	32	48	6	5.9	2,500	Combination Type Supply Air Intake Louver
Main Process Room Intake Louver 2	32	48	6	5.9	2,500	Combination Type Supply Air Intake Louver
Chlorine Room Exhaust Fan	16	16	6	0.73	200	Exhaust for EXF-3, adjustable
Chlorine Room Intake Louver	16	24	6	1.15	200	Combination Type Supply Air Intake Louver

1.02 QUALITY ASSURANCE

Louvers
15944-1

Contract 2
Bid Issue

A. REFERENCE:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AA 45	Designation System for Aluminum Finishes
AMCA Standard 500	Test Methods for Louvers, Dampers, and Shutters
ASTM B221	Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM C1071	Standard Specification for Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material)

B. CERTIFICATION:

Louvers shall bear the AMCA certified ratings seal for both air performance and water penetration.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

Louvers shall be Airolite, Construction Specialties, Ruskin, or equal, modified to provide the specified features.

2.02 MATERIALS

Component	Material
Blades	ASTM B221, 6063-T52 extruded aluminum alloy
Frame	ASTM B221, 6063-T52 extruded aluminum alloy
Fasteners	Stainless steel or aluminum
Bird screen	Aluminum

2.03 EQUIPMENT FEATURES

A. BLADES:

Blades shall be of the fixed, drainable type with interlocking blade braces to provide an uninterrupted horizontal line. Blades for all louvers shall be minimum 0.081 inch (12 gage) thick. Slideable interlocked mullions shall have provisions for expansion and contraction.

B. FRAME:

The frame shall be minimum 0.081 inch (12 gage) thick for all louvers. The louver frame shall be assembled by welding. The head, sill, and jamb shall be one-piece structural members and shall have an integral calking slot and retaining bead.

C. SCREEN:

The louver shall be furnished with a removable bird screen constructed of 1/2-inch mesh, 16-gage (0.063 inch) wire and secured within a 10-gage extruded aluminum frame. The screen shall be mounted on the interior louver face but independent of the louver.

D. FINISH:

Unless otherwise specified, all louvers shall receive a 215-R1, Aluminum Association Code AA-C22A41, clear anodized finish after assembly. Minimum coating thickness shall be 0.7 mil.

2.05 COMBINATION LOUVERS

Combination louvers shall be a stationary blade type louver and adjustable blade damper mounted together in a common frame. The stationary louver and frame shall be as specified in paragraphs 15944-2.02 and 15944-2.03. The adjustable blades shall be extruded 6063T5 aluminum, 0.125-inch thick. The adjustable blade linkage shall be concealed in the louver frame and located out of the air stream. Vinyl edge seals shall be provided on the damper blades. The adjustable blades shall pivot on 1/2-inch diameter aluminum or steel pins located at the blade ends and attached to the operator linkage. The pivot pins shall be mounted on self-lubricating nylon or oil impregnated bronze bearings. Jamb seals shall be provided to prevent air leakage around closed damper blades.

2.06 OPERATORS

A. ELECTRIC ACTUATORS:

Operators for combination louvers, where specified, shall be 120-volt AC spring return motor actuators provided complete with all necessary linkage to position the damper throughout its full operating range. The actuator shall be mounted on the outside of the louver frame and shall have sufficient torque to position the size of the damper served at the specified conditions. The damper area served by each operator shall not exceed the maximum area recommended by the actuator manufacturer. Time required for the operator's full stroke shall not exceed one minute.

2.04 PRODUCT DATA

Certified results of pressure drop test data and water penetration data for all louvers shall be provided in accordance with Section 01300.

PART 3--EXECUTION

3.01 INSTALLATION

The louver shall be aligned, connected, and installed as specified and in accordance with the manufacturer's recommendations. A bituminous coat shall be applied to all aluminum surfaces in contact with concrete or masonry.

3.02 TESTING

After completion of installation, all louvers with operating dampers, both manually and automatically operated, shall be completely field tested to ensure compliance with these specifications.

****END OF SECTION****

SECTION 16000

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section. The electrical drawings and schedules included in this project manual are functional in nature and do not specify exact locations of equipment or equipment terminations.

Schedule and coordinate work to minimize water system control outages. Refer to Sections 01014, 11830, and 17900.

Summary of work, is further detailed in Section 17000:

1. Lower Greasewood Well 1 exists. Replace all electrical equipment and telemetry unit. Provide equipment inside building.
2. Lower Greasewood Well 2 exists. Replace telemetry unit.
3. Lower Greasewood Well 3 exists. Reorient existing telemetry antenna from direction of Lower Greasewood Tank toward Lower Greasewood Treatment Plant.
4. Provide Lower Greasewood Treatment Plant for treatment of well water. Provide equipment and telemetry inside building, and underground fiber optic cable to intercept existing cable. Demolish existing chlorination facility. Test and verify operation of Wells 1, 2, and 3 to control tank level, and operation of Treatment Plant when wells operate.
5. Lower Greasewood Tank exists. Replace telemetry unit.
6. Provide Ganado Well N0. Provide equipment and telemetry inside building, and underground fiber optic cable to intercept existing cable.
7. Ganado South Tank exists, but work is at the existing Ganado Tank. Add a third telemetry antenna system at existing Ganado Tank to relay signals so that the separate Ganado South Tank controls Well N0. Test and verify operation of Wells N0 to control tank level in addition to existing booster pumps.

8. Provide motor starters and telemetry units per details from Navajo Area Indian Health Service/NTUA – Technical Provisions 4.0 for Motor Control Center and Tank Control Panel.

9. Provide work as specified and per Indian Health Services – Navajo Nation – Standard Drawings.

10. Provide testing per Section 16030.

11. Provide arc flash hazard analysis and labeling per Section 16431.

12. Telemetry PLC and touchscreen programming will be provided as specified in Paragraph 17000-1.01 B, coordinate work, programmers, and provide testing. Refer also to Section 17000.

13. Equipment to be Owner furnished:

a. Only that which is labeled as “EXISTING” on drawings.

14. All replaced or removed items shall be salvaged. Salvaged items shall be properly disconnected to retain their full salvage value and cleaned before turning over to the Owner.

B. DEFINITIONS:

1. **ELEMENTARY OR SCHEMATIC DIAGRAM:** A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.

2. **ONE-LINE DIAGRAM:** A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.

3. **BLOCK DIAGRAM:** A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.

4. **WIRING DIAGRAM OR CONNECTION SYSTEM:** A wiring or connection diagram includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.

5. INTERCONNECTION DIAGRAM: Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable.

Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.

All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.

6. ARRANGEMENT, LAYOUT, OR OUTLINE DRAWINGS: An arrangement, layout, or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
-----------	-------

Reference	Title
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA	National Fire Protection Association
NFPA-70	National Electrical Code (NEC) 2011
NFPA-70E	Electrical Safety in the Workplace
ACI 318	Building Code Requirements for Structural Concrete
	Navajo Area Indian Health Service/NTUA – Technical Provisions 4.0 for Motor Control Center and Tank Control Panel
	Indian Health Service – Navajo Nation – Standard Drawings

B. IDENTIFICATION OF LISTED PRODUCTS:

Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.

When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

C. FACTORY TESTS:

Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract price.

D. POWER UTILITY:

The power utility is Navajo Tribal Utility Authority (NTUA), (928) 729-5721.

1. Coordinate power utility disconnection and connection with the power utility. Provide installations per their requirements.
2. Provide submittals per paragraph 1.03 B.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

General Requirement for Electrical Work
16000-4

A. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Catalog cuts of equipment, devices, and materials for products to be provided. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply. Submit catalog cuts for only the following:
 - a. Service Entrance Meter Socket.
 - b. Fusible Panelboard.
 - c. Temperature Switch.
 - d. Luminaires.

B. POWER UTILITY:

1. After shop drawing review, submit Service Entrance Meter Socket to power utility for review. Submit separate submittals for each of the following sites:
 - a. Lower Greasewood Well 1.
 - b. Lower Greasewood Treatment Plant.
 - c. Ganado Well N0.

1.04 DRAWINGS

Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 11 by 17 inch drafting media complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing.

Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals.

1.05 PROJECT/SITE CONDITIONS

A. GENERAL:

Unless otherwise specified, equipment and materials shall be sized and derated for the ambient conditions specified in Section 01800, but not less than an ambient temperature of 45 degrees C at an elevation ranging from sea level to 6,500 feet without exceeding the manufacturer's stated tolerances.

B. CORROSIVE AREAS:

The following areas are designated as corrosive:

- a. Well pump house chlorine room
- b. Treatment Plant interior

C. HAZARDOUS (CLASSIFIED) AREAS:

The following areas are designated as hazardous (classified) in accordance with the NEC:
None.

D. SEISMIC:

Electrical equipment, supports, and anchorage shall be designed and installed in accordance with the seismic design requirements specified in Section 01900 and on the Structural drawings.

1.06 STORAGE OF MATERIALS AND EQUIPMENT

Materials and equipment shall be stored as specified in paragraph 01605-3.0 E. Equipment and materials to be located indoors shall be stored indoors and sealed with plastic film wrap.

PART 2--PRODUCTS

2.01 EQUIPMENT AND MATERIALS

General Requirement for Electrical Work
16000-6

A. GENERAL:

Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

B. EQUIPMENT FINISH:

Unless otherwise specified, electrical equipment shall be painted by the manufacturer.

2.02 600 VOLT WIRE AND CABLE

A. INSULATION:

1. MEPR/CPE multi-conductor control cable, XLP or CPE insulation and jacket.
2. XHHW-2 for single conductors
3. THWN for indoor lighting and receptacles
4. PVC jacket and insulation for shielded signal cables.
5. Coaxial cable as specified on drawings.
6. Ethernet cable, CAT6 with factory attached RJ-45 connections.
7. SOOW or SJOOW for portable cord.

B. COLOR CODING:

1. CONTROL CONDUCTORS:

Single-conductor control conductors shall have the following colors for the indicated voltage:

Control Conductor	120V
Power (AC)	Black
Control (AC)	Red
Neutral	White
Ground	Green
Power (DC)	Blue

Control (DC)	Violet
--------------	--------

2. POWER CONDUCTORS:

Power conductors shall have the following colors for the indicated voltage:

Power Conductor	480V	208/120V
Phase A	Brown	Black
Phase B	Orange	Red
Phase C	Yellow	Blue
Ground	Green	Green
Neutral	-	White

Cables may be black with colored 3/4-inch vinyl plastic tape applied at each cable termination. Tape shall be wrapped with 25 percent overlay to provide 3 inches minimum coverage.

3. SIGNAL CONDUCTORS:

Signal cable conductors shall be color coded black and white for pairs or black, white, and red for triads.

C. SPLICING AND TERMINATING MATERIALS:

Connectors shall be tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper.

Connectors for wire sizes No. 8 AWG and larger shall be compression tool installed one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable. In-line splices and taps shall be used only by written consent of the Construction Manager.

Power conductor splices shall be compression type, made with a compression tool die approved for the purpose, as made by Thomas and Betts Corp., or equal. Splices shall be covered with electrical products designed for the application, insulated, and covered with a heat-shrinkable sleeve or boot, as specified elsewhere.

Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connections may use the Tyco Electronics removable boot product line.

D. CORD GRIPS:

Cord grips shall be provided where indicated on the Drawings to attach flexible cord to equipment enclosures. Cord grips shall consist of a threaded aluminum body and compression nut with a neoprene bushing and stainless steel wire mesh for strain relief. Cord grip shall provide a watertight seal at enclosure interface and sized to accommodate the flexible cord.

E. WIRE MARKERS

Each power and control conductor shall be identified at each terminal to which it is connected. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors No. 8 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.

Conductors shall be identified in accordance with paragraph 16000-1.07 B. Adhesive strips are not acceptable.

The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeves shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot air after installation to fit the conductor.

Conductor and Wire Marker Manufacture:

1. TMS Thermofit Marker System by Raychem Co
2. Sleeve style wire marking system by W. H. Brady Co.
3. or equal.

2.03 RACEWAY

A. BOXES AND GUTTERS:

1. Well chlorine addition and storage room: Non-metallic, NEMA 4X.
2. Well control room, outdoors: Painted Steel, NEMA 3R.
3. Treatment plant treatment area: Non-metallic, NEMA 4X.

B. SUPPORTS, HANGERS, AND RACKS:

1. Well chlorine addition and storage room: Stainless Steel or Fiberglass.
2. Well control room, outdoors: Galvanized Steel.

3. Treatment plant treatment area: Stainless Steel or Fiberglass.

C. RACEWAY:

1. Well chlorine addition and storage room: PVC coated rigid steel.
2. Well control room, outdoors: Galvanized rigid steel.
3. Treatment plant treatment area: PVC coated rigid steel.
4. Underground: PVC schedule 40, taped or PVC coated rigid steel 90 degree elbows at transition to above-ground.
5. Final connections: Liquidtight flexible conduit.

D. RACEWAY MARKERS:

1. Solid brass with 0.036-inch minimum thickness.
2. Raceway number stamped or engraved in 3/16-inch minimum height characters
3. Attached to the raceway with 316 stainless steel wire.
4. Engraving per circuits shown on panel schedules and one-line diagrams.

E. UNDERGROUND MARKING TAPE

Underground detectable marking tape shall be for early warning protection of digging around direct buried cables, conduits, and concrete duct banks. Tape shall be OSHA approved.

Marking tape example: Low density polyethylene plastic, nominally 6 inches wide and 4 mil thickness with metallic lined tape with red polyethylene film on top and clear polyethylene film on the bottom. Tape shall be imprinted with a warning continuously along the length similar to: "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW."

Tape Products: Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or equal.

2.04 COMPONENTS

A. 120V RECEPTACLES:

Receptacle shall be duplex, 20 ampere, NEMA 5-20R, and shall accept NEMA 5-15P and

5-20P plugs. Receptacle and plug shall be corrosion resistant, marine duty with polycarbonate weatherproof-in-use covers.

Manufacturers: Hubbell 53CM62/53CM21, or equal.

B. 250V RECEPTACLES:

Receptacles shall be duplex 15 amp, NEMA 6-15R, and shall accept NEMA 6-15P plug caps. Receptacles shall be Hubbell 5662, Arrow Hart 5662, or equal. Plug caps shall be Hubbell 5666-C, Arrow-Hart 6866, or equal.

C. PLUG CAPS:

Male plug caps for 120 volt and 250 volt receptacles shall be of the cord grip armored type with heavy phenolic housing, of the same manufacture as the receptacle. Plug caps shall be rated 15 amps.

D. SWITCHES:

Switches shall be 20-ampere with weatherproof/ corrosion resistant neoprene plate. Switches shall be mounted in "FS" type copper-free aluminum or PVC mounting boxes.

Manufactures: Hubbell or Arrow-Hart as follows:

	Hubbell with 17CM50 plate	Arrow-Hart with 2881 plate
Single pole	1281	2991
Double pole	1282	2992
3-way	1283	2993
4-way	1284	2994

E. DEVICE PLATES:

Device plates shall be corrosion-resistant/marine-duty type.

F. LUMIINAIRES:

Provide as specified on drawings. Provide lamps.

G. GROUND RODS:

Ground rods shall be copper covered steel, 3/4-inch diameter and 10-feet long. Rods shall have threaded type removable caps so that extension rods of same diameter and length may be added where necessary.

H. GROUNDING CONNECTORS:

1. Compression connections shall be irreversible, cast copper as manufactured by Thomas and Betts, or equal.
2. Bolted connectors shall be Burndy, O. Z. Gedney, or equal.
3. Exothermic welding products shall be Erico's Cadweld Plus system with a remotely operated battery powered electronic ignition device and moisture resistant weld metal cup for the required mold, or equal.

I. TEST WELLS:

Provide concrete test well with cover and connect the ground grid extension using a removable connector.

J. TERMINAL BLOCKS:

Unless otherwise specified, terminal blocks shall be panhead strap screw type. Terminals shall be provided with integral marking strips that permanently identify with the connecting wire numbers as shown on the drawings:

1. Terminal blocks for P-circuits (power 208-600 volts)
 - a. Rated not less than the conductor current rating
 - b. Rated less than 600 volts AC.
2. Terminal blocks for C-circuits and S-circuits:
 - a. Rated not less than 20 amperes
 - b. Rated less than 600 volts AC.
3. Terminals shall be tin-plated.
4. Insulating material shall be nylon.

2.05 EQUIPMENT

A. TRANSFORMERS:

Provide as specified on drawings.

B. LOAD CENTERS:

1. Provide as specified on drawings.
2. Provide metal oxide varistor (MOV) surge protective device (SPD) integral within each panelboard that indicates the status and condition of the SPD, tested per NEMA LS-1, rated IEEE C3 Combined Wave of 20kV and 10kA with 200kAIC internal fusing and listed / labeled per UL 1449.
3. Provide "Circuit Directory and Circuit Identification" in accordance with NEC 408.4. Each circuit shall be of sufficient detail to allow each circuit to be distinguished from other circuits. Circuit identification shall include load location and provide equipment or instrument Tag Number and Tag Description, where shown on the drawings.

C. SAFETY DISCONNECT SWITCHES:

Heavy duty fused and non-fused disconnect switches with current range of 30 to 600 amperes shall be provided as shown on the drawings with the enclosure type matching the area rating. Provide lock-off provision for a hasp padlock. Provide visible knife blades through a cover viewing window. Provide shielded or insulated line terminals with quick-make / quick-break switch operator. Provide internal barrier kit for additional personnel barrier from accidental contacts with live parts. Provide a legend plate with equipment tag, equipment description, and power feeder circuit source and location identification.

Disconnects shall include one auxiliary contact that operates with the power switch blades. The auxiliary contact shall be wired as shown on the drawings for remote status monitoring of the disconnect position where shown or for disconnecting motor space heater where shown.

Fuse clips shall be Class R rejection type and sized for UL Class R, one-time, time-delay fuses. Fuse assembly shall have a minimum short circuit capacity of 100,000 amps symmetrical. Provide fuses as shown and one set of spare fuses with each switch.

D. SERVICE ENTRANCE METER SOCKET:

Provide as specified on drawings.

E. FUSIBLE PANELBOARD:

Provide as specified on drawings.

F. MOTOR STARTERS:

Provide as specified on drawings. Refer also to Spec. 16155.

G. TELEMETRY PLC:

Provide as specified on drawings. Refer also to Spec. 17110.

H. TEMPERATURE SWITCH:

Weatherproof enclosure, contacts rated 20 amps, adjustable setpoint knob. Settings per Drawing H-100. Honeywell, or equal.

I. DOOR SWITCH:

Provide as specified on drawings.

2.06 NAMEPLATES

A. MATERIALS:

Nameplates shall be made from laminated phenolic plastic.

1. Nominal size: 3/4 inch high by 2 inches long.
2. Black backgrounds with 3/16-inch white letters.
3. Fastened using self-tapping stainless steel screws.

B. ENGRAVING:

1. Abbreviations shall be submitted to the Construction Manager prior to manufacture because of space limitations.
2. Nameplate adhesives will not be permitted on the outside of enclosures.
3. Provide nameplate for each electrical equipment item engraved as follows:
(EQUIPMENT NAME) / (VOLTAGE) VOLTS.

2.07 PRODUCT DATA

The following information and product data specified under individual specification sections shall be provided in accordance with Section 01300.

1. Applicable operation and maintenance information on an item-by-item basis in accordance with Section 01730. Operation and maintenance information shall be provided at the time of equipment, device, or material site delivery, or at a certain stage of project completion as required by Section 01730, whichever is the earlier. Full-size drawings shall be reduced to 11 x 17 inches.

2. Test results for motors and electrical systems on the forms specified in Section 16030. A file of the original test results shall be maintained by the Contractor. Prior to acceptance of work, the resulting file shall be provided to the Construction Manager.
3. Record documents specified in Section 01720 and paragraph 16000-3.03.

PART 3--EXECUTION

3.01 GENERAL

A. CONSTRUCTION:

The work under Division 16 shall be performed in accordance with these specifications.

Refer to the National Electrical Contractors Association's (NECA) National Electrical Installation Standards (NEIS) for Standard Practices for Good Workmanship in Electrical Contracting (NECA-1) as a minimum baseline of quality and workmanship for installing electrical products and systems that defines what is meant by "neat and workmanlike" as required by the National Electrical Code Section 110-12. Specified requirements supersede NECA practices.

Electrical layout drawings are diagrammatic, unless otherwise detailed or dimensioned. The Contractor shall coordinate the location of electrical material or equipment with the work.

Major electrical openings may compromise the structural integrity of the slab and wall elements. Major electrical openings are defined as openings or penetrations greater than two times the wall thickness in any dimension, and include duct bank transitions into a building through structural elements. Major electrical openings shall be constructed according to standard details on the drawings, up to an opening dimension of three feet. For opening dimensions greater than three feet, construct walls and slabs as specifically detailed on the drawings for that case. Major electrical openings proposed by the Contractor shall be submitted to the Structural Engineer of Record for the project for review.

Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.

B. CONDUITS IN CONCRETE CONSTRUCTION:

Conduits for power, control and instrumentation may be embedded in and pass through concrete construction subject to the limitations in this paragraph. Where concrete strength or serviceability requirements prevent the direct embedment of conduit, provide adequate support, bracing, and serviceability details:

1. Concrete strength shall not be impaired significantly by the embedment of conduits in or through structural sections.
2. Conduit layout shall conform to the requirements of ACI 318, Sections 3.3 – Aggregates and 6.3 – Conduits and Pipes Embedded in Concrete.
3. Conduits shall be treated similarly to reinforcing steel for purposes of clearance. In general, code sections require conduit spacing the greater of:
 - a. 1.33 times the maximum concrete aggregate size, clear
 - b. Three diameters center to center

Alternate spacing and layout shall be as reviewed and accepted by the Engineer.

4. Conduit and raceway penetrations through walls and slabs where:
 - a. one side is a conditioned or an occupied space and the other side not, or
 - b. one side has liquid or groundwater contact and the other not,

shall be detailed and constructed to prevent liquid and moisture penetration through the wall or slab section for each conduit.

C. HOUSEKEEPING:

Electrical equipment shall be protected from dust, water and damage. Motor control centers, switchgear, and buses shall be wiped free of dust and dirt, kept dry, and shall be vacuumed on the inside within 30 days of acceptance of the work.

Before final acceptance, the Contractor shall touch up any scratches on equipment.

Electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction shall be protected as specified in paragraph 01605-3.0 F.

D. ELECTRICAL EQUIPMENT LABELING

Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.

Electrical equipment shall have NFPA 70E labels installed stating the results of the Arc Flash analysis specified in Section 16431 Short Circuit and Protective Device Coordination Study Report.

Electrical distribution equipment and utilization equipment shall be field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.

E. MOTOR CONNECTIONS

Verify that the motors are purchased with the correct size motor termination boxes for the circuit content specified as shown on the power single line diagrams or submit custom fabrication drawing indicating proposed motor termination box material, size, gasket, termination kit, grounding terminal, motor lead connection method, and motor terminal box connection/support system. Verify the motor termination box location prior to raceway rough-in.

F. CONDUCTOR INSTALLATION

An enclosure containing disconnecting means, overcurrent devices, or electrical equipment shall not be used as a wireway or raceway for conductors not terminating within the enclosure. Provide wireways, raceways, termination boxes, or junction boxes external to the enclosure for the other conductors.

3.02 TESTING

A. GENERAL:

Refer to Section 16030.

3.03 RECORD DOCUMENTS

Contract documents shall be maintained and annotated by the Contractor during construction, including the record drawings specified in Section 01720.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 16030

ELECTRICAL ACCEPTANCE TESTING

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies the acceptance testing of electrical materials, power distribution and utilization equipment and circuits. Contractor shall provide all labor, tools, material, power, and other services necessary to provide the specified tests.

B. SCHEDULE:

Provide testing for all equipment at the following sites:

1. Lower Greasewood Well 1 including existing well pump motor.
2. Lower Greasewood Treatment Plant.
3. Well N0.

1.02 REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NFPA-70	National Electrical Code (NEC) Electrical Acceptance Testing 16030-1

1.03 SUBMITTALS

Functional testing and checkout procedures and schedule shall be provided in accordance with Section 01300.

PART 2--PRODUCTS

2.01 TEST EQUIPMENT AND MATERIALS

Test instruments shall be calibrated to references traceable to the National Institute of Standards and Technology and shall have a current sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required.

2.02 PRODUCT DATA

In accordance with Section 01300, the Contractor shall submit the completed test report forms 16000-A, B, C, and D for each site as specified in Part 3 herein.

PART 3--EXECUTION

3.01 TESTING

A. GENERAL:

The following specified tests, including correction of defects where found and the subsequent re-testing, shall be completed prior to energization of the equipment or systems. Submit all completed test report forms in a 3-ring binder type notebook at the project Substantial Completion date.

A 1,000 volt megohmmeter shall be used for insulation resistance measurements.

B. INSULATION RESISTANCE MEASUREMENTS:

1. GENERAL: Insulation resistance measurements shall be made on conductors and electrical equipment that will carry current. Minimum acceptable values of insulation resistance shall be in accordance with the applicable NETA-ATS, ICEA, NEMA, or ANSI standards for the equipment or material being tested. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for all circuits 120 volts and above except lighting circuits. Measurements may be made with motors and other load equipment connected. Insulation resistance measurements shall be recorded in a format similar to Form 16000-A contained in Section 01999, and submitted for acceptance. Insulation with resistance of less than 10 megohms is not acceptable.

3. MOTOR TESTS: The Installed Motor Test Form, 16000-B, contained in Section 01999, shall be completed for each motor after installation and submitted for acceptance. All motors shall have their insulation resistance measured before they are connected.

Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery and when they are connected. Insulation resistance values less than 50 megohms are not acceptable.

Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

4. POWER DISTRIBUTION EQUIPMENT: Transformers, panelboards, and other power distribution equipment shall have their insulation resistance measured phase-to-phase and phase-to-ground. Utilize forms provided in Section 01999 as examples.

5. POWER UTILIZATION EQUIPMENT: Test receptacles and power outlets using a device to verify polarity, grounding, and the correct wiring connections.

C. FUNCTIONAL TESTING:

Contractor shall submit a description of proposed functional test and checkout procedures conforming to the following requirements, including a schedule for conducting these procedures, not less than 30 days prior to the performance of functional testing.

Prior to functional testing, all protective devices shall be adjusted and made operative.

Prior to energization of associated equipment, perform a functional checkout of all electrical and instrumentation control circuits as specified in the following and in Division 17. Checkout shall consist of energizing each control circuit and operating each control, alarm, safety device, and each interlock, in turn, to verify that the specified action occurs.

3.02 PROTECTIVE DEVICE FIELD SETTINGS

The Contractor or Study Firm shall verify, and certify in the acceptance test final report, that the protective device coordination study settings for new and existing equipment based on the Short Circuit and Protective Device Coordination Report specified in Section 16431 have been implemented.

3.03 ARC FLASH SIGN INSTALLATION

The Contractor shall install the Arc Flash Hazard signs per direction from Section 16431 Study Firm.

16000-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.: _____ Temperature, °F: _____

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

Electrical Acceptance Testing
16030-4

Contract 2
Bid Issue

16000-B. INSTALLED MOTOR TEST FORM

Motor Equipment Number: _____ Date of test: _____

Equipment Driven: _____

MCC Location: _____

				Ambient temp	°F
Resistance:					
Insulation resistance phase-to-ground megohms:					
Phase A		Phase B		Phase C	
Current at Full Load:					
Phase		Current, amps			
Phase		Current, amps			
Phase		Current, amps			
Thermal Overload Device:	Manufacturer/catalog #			Amperes	
Circuit breaker (MCP) setting:					

Motor Nameplate Markings:

Mfr		Mfr Model		Frame		HP	
Volts		Phase		RPM		Service factor**	
Amps		Freq		Ambient temp rating	°C		
Time rating				Design letter**			
	(NEMA 1-10.35)				(NEMA MG-1.16)		
Code letter				Insulation class			

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

Electrical Acceptance Testing
16030-5

Contract 2
Bid Issue

16000-C. DRY TRANSFORMER TEST DATA FORM

(Note: Use Data Form for dry type transformers with voltage rating of 600 Vac or less and sizes to 167 kVA single phase and 500 kVA three phase. Use NETA Test Forms and Test Procedures for higher voltages and larger transformers.)

Equipment Tag No.: _____ Temperature Rating: _____

Description/Location: _____ Feeder size/Source: _____

Primary Voltage: _____ Secondary Voltage: _____ Winding Connection: _____

A. VISUAL INSPECTION

Transformer Inspection	Pass	Fail	Note
1. Nameplate data as specified			
2. Mechanical condition			
a. Free of dents and scratches			
b. Anchored properly			
c. Shipping brackets removed			
d. Spacing from wall per nameplate			
3. Grounding *			
a. Equipment grounding			
b. System grounding			

B. INSULATION-RESISTANCE TESTS:

Perform tests with calibrated megohmmeter. Apply 1000 Vdc test voltage for 60 seconds and record readings in megohms at 30-seconds and 60-seconds intervals.

Test Group	Resistance between		30-second reading	60-second reading	Absorption Ratio Index 60-sec. / 30-sec.
Primary Winding to ground	A	GRD			
	B	GRD			
	C	GRD			
Secondary Winding to ground with * N-G Bond removed	a	GRD			
	b	GRD			
	c	GRD			
Primary Winding to Secondary Winding	A	a			
	B	b			
	C	c			

Submit resistance readings to the Construction Manager immediately after the tests that are less than the manufacturer's recommended value or less than 10-megohms. Record the Absorption Ratio Index values for future reference. Ratio must be 1.0 or greater, with infinity (∞) equal to 1.0.

Contractor Representative Certified: _____ Date _____

Owner Representative Witnessed: _____ Date _____

16000-D. MOTOR STARTER TEST FORM

Equipment No.: _____ Ambient room temperature: _____

Location: _____

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for 1 minute using a megohmmeter at 1000 volts.

Test results (megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.
3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

17000-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance ^a		Insulation Resistance ^b			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

- Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ± 2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.
- Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

Electrical Acceptance Testing
16030-8

Contract 2
Bid Issue

17000-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

Electrical Acceptance Testing
16030-9

Contract 2
Bid Issue

17000-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
% Deviation Allowed:				

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

****END OF SECTION****

Electrical Acceptance Testing
16030-10

Contract 2
Bid Issue

SECTION 16124

SINGLE MODE FIBER OPTIC DATA COMMUNICATION SYSTEM

PART 1--GENERAL

1.01 SCOPE

This section specifies requirements for indoor/outdoor rated single-mode fiber optic data communication cables including installation, terminations, termination cabinets, testing, and accessories.

Provide tools, supplies, materials, equipment, test equipment and the labor for the raceways system, cable installation, and testing of a complete and operable fiber optic cabling system as specified herein on the Cable Specification Sheets.

Provide fiber optic cable with each fiber usable and tested as specified herein.

Provide the fiber optic cable terminations, splices, and appurtenances required to complete the fiber optic cabling system. Appurtenances are specified in Section 17110.

Refer to the drawings and drawing notes for specific requirement for the project, since not all specified products, methods, and procedures are applicable to the project.

1.02 QUALITY ASSURANCE

A. MANUFACTURER:

Equipment and cabling shall be the product of firms regularly engaged in the design and manufacturer of equipment and cables for a minimum of five years. Manufacturer shall have minimum of seven years experience and shall be ISO 9001 certified.

B. INSTALLER:

Installation, termination, and testing of equipment and cabling provided under this section shall be performed by qualified, skilled technicians regularly engaged in fiber optic cabling system work of similar complexity and who possess the licenses or certificates required to perform such work.

C. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced

directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO	HS-20 Truck Loading
ASTM F 512	Smooth-Wall Poly (Vinyl Chloride)(PVC) Conduit and Fittings for Underground Installation
ANSI/ICEA S-87-640	Standard for Optic Fiber Outside Plant Communications Cable.
ANSI/TIE/EIA 568-B.3	Commercial Building Telecommunications Cabling Standard part 3
BELLCORE GR-20-CORE	Generic Requirements for Optical Fiber and Optical Fiber Cables
BELLCORE GR-409-CORE	Generic Requirements for Intrabuilding Fiber Cable
BELLCORE GR-487-CORE	Generic Requirements for Electronic Equipment Cabinets
BELLCORE GR-771-CORE	Generic Requirements for Fiber Optic Splice Closures
ISO 9001	Quality Management Systems
ITU G.652	Recommendation - Characteristics of a single-mode optical fiber cable.
ANSI/NECA 301	National Electrical Contractors Association – Standard for Installing and Testing Fiber Optic Cables
TIA/EIA-455-86	FOTP-86 Fiber Optic Cable Jacket Shrinkage
TIA/EIA-455-107A	FOTP-107 Determination of Component Reflectance or Link/System Return Loss Using a Loss Test Set
TIA/EIA-526-7	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA/EIA-598-B	Standard for Optical Fiber Cable Color Coding
NFPA 70	National Electric Code (NEC)

D. FACTORY TEST:

Single Mode Fiber Optic Data Communication System
16124-2

Contract 2
Bid Issue

Manufacturer's factory testing shall be conducted for all fiber optic cable reels provided for this Contract. Test documentation shall include the following:

1. Measurement of fiber length using Optical Time Domain Reflectometer (OTDR).
2. Measurement of average attenuation using OTDR.
3. Traces of OTDR measurements taken.
4. Test for short distance cable fault detection using Visual Tracer.

E. CERTIFICATION:

Splicing, terminating, and testing shall be conducted by Fiber Optics Association Certified Fiber Optic Technicians (CFOT).

1.03 SUBMITTALS

The following information shall be submitted for review in accordance with Section 01300:

A. Product Literature:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*
2. A copy of the contract document drawings for Well N0: C-103, E-600, E-601, and E-602, and process and instrumentation drawing I-002 that apply

to the equipment in this section marked to show specific changes necessary for the supplied equipment. If no changes are required, the drawings shall be marked "No Changes Required." Manufacturer's specifications, data sheets, and catalog literature for the indoor/outdoor rated fiber optic cable that clearly and unambiguously shows that the cable meets all the requirements specified herein.

3. A copy of the contract document, drawings for Treatment Plant: C-121, C-122, C-123, E-401, and E-402, and process and instrumentation drawing I-001 that apply to the equipment in this section marked to show specific changes necessary for the supplied equipment. If no changes are required, the drawings shall be marked "No Changes Required." Manufacturer's specifications, data sheets, and catalog literature for the indoor/outdoor rated fiber optic cable that clearly and unambiguously shows that the cable meets all the requirements specified herein.
4. Manufacturer's catalog literature and catalog data sheets for the following items, marked to indicate products proposed, as applicable to the project:
 - a. Fiber optic cables including manufacturers' maximum recommended pulling tension.
 - b. Fiber optic cable termination connectors.
 - c. Not used.
 - d. Not used.
 - e. Fiber optic adapter plug-in.
 - f. Fiber optic patch cord storage.
 - g. Fiber optic cable clamp kit.
 - h. Connector/Adapter cleaning kit.
 - i. Innerduct including manufacturers' maximum recommended pulling tension and accessories.
 - j. Not used.
 - k. Cable pulling grips, swivel, and lubricant.
5. Shop drawings:

- a. Interconnection cable diagrams for each SCADA Network Cabinet to the existing cable splice location, showing each fiber in each cable with each splice and termination point.
- B. Qualifications:
 - 1. Contractor's experience and resumes for the personnel installing and testing the fiber optic system including factory training certifications.
 - 2. Information on five successfully performed cable installations of comparable size and complexity with name, address, and telephone number of facility owner, name of project and completion date, and type of conduit system and length of cable pulled.
 - 3. Proof of certification for splicing, terminating, and testing personnel per paragraph 1.02 E.
- C. Innerduct pulling plan as specified in Part 3.
- D. Fiber cable pulling and splicing plan as specified in Part 3.
- E. Submit cable samples for review that include the specified cable marking.

PART 2--PRODUCTS

2.01 GENERAL

Provide fiber optic cable jacket: free of holes, splits, and blisters with no metal elements and of a consistent thickness.

2.02 CONDUIT

Provide 4 -inch diameter PVC Schedule 40 conduit that shall be direct buried as shown.

2.03 PULL BOXES

Unless otherwise shown, provide pull boxes with the approximately dimensions of 30 inches wide by 48 inches long, by 18" deep with hollow bottoms, designed for H-20 traffic loading.

Pull box covers shall be galvanized steel with the words "FIBER OPTICS" in raised letters on the upper surface. Covers shall have locking devices and form a watertight seal to prevent surface water from entering. Knockouts in the sidewalls shall permit underground conduit side entry and exit.

Pull boxes shall be by George Ingraham, Vikamatic or equal.

2.04 CONDUIT SEALANT

Conduit sealant shall be Semco duct sealing compound or equal.

2.05 IDENTIFICATION TAPE

Provide a 6-inch wide magnetically detectable warning tape with orange protective polyethylene jacket. Provide polyethylene tape continuously imprinted "CAUTION-FIBER OPTIC CABLE".

Identification warning tape shall be Teletrace by George Ingraham, Vikamatic, or equal.

2.06 TRACER WIRE

Provide a #12 AWG XHHW insulated green stranded copper wire with a multi-pin terminal block for termination of the tracer wire in concrete manhole / pullbox for tracer wire access.

2.07 PULL ROPE

Provide a low friction, polyethylene jacketed, polypropylene rope with 1,800 psi of tensile strength.

Pull rope shall be Vikamatic "Fiber Glide" or equal.

2.08 INNERDUCT

Plenum rated corrugated innerducts shall be orange colored PVC 1-inch or 1-1/4 inch inside diameter, for indoor applications. Innerduct shall be used in new conduits in which fiber optic cables are installed.

Provide 4-inch fiber optic conduits for underground installations equipped with three smooth-wall 1-1/4 inch High Density Polyethylene (HDPE) innerducts. Nominal innerduct size shall be 1-1/4 inch inside diameter. The standard ratio of the diameter to the wall thickness shall be 9 or less.

1. Cap innerduct reels prior to shipment to prevent the entrance of debris or moisture.
2. Provide innerduct colors of Orange, Blue, and White with ultraviolet light stabilizers (2% carbon black) to protect the color while exposed to light.

3. Perform splicing of innerduct in concrete manholes or pull boxes. Splices in between pull boxes or concrete manholes are not allowed.
4. Provide waterproof splice couplers with splice materials recommended by the innerduct manufacturer. Interior of the splices shall be deburred and smooth.
5. Innerduct shall conform to ASTM D 1248. The interior of the innerduct shall be smooth. Innerduct installation shall be performed in accordance to the manufacturer's recommendations.
6. Innerduct shall be manufactured by Carlon, Integral or Petroflex NA.

2.09 SLACK ENCLOSURES

Provide slack enclosure with minimum inside dimensions of 30 inches x 24 inches x 9-1/2 inches.

Slack enclosure shall be Carlon SLK 12 or approved equivalent.

2.10 DUCT PLUGS

Duct plugs shall be Jackmoon or equivalent.

2.11 CABLE IDENTIFICATION TAGS

Provide identification tags:

"FROM: _____ TO: _____ CIRCUIT: _____ PURPOSE: _____".

Cable identification tags shall be Brady or Thomas & Betts or equal.

2.12 FIBER OPTIC BUFFERED CABLE CONNECTORS AND PATCH CORDS

A. GENERAL:

Provide preparation for the connections including polishing, connectors, hardware, cleaving tool, continuity tester, visual fault locator, and supplies for installation of connectors. Terminations shall be LC or SC type, as required by the Switch specified in Section 17110. Fusion-spliced pigtails are not acceptable.

Fiber optic cable connections shall be provided with ceramic ferrules, polycarbonate not acceptable.

B. CONNECTOR CHARACTERISTICS:

Connectors shall be specifically designed for fiber optic buffered cables specified herein.

C. PATCH CORD CHARACTERISTICS:

Patch cords shall be 8.3 μm single 125 μm coated duplex fiber with jacket and connectors on both ends. Attenuation shall be a maximum of 0.2 dB. Provide length required for connection from patch panel to equipment. Color: Yellow.

2.13 FIBER OPTIC PANELS

A. GENERAL:

Fiber optic patch panels shall consist of a system of components for routing, supporting, and terminating the fiber optic cables specified herein. Coordinate supply with Section 17110 SCADA Network Cabinet, panels may be included therein.

B. DESCRIPTION:

Provide the following:

1. Rack-mounted type fiber optic patch panels constructed of aluminum or steel with removable hinged metal doors, slide rails that permit the patch panel to slide in and out of the unit while being fully supported.
2. Rack modules mounting hardware, cable clamps and grommets, cable routers, storage decks, connector racks, and items for a complete system.
3. 1U high rack units with a machine printed port labeling system.
4. Cable routers and storage decks to retain cables' minimum bending radius.
5. Sufficient quantity of ports to terminate the number of fiber strands specified and blank covers for unused port spaces.
6. One port for each fiber in accordance with the specified cable type.

2.14 PRODUCT DATA

The following information and product data specified shall be provided in accordance with Section 01300.

1. Factory test results as specified in paragraph 1.02.
2. Cable pull records as specified in Part 3.

3. Results of all tests specified in Part 3.

PART 3--EXECUTION

3.01 RACEWAY SYSTEM

A. CONDUIT INSTALLATION:

Conduit bends shall have a radius of 24 times the conduit diameter. Conduit sections shall be joined in accordance with the manufacturers' recommendations and shall be watertight.

Conduits entering pull boxes shall be capped or sealed watertight. Conduits entering access concrete manholes and vaults shall be terminated with flush end bells. Provide bushings on ends of conduits entering pull boxes.

Annular spaces around the conduit and precast unit walls shall be grouted. Bedding and backfill shall be as specified for the pipeline trench.

Concrete encasement shall be red concrete in accordance with Section 03300 placed at least 4 inches thick below and above the conduit.

Provide identification tape above underground conduit along the entire length of the conduit route

Provide triplex duct plugs to seal the three innerducts at the entrance of each pullbox/concrete manhole/vault.

Provide blank duct plugs to seal empty or spare conduit and innerduct in each pullbox/concrete manhole/vault.

Provide and install fiber cable identification tags in each access vault, pullbox, and/or vault

Tracer wire shall be installed in the trench with fiber optic cable conduit and at pullbox / manholes with ten feet of tracer wire coiled and secured as specified herein.

B. PULL BOX INSTALLATION:

Pull boxes shall be installed on a compacted level foundation consisting of 4 inches of granular material. Backfilling around pull boxes shall not be done until mortar sealant has thoroughly set.

Install the pull box covers with the top of the cover flush with the finished grade. Install pull boxes in soil areas with top of the cover 3 inches above the final grade level of the restored

surface to prevent accumulation of dirt, silt and debris on the top of the cover. Perform conduit integrity tests for each section between the pull boxes after backfilling and compaction using the test and procedures described in this Section, prior to installation of the pull rope.

Pull boxes shall be free of debris and water, ready for cable installation upon final acceptance of the conduit system. Pull box conduit entries shall be sealed with grout to prevent the intrusion of water and debris into the pull boxes. Use red urethane: Greybar catalog #02044 or equal.

C. CONDUIT SYSTEM CLEANING AND TESTING:

Conduits shall be cleaned of loose material by brush and compressed air following the backfill placement and compaction. Provide a test mandrel approximately 3/8 inch smaller than the inside diameter to be passed through conduits to detect alignment and deformation problems. Remove and replace conduit that fails the mandrel test. The replacement conduit shall then be cleaned and tested as described herein.

Cleaning and testing of the conduit shall be witnessed by the Construction Manager for conduit sections between adjacent pull boxes or manholes for the entire conduit route. Provide 5-day advance notice of the schedule and test location to the Construction Manager.

D. INNERDUCT INSTALLATION PULLING PLAN:

Develop an innerduct pulling plan with proposed pull points, the direction of the pull, and the equipment with raceway lengths and bends included.

Verify routes and pull distances using the drawings and by field inspection.

Perform the pull tension calculations during the development of the pull plan and submit with the plan for approval not later than 30 days prior to installation.

E. INNERDUCT INSTALLATION:

Conduits shall be cleaned and tested prior to installation of innerducts, where shown. Innerduct handling and storage shall be performed in accordance with the manufacturer's recommendations and installed in continuous lengths without intermediate splices inside of the conduits. The installation personnel shall be experienced with specific knowledge of the innerduct manufacturer's recommended procedures.

Provide large diameter wheels, pulling sheaves, and cable guides to maintain the specified bending radius. Tension monitoring shall use commercial dynamometers or load-cell instruments. Conduits shall have a lubricant applied at each conduit ingress and egress location and during the pull operation. Innerducts and conduits shall be continuously lubricated during the pulling procedures. Lubricant shall be Polywater Type F or equal.

Innerduct shall be installed using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions and pulled in a steady continuous manner without exceeding the bending radius of the innerduct. Tension in the innerduct during installation shall not exceed the manufacturer's specification for tensile loading or bend limits.

Installation equipment shall prevent preset pulling tension from being exceeded as determined by the Innerduct manufacturer. After the innerducts are installed, rack the three innerducts to the side wall inside of pullbox or manhole wall with a slack enclosure (every fourth pull point) with the bottom of the slack enclosure 3" above the highest racked innerduct.

Align cable entry cutouts in the same direction as the racking. The orange innerduct shall be laid into the cable entry cutouts on each side and not coupled.

After racking, all conduits and innerducts shall be sealed as follows:

1. Triplex duct plugs shall be installed on conduits that have innerduct.
2. Blank duct plugs shall be installed on empty conduits.
3. Blank duct plugs shall be installed on innerducts that are not coupled.

The tracer wire terminal block shall be located on the inside wall near the top of the concrete manhole ladder or pullbox and the wire routed to the terminal block and terminated.

F. INNERDUCT ACCEPTANCE:

The installation will be inspected for:

1. Slack enclosures: properly located and secured.
2. Racking of innerducts: complete and securely attached.
3. Conduits and innerducts: securely plugged with the proper sized duct plug.
4. Tracer wires: properly routed and terminated.
5. Defective Work: corrected and the innerduct re-inspected.

3.02 FIBER OPTIC SYSTEM

A. FIBER OPTIC CABLE INSTALLATION AND SPLICING PLAN:

Submit 30 days prior to cable installation.

Air assisted cable placement method using high speed air blowing, push-pull, cable jetting plan with the procedure, the equipment setup, and a work plan.

Work plan shall include the following:

1. Pull tension calculations.
2. Indicate additional pull boxes required, including station number and a written description of the location.
3. Detailed description of pull operation methods for raceways.
4. Tools and equipment for cable installation and testing
5. Physical location of equipment setup and type
6. Exact location of splice points
7. Safety Plan and cable pulling operations
8. Detailed schedule for pulling and testing cables

B. FIBER OPTIC CABLE INSTALLATION:

Fiber optic cable handling and storage shall be performed in accordance with the manufacturer's recommendations. The cable installation personnel shall be experienced with specific knowledge of the cable manufacturer's recommended procedures. Cable reel lagging shall remain on the cable reels until they arrive at the installation site. If the lagging has been removed, securely fasten the cable ends to avoid damage during transit. The cable shall not be left exposed or unattended during the installation process. Verify cable is not damaged during storage and installation.

Cable tension shall not exceed the manufacturer's specification for tensile loading. Pulling tension shall be continuously monitored and recorded during installation. Fiber cable shall be pulled in a steady continuous manner. The bending radius of the cable shall not be exceeded. Cable tension monitoring devices shall not exceed cable pull tension and bend limits.

Cable shall be installed in continuous lengths without intermediate splices. Cable shall be provided without splices except as shown on the plans. If additional splices are required, advanced approval of the Construction Manager shall be obtained.

Additional cable shall extend to the nearest clean and level work area. Coils shall measure 100 feet for splice work locations.

Cable strength elements shall be properly attached to a pulling eye and 600 lb breakaway swivel. Kellums pulling grips are not allowed except for short-length hand pulls.

Cable and conduits shall be lubricated during the pulling procedures. Each pullbox / concrete manhole / vault shall contain cable coiled into a slack loop and stored in a slack enclosure.

Tensile and bending limitation shall not be exceeded when power equipment is used to install cables. Tension monitoring shall use commercial dynamometers or load-cell instruments with chart recorder. Large diameter wheels, pulling sheaves, and cable guides shall maintain the specified bending radius.

Cable shall be installed using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions. Provide Polywater Type 5 lubricant, or equal.

Cable pull records shall be documented by a graph which is annotated with the following information:

1. Reel number.
2. Station or pullbox from and station or pullbox to.
3. Date and time.
4. Explanations for abnormalities in readings or interruptions.
5. Sign-off by Contractor and Construction Manager.
6. Submit fiber optic pull records as specified herein.

Racking shall conform to the following:

1. Loosely secure innerduct/cables in racked position with Ty-Raps or equal.
2. Attach imprinted plastic coated cloth identification/warning tags to the innerduct/cable in at least two locations in each pullbox/concrete manhole/vault.
3. Provide tags manufactured by Brady or Thomas & Betts.

Protect coiled cable to prevent damage to the cable and fibers with racking securing cables to brackets and racking hardware that extend from the sidewalls of the handhole. When cables are securely racked, unused conduits and void areas around conduit containing cables

shall be sealed. In concrete manholes and vaults, coiled cable shall be placed into a slack enclosure to prevent damage to the cable and fibers.

Provide Semco compound or equal material.

C. FIBER OPTIC CABLE SPLICING AND TERMINATIONS:

Prior to beginning the splicing, provide a work area to protect the cable splices from physical damage.

Work shall be performed by trained and FOA certified technicians and in accordance with the manufacturer's recommendations in the performance of installation, splicing and termination work.

Active and spare fiber optic cables fibers shall be provided with a breakout kit, and terminated with ST type terminations.

Splices shall have a loss no greater than 0.15 dB, as determined by either a Profile Alignment System (PAS) or Light Injection (LID) splice loss estimate, at the time the splice is made. Splices with an optical loss of greater than 0.15 dB shall be redone.

Indoor splices shall be mounted in a splice tray and the splice trays may be stored in either a separate indoor rack mounted splice module or within the patch panel. Outdoor splices shall be in an outdoor plant splice NEMA 3 or NEMA 4X enclosure as shown.

3.03 FIBER OPTIC TESTING:

The Construction Manager shall be notified a minimum of 5 days prior to tests and reserve the right to witness field tests.

A. TEST EQUIPMENT:

Test equipment shall be traceable to NIST standards. Use the following to perform the pre-installation and post-installation cable tests:

Optical time domain reflectometer (OTDR) shall be laser precision, ALT, Inc. Model 5200 LRFL or equal.

B. PRE-INSTALLATION TESTS:

Perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation and manufacturing processes. Perform tests on all reels of cable. Cable shall not be installed until the Construction Manager has reviewed the test report.

Verify continuity and attenuation or loss for each fiber on each reel and document results of physical inspections to identify any cable and reel damage conditions, and any deviations from the manufacturer's specifications.

Notify the Construction Manager 5 days prior to tests. Document test results and submit the report to the Construction Manager for review. Documentation shall consist of both hard copy and electronic disk complete with application software.

C. POST-INSTALLATION TESTS:

1. OTDR: Conduct the following tests on each cable segment with an OTDR each optical fiber in the fiber cable. Tests shall be conducted at both 1310 and 1550 nm. No splice loss shall have a loss of 0.15 dB or greater with fiber attenuation measured in dB/km.

Excess Fiber Coefficient (EFC) Test shall be made as part of the cable testing. The following procedure shall be performed from both ends on each fiber provided.

- a. Prior to stripping the cable for splicing, record the meter marks to determine the physical cable length.
- b. Record the fiber Index of Refraction (IOR) from the cable data submitted by the Manufacturer.
- c. With the OTDR, set to the proper IOR and record the OTDR fiber length.
- d. Calculate the excess fiber coefficient (EFC) according to the following formula: $EFC = OTDR \text{ length} / \text{Sheath length}$

2. OLTS FIBER ATTENUATION: Measure the attenuation of each optical fiber in both directions using a with an Optical Loss Test Set (OLTS) at both 1310 nm and 1550 nm. Test shall be conducted per TIA/EIA 526-7. Provide a reference power level measured with a patch cord and connectors of the same types used on the fiber cable. Measure and record the reference power level of the Laser Light Source. Measure and record the received power level of each optical. Repeat the same measurements in the other direction.

The measured insertion loss shall be no greater than the loss calculated in the formula below:

$$IL = 2(Ls) + 2(Lc) + (La)(Length) + 0.5$$

where:

IL = Insertion Loss
Ls = Splice losses at the pigtails (maximum 0.15 dB)

Lc = Connector face loss (maximum 0.6 dB)
La = Manufacturer's cable attenuation (dB/km)
Length = Fiber length (km)

D. CABLE ACCEPTANCE:

Pigtail splices shall have a loss no greater than 0.15 dB, as determined by either a Profile Alignment System (PAS) or Light Injection (LID) splice loss estimate, at the time the splice is made. Splices with an optical loss of greater than 0.15 dB shall be redone.

OTDR traces at both 1310 nm and 1550 nm wavelengths display no unexplained losses, reflectance events, or other discontinuities.

The insertion losses measured at both 1310 nm and 1550 nm wavelengths and in both directions do not exceed the maximum allowed values. After cable tests, the cable installation shall be subject to a physical inspection to verify the remaining fiber optic specification requirements have been met. If any test requirements are not met, or in the event of fiber test failure of one or more fibers, splice or replace cable as necessary until tests pass.

E. FIBER OPTIC SYSTEM ACCEPTANCE:

Perform the inspection and establish a punch-list of the following:

1. Fiber splices: neatly organized.
2. Connectors: capped and undamaged.
3. Cabling: organized with no excessive bending.
4. Specified coiled cable present in the splice cabinet.
5. Cable entrances to the cabinets secured.
6. Unused cable delivered to the Owner.

Identify cables with the directories installed in each fiber cabinet. Discrepancies found during the inspection of the fiber system installation shall be listed and provided on the punch-list. Inform the Construction Manager upon resolution and completion of the punch-list items.

3.04 CABLE SPECIFICATION SHEETS (CABLESPEC)

A. GENERAL:

Cable types for different locations, service conditions and raceway systems are specified on individual cable specification sheets. Cables that are scheduled herein shall be installed in accordance with the CABLESPEC SHEETS.

Single mode fiber optic cables shall meet the requirements of the referenced ANSI, ICEA, ITU, TIA, and EIA standards for outside plant data communications cable.

CABLESPEC SHEETS:

The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
FOC-SM	300	FIBER OPTIC CABLE INDOOR/OUTDOOR	DATA COMMUNICATION

3.04 CABLE SPECIFICATION SHEET--CABLESPEC

Cable System Identification: FOC-SM

Description: Single Mode Fiber Optic Data Cable; 6-pair fiber conductor:

Outdoor; Heavy Duty-MFPT; Cable Tray Rated

Loose tube construction. Optical fibers shall not adhere to the inside of the buffer tube.

Fibers and buffer tubes shall be color coded with distinct and recognizable colors in accordance with EIA/TIA-598-B.

Material: 8.2/125/250 micron

Jacket: Chlorinated Polyethylene (CPE)

Color: Yellow or Black

Mark the exterior sheathing with the manufacturer's name, month and year of manufacture, and sequential meter or foot markings for easily determining the length of the cable at all points along the cable run.

Provide a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type.

Type: OFNR with industrial cable tray rating and IEEE flame test rated: 802.3Z

Fiber Type: Single Mode

Clad Diameter: $125 \pm 0.7 \mu\text{m}$

Coating Diameter: $245 \pm 5 \mu\text{m}$

Core Diameter: $8.2 \mu\text{m}$

Attenuation: $\leq 0.35 \text{ db/km @ } 1310 \text{ nm}$
 $\leq 0.25 \text{ db/km @ } 1550 \text{ nm}$

Operating Temperature Range: -40 to +70 Deg C

Maximum Tensile Loading: 600 lbf

Minimum Cable Bending Radius: 10 x diameter

Manufacturers: Corning Cable Systems
Alcoa Fujikura
Corning SMF-28e fiber
or approved equal

Execution:

Application: Data Communications.

Installation: Install in accordance with manufacturers instructions and as specified.

Testing: Test as specified above.

****END OF SECTION****

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16155

INDIVIDUAL MOTOR STARTERS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies individual motor starters and motor controllers installed in enclosures other than motor control centers. Refer to drawings for product, device, and circuit requirements.

Provide well pump starter panels per details from NTUA Technical Provisions 4.0 for Motor Control Center and Tank Control Panel, as included in the Bid Documents.

Provide Treatment Plant pump starter panels as specified.

B. DERATING:

The starters shall be derated for operation at altitudes of 6,000 feet at Lower Greasewood, and 6,500 feet at Ganado.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
NEMA ICS 1	General Standards For Industrial Control and Systems
NEMA 250	Enclosures for Electrical Equipment (1000-Volt Maximum)

B. LISTED PRODUCTS:

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

C. ENVIRONMENTAL CONDITIONS:

Refer to Section 16000.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owners Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*
2. A copy of the contract document Electrical Drawing One Line Diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure*

to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.

3. A copy of the contract document NTUA Technical Provisions 4.0 for Motor Control Center and Tank Control Panel drawings, as included in the Bid Documents, relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
4. Catalog cuts of equipment, devices, and materials for products to be provided. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
5. Starter layout drawings, schematic diagrams, and bill of materials.
6. Nameplate engraving schedule:
 - a. Indicate engraving by line.
 - b. Character size.
 - c. Nameplate size.
 - d. Panel and equipment tag number and description.
7. Verification of fault withstand ratings, and interrupting ratings.

PART 2--PRODUCTS

2.01 GENERAL

Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of equipment, component, accessory, and device used throughout the work shall be manufactured by one firm, where possible.

2.02 WELL PUMP STARTER PANEL

Equipment and components shall be as specified on the drawings referenced in Paragraph 1.01 A, and in this Section where not specified on the drawings.

A. SOFT STARTER:

Starter shall be a Reduced Voltage Solid State (RVSS) “soft” starter as specified. For starters larger than 100 horsepower, base the layout on the “60 HP to 100 HP Applications” detail as a guide, enlarging the enclosure per starter manufacturer clearance and NEC cable requirements. Starter shall be derated per Paragraph 1.01 B.

2.03 INDIVIDUAL MOTOR STARTER

A. ENCLOSURE:

The door to the motor starter enclosure shall be interlocked with an externally operated disconnect handle. Disconnect handle shall be arranged to indicate disconnect position. The disconnect operator handle shall have provisions to accept up to three 3/8-inch shackle padlocks to lock the disconnect in the open position.

Enclosures shall be:

1. NEMA 12 for indoor areas.
2. NEMA 4X for outdoor, chlorine, and treatment plant locations.

B. FUSED DISCONNECT SWITCHES:

Fused disconnect switches shall be provided with visible knife blades, shielded line terminals and quick-make, quick-break switch operator. Fuse clips shall be Class R rejection type and sized for UL Class R, one-time, time-delay fuses. Fuse assembly shall have a minimum short circuit capacity of 50,000 amps symmetrical.

C. MOTOR STARTERS:

The basic full voltage, non-reversing motor starter (FVNR) shall consist of a 3 pole, 600 volt AC contactor, transient surge suppressor, and solid-state overload relay, NEMA Size-1 minimum.

The contactors shall comply with NEMA ICS and NEMA rated for the horsepower as specified.

Overload relays shall be adjustable solid-state with protection for each of the poles. An overload condition shall cause the overload relay to latch in the open position. Reset shall be accomplished with a reset button located on the unit door exterior. Trip setting shall be adjustable

from 85 to 115 percent of rating. Provide one Form-C 2-ampere auxiliary contact for remote monitoring of the overload alarm condition.

D. TERMINAL BLOCKS:

Terminal blocks shall be heavy duty, rated at 20 amperes, 600 volts, and shall contain integral marking strips.

Terminal blocks shall be provided for external control connections. Spare terminals shall be provided as specified. Terminals shall be permanently identified with the numbers specified.

E. CONTROL DEVICES:

Combination starters shall be provided with door-mounted control devices as shown on the diagrams.

G. TRANSIENT SURGE SUPPRESSORS:

Transient surge suppressors shall be provided in each starter. Suppressors shall be encapsulated, three component, solid-state circuit, in a module suitable for mounting directly to the starter coil. Additional space for suppressors shall not be required. Suppressors shall be rated 120 volts AC/DC.

H. CONTROL CIRCUIT TRANSFORMERS:

Each combination motor control unit shall be provided with a control circuit transformer rated for 480 x 240-120V, single phase, 60 Hertz. Unless otherwise specified, transformers shall have a minimum volt-ampere rating as follows:

Starter	CPT Minimum Volt-Ampere Rating
Size 1	100
Size 2	150
Size 3	200
Size 4	300

The transformer size shall be increased if the devices applied will cause a control transformer overload or secondary terminal voltage to drop to or below 95 percent of rated secondary control voltage when rated primary voltage is applied. Each control transformer shall be mounted within the enclosure along with its associated circuit breaker and starter.

I. CONTROL CIRCUIT FUSING:

Two primary fuses, rated to interrupt 200,000 amperes at 600 volts, shall be provided on all motor starters.

Each control circuit transformer shall be provided with one control circuit secondary fuse. The secondary fuse shall have an interrupting rating of 10,000 amperes at 250 volts. The secondary fuse shall be sized at 125 percent of full load current. Fuses shall have time delay characteristics as required to prevent false tripping due to coil in-rush currents.

Fuse holders shall be lamp indicating type for blown fuse indication and shall contain neon lamp, clear transparent knob, and solder terminals.

2.04 WIRING

Conductors shall be 90-degree C switchboard type. Conductors shall be identified with tag numbers as specified in 16000.

2.05 MANUAL STARTERS

Manual starters shall comprise a horsepower rated quick-make, quick-break, toggle mechanism together with overloads in all phase conductors.

2.06 NAMEPLATES

Nameplates shall be provided in accordance with the requirements of 16000.

2.07 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Operating and maintenance as specified in Section 01730, including:
 - a. Final reviewed submittal
 - b. As-built drawings.
 - c. Record of soft starter configurations.
2. A copy of the electrical diagrams in a plastic folder in the units.

PART 3--EXECUTION

3.01 DEVICE CALIBRATION AND TESTING

Size the overload relay heater elements or adjust the solid-state overload device to the actual nameplate full load amperes of the motor connected to the starter.

Adjust motor circuit protector to the lowest setting not causing false tripping.

Configure the soft starter as required for the pump operation. Record settings and include with operations and maintenance manual.

Record the settings on each motor controller and record the settings as part of the Record As-Built drawing submittal.

3.02 TESTING

Local motor starters and circuits shall be tested in accordance with Section 16030.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 16431

ARC FLASH ANALYSIS, SHORT CIRCUIT STUDY, AND PROTECTIVE DEVICE COORDINATION REPORT

PART 1--GENERAL

1.01 DESCRIPTION

A. GENERAL:

This section specifies that the Contractor subcontract an independent full member NETA Engineering and Study Firm / Testing Firm to prepare:

1. Electrical equipment short circuit study (SCS).
2. Protective device coordination study (PDCS) report.
3. Arc flash analysis (AFA) and labeling.

B. SCHEDULE:

Provide study, report, and labeling for all equipment at the following sites:

1. Lower Greasewood Well 1 including existing well pump motor.
2. Lower Greasewood Treatment Plant.
3. Well N0.

C. SCOPE:

The Short Circuit and Protective Device Coordination Report shall include analysis including Utility Company equipment that affect the installed equipment's short circuit ratings, protective device ratings and protective device settings.

Report shall also include analysis of the equipment's short circuit ratings, protective device ratings and protective device settings affected by the installed equipment.

Report shall include the results of the arc flash hazard analysis study for energized electrical equipment in accordance with the methods outlined in IEEE Standard 1584 and stated hereinafter.

Work shall include the fabrication of signs with the arc flash hazard study results and the installation of the signs on the equipment in accordance with NFPA 70E Table 3-3.9.3 that includes the personnel protective equipment (PPE) risk category, the energy available, and the clothing recommendation.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
NFPA 70E	Standard for Electrical Safety in the Workplace
NETA ATS	Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, 1999

B. QUALIFICATIONS:

The short circuit and coordination report shall be performed, and signed by the professional electrical engineer (Study Firm) responsible for the studies and registered to practice engineering in the state of Arizona.

1.03 SCHEDULE

The report shall be completed, submitted to the Construction Manager for acceptance and reworked to include the Construction Manager comments and corrections, as required. The report shall be approved by the Construction Manager prior to purchase and fabrication of electrical equipment including switchgear.

A copy of the Construction Manager accepted report shall be sent by the Contractor to all affected manufacturers prior to fabrication.

1.04 SUBMITTALS

The report specified in this Section shall be provided in accordance with Section 01300.

PART 2--PRODUCTS

2.01 REPORT

The product shall be a certified report summarizing the short circuit and coordination study and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:

1. The equipment manufacturer's information used to prepare the study.
2. Power Utility Company system information applicable to the project.
3. Short circuit calculations listing short circuit levels at each bus. Provide a sketch of the bus and use both the project term and the bus-code-name to identify the bus, branches, sources, loads. Base the system on the Project One-Line diagram.
4. Coordination study time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.
5. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment protecting that bus.
6. Data used as input to the report that includes cable impedances, source impedances, equipment ratings for the equipment being purchased for the project, etc.
7. Assumptions made during the study.

PART 3--EXECUTION

3.01 GENERAL

Provide a short circuit and coordination study on the electrical power distribution system as specified and as described in Section 6.1 of NETA ATS. The studies shall be performed in accordance with IEEE Standards 141 and 242 and shall utilize the ANSI method of short circuit analysis in accordance with ANSI C37.010.

The studies shall be performed using actual equipment data for both existing and new equipment. The coordination study shall use the data from the same manufacturer of protective relay devices as being provided by the switchgear manufacturer.

For new equipment, the Contractor shall provide copies of final reviewed equipment submittals upon request by the Study Firm.

The Study Firm shall provide three separate one man-day trips of onsite investigation to identify loads and power distribution equipment data.

Any power distribution equipment outages shall be scheduled in advance and coordinated with the Owner to limit water service outages.

3.02 NOT USED

3.03 SHORT CIRCUIT STUDY

The Contractor shall be responsible to obtain and verify all data needed to perform the study. As a minimum, the short circuit study shall include the following:

A. One-Line Diagram

1. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
2. Type designation, current rating, range or adjustment, manufacturer's style and catalog number for all protective devices.
3. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
4. Type, manufacturer, and ratio of all instrument transformers energizing each relay.

5. Nameplate ratings of all motors and generators with their subtransient reactances. Transient reactances of synchronous motors and generators and synchronous reactances of all generators.
6. Sources of short circuit currents such as utility ties, generators, synchronous motors, and induction motors.
7. Significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.
8. Emergency as well as normal switching conditions, as applicable.
9. The time-current setting of existing adjustable relays and direct-acting trips, as applicable.

B. Impedance Diagram

1. Available MVA, voltage, and impedance from the power utility company.
2. Local generated capacity impedance.
3. Bus impedance.
4. Transformer and/or reactor impedances.
5. Cable impedances.
6. Equipment impedances.
7. System voltages.
8. Grounding scheme for the project: resistance grounding, solid grounding, or no grounding.

C. Calculations

1. Determine the paths and situations where short circuit currents are the greatest.
2. Study shall address bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
3. Calculate the maximum and minimum fault currents.

3.04 ARC FLASH ANALYSIS

The Contractor shall be responsible to obtain and verify all data needed to perform the study. The arc flash analysis study shall include the following IEEE Standard 1584 nine step analysis process:

1. Collect system and installation data.
2. Determine modes of operation.
3. Determine bolted fault current.
4. Determine arc fault current.
5. Determine protective device characteristic and arc fault duration.
6. Document system voltages and equipment class.
7. Select working distances.
8. Calculate incident energy.
9. Calculate the arc flash protection boundary.

3.05 PROTECTIVE DEVICE COORDINATION STUDY

As a minimum, the coordination study for the power distribution system shall include the following on 5-cycle, log-log graph paper:

1. Time-current for each protective relay or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the tap and time dial settings shall be specified.
2. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Construction Manager shall be notified as to the cause.
3. Time-current curves and points for cable and equipment damage.
4. Circuit interrupting device operating and interrupting times.
5. Indicate maximum fault values on the graph.

6. Sketch of bus and breaker arrangement.

3.06 IMPLEMENTING PDCS SETTINGS

The Study Firm or Contractor shall implement the protective device coordination study settings on new and existing equipment as required in Section 16030, based on the Engineers accepted Protective Device Coordination Report specified herein and submit a final amended report of the Record As-Built electrical equipment protective device settings subsequent to start-up and testing.

3.07 ARC FLASH SIGN INSTALLATION

The Study Firm shall work with the Contractor for implementing the Arc Flash Hazard sign installation requirements for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 17000

GENERAL REQUIREMENTS FOR INSTRUMENTATION AND CONTROL

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies general requirements which are applicable to providing a complete, functional process control, instrumentation, communication, and telemetry systems and modifications for the Lower Greasewood and Ganado water systems. The requirements of this section are applicable to all work specified in Division 17 of these specifications.

Schedule and coordinate work to minimize water system control outages. Refer to Sections 01014, 11830, and 17900.

Electrical requirements applicable to this work include those specified in Section 16000 for general electrical requirements.

B. DESCRIPTION OF WORK:

1. Lower Greasewood Well 1 exists. Replace all controls and telemetry unit.
2. Lower Greasewood Well 2 exists. Replace telemetry unit.
3. Lower Greasewood Well 3 exists. Reorient existing telemetry antenna from direction of Lower Greasewood Tank toward Lower Greasewood Treatment Plant.
4. Provide Lower Greasewood Treatment Plant for treatment of well water, including controls, telemetry, SCADA switch, and fiber optic switch in SCADA Network cabinet. Test and verify operation of Wells 1, 2, and 3 to control tank level, and operation of Treatment Plant when wells operate.
5. Lower Greasewood Tank exists. Replace telemetry unit.
6. Provide Ganado Well N0. Provide controls, telemetry, SCADA switch, and fiber optic switch in SCADA Network cabinet.
7. Ganado South Tank exists, but work is at the existing Ganado Tank. Add a third telemetry antenna system and communication module at existing

Ganado Tank to relay signals so that the separate Ganado South Tank level controls Well N0. There are two existing antenna systems, one supports obsolete MDS 9810 telemetry radios, and the other is for regional SCADA communications. Well N0 will be equipped with a current model radio which is not compatible with the 9810 radio or SCADA radio system. Test and verify operation of Well N0 to control tank level in addition to the existing booster pumps.

8. Provide telemetry units per details from NTUA Technical Provisions 4.0 for Motor Control Center and Tank Control Panel.
9. Provide work as specified and per NTUA Standard Drawings and Indian Health Services – Navajo Nation – Standard Drawings.
10. Provide testing per Section 01660, 16030, and 17030.
12. Provide Telemetry PLC and touchscreen programming TELEMETRY System Programmer to program the following and witness testing Coordinate work, programmers, and provide testing:
 - a. Lower Greasewood Well 1 modifications.
 - b. Lower Greasewood Well 2 replacement.
 - c. Lower Greasewood Chlorination Facility demolition.
 - d. Lower Greasewood Treatment Plant addition.
 - e. Lower Greasewood Tank modifications.
 - f. Ganado Well N0 addition.
 - g. Ganado Tank modifications.
13. Equipment to be Owner furnished:
 - a. Only that which is labeled as “EXISTING” on drawings.
14. Programming to be Owner furnished for existing PLCs and touchscreens, coordinate:
 - a. Lower Greasewood Well 1 program modifications to work with
 - b. Ganado Tank program modifications for Well N0.

Treatment Plant

General Requirements for Instrumentation and Control
17000-2

Contract 2
Bid Issue

c. Ganado South Tank program modifications for Well N0.

15. All replaced or removed items shall be salvaged. Salvaged items shall be properly disconnected to retain their full salvage value and cleaned before turning over to the Owner.

C. DEFINITIONS:

1. SYSTEMS INTEGRATOR: A firm engaged in the business of detailed control system design and engineering, instrumentation component purchase, system and panel assembly, programming, and implementing the specified process control and industrial automation systems.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

B. SYSTEMS INTEGRATOR RESPONSIBILITY:

1. GENERAL

- a. The specified control system and instrumentation integration including panel building, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.
- b. The control system components shall, as far as practical, be of one manufacturer.
- c. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.
- d. The overall system performance shall be demonstrated to and accepted by Owner.

2. SYSTEMS INTEGRATOR QUALIFICATIONS:

- a. NOT USED
- b. Contractor-proposed Systems Integrator shall be evaluated based on submittal of the following Evidence of Experience:
 - 1) Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or competed within the last two years.
 - 2) Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.
 - 3). Submit organization chart and resumes for proposed project personnel.
 - 4) Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following certifications included with the Systems Integrator's personnel experience requirements described above:

- a) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
 - b) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.
 - c) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.
 - d) Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.
 - e) Certified training programs, as offered by ISA.
- 5) Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.
- a) Financial Statement.
 - b) Balance Sheet.
 - c) Dun & Bradstreet Report.

C. PROCESS EQUIPMENT COORDINATION

1. Division 17 specified equipment shall be coordinated for proper operation with equipment related process equipment specified in other Divisions.
2. Equipment shall be integrated, furnished, and installed in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.
3. Systems Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.
4. Systems Integrator shall coordinate with project subcontractors and equipment suppliers.

5. Systems Integrator shall provide installation supervision for the duration of the project, a minimum of four man-weeks on-site.
6. Conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., shall be presented to the Construction Manager for resolution before proceeding.

1.03 ENVIRONMENTAL CONDITIONS

A. GENERAL:

Specified data communication and process control equipment shall be suitable for operation in indoor locations and in outdoor locations. Ambient conditions are specified in Section 01800.

B. CORROSIVE LOCATIONS:

Corrosive locations: Chlorine storage areas.

1.04 FUNCTIONAL REQUIREMENTS

A. GENERAL:

The instrumentation and control system functions are shown on the drawings and specified in subsequent sections of Division 17. The Systems Integrator drawings and integration practices shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

1.05 SUBMITTALS

The following information shall be provided in accordance with and Section 01300:

A. SYSTEMS INTEGRATOR QUALIFICATIONS:

1. Systems Integrator Evidence of Experience per paragraph 17000-1.02 B 3. Acceptable review required prior to any other Division 17 submittal.

B. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and

denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Nameplate list with material, tag number and description as specified herein.
3. Catalog cuts of equipment, devices, and materials for products to be provided. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply. Submit catalog cuts for only the following:
 - a. Radio components, and list by location.
 - b. Flood level switch for treatment Plant.

PART 2--PRODUCTS

2.01 GENERAL

A. MATERIALS AND QUALITY:

Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

Equipment and components shall be as specified on the drawings referenced in Paragraph 1.01 B, and in this Section where not specified on the drawings.

B. RADIO COMPONENTS:

1. Antenna, directional: Kathrein SCALA TY-900, 10 dB Yagi.

2. Antenna, omni-directional for Ganado Tank and Treatment Plant:
Kathrein SCALA K7515641, 5 db.

3. Transmission Line: Times Microwave LMR-400 with type N connectors.

4. CommScope Andrews 221213 or 3M 2212 tape kit.

C. FLOOD LEVEL SWITCH:

1. NEMA 4X, industrial, protective cage, stainless steel float, magnetic coupling, aluminum switch and terminal housing, Form C contacts. Magnetrol FLS.

D. LEVEL (PRESSURE) TRANSMITTER:

1. NEMA 4X, industrial, bleed valves, stainless steel wetted parts, 4-20mA output. Request range of existing unit from Owner prior to submittal. Provide factory calibration to match and configure readout in feet and hundredths of feet of water level. Rosemount 3051CD, verify manufacturer and model with Owner prior to submittal.

2.02 NAMEPLATES

Nameplates shall be provided for all field mounted instrument, analyzer, or equipment specified in Division 17. Nameplate lettering shall include the equipment or instrument loop title and the instrument or equipment tag number, where nameplate engraving is not specified or shown. Nameplates shall be machine engraved black phenolic with white 5/32-inch high lettering, as minimum, unless otherwise specified or shown. Nameplate wording may be changed without additional cost or time, if changes are made prior to commencement of engraving.

Nameplates shall be attached to support hardware with a minimum of two self-tapping type 316 stainless steel screws in a readily visible location so the nameplate will remain to identify the service when the device is removed. Field instrument nameplates shall be attached with braided stainless steel straps where not stand mounted.

2.03 PRODUCT DATA

The following Product Data shall be provided in accordance with Section 01300.

1. Record drawings specified by paragraph 17000-1.04 B shall be provided in accordance with Section 01720 in the AutoCAD format and PDF format on CD.

Provide record drawing prints of all drawings following project start-up, but prior to acceptance of the work showing the final constructed state of the instrumentation and control systems.

2. Operating and maintenance information shall be provided in accordance with Section 01730. Include the following in each Operation and Maintenance manual:
 - a. Final reviewed Submittals, including revised as-built record drawings.
 - b. Manufacturer's operation and maintenance instructions, edited for this project.
 - c. Written record of menu configuration, jumpers, switch settings, and other configurable parameters for each instrument.
 - d. Written summary of panel operation.

PART 3--EXECUTION

3.01 INSTALLATION

A. GENERAL:

Equipment shall be installed in locations that are accessible for operation and maintenance services. Equipment not accessible shall be reinstalled at no cost to the Owner.

Installation, calibration, settings, and testing procedures are specified in Section 17000 and subsequent sections of Division 17

B. FIELD EQUIPMENT:

Equipment shall be provided with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 48 inches and 60 inches above the floor or permanent work platform. Equipment shall be mounted to avoid shock or vibration that may impair operation. Equipment shall be mounted for unobstructed access and walkways. Equipment support systems shall not be attached to handrails, process piping or mechanical equipment.

Instruments and cabinets supported by concrete walls shall be spaced 5/8 inch by strut channel between instrument or cabinet and wall. Block wall shall have additional installation supports, as required, to avoid damage to the wall. Equipment supports shall be hot-dip galvanized, 316L stainless steel in chlorine areas.

Support systems including panels shall be designed in accordance with Section 01900 to prevent deformation greater than 1/8 inch in any direction under the attached equipment load and under an external load of 200 pounds.

In wet or outdoor areas, conduit penetrations into instrument housing shall be made through the bottom (preferred) or side of enclosures to minimize water entry from around or from inside of conduits. Provide conduit hubs for connections and waterproof mastic for moisture sealant.

Nameplates shall be provided for all field mounted equipment. Nameplates shall be attached to support hardware with a minimum of two self-tapping Type 316 stainless steel screws in a readily visible location, but such that if the field device is changed out, the nameplate will remain to identify the service.

C. ELECTRICAL POWER CONNECTIONS:

Equipment electric power wiring shall comply with Division 16. Power disconnect switches shall be provided within sight of equipment and labeled to indicate the specific equipment served and the power source location. "Within sight of" is defined as having an unobstructed view from the equipment served and within 50 feet of the equipment served.

Equipment power disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location requirements cannot be met by a single disconnect switch, provide two disconnect switches: one at the equipment and one at the work platform.

D. SIGNAL CONNECTIONS:

Equipment electric signal connections shall be made on terminal blocks or by locking plug and receptacle assemblies. Flexible cable, receptacle and plug assemblies shall be used where shown or specified.

Jacketed flexible conduit shall be used between equipment and rigid raceway systems. Flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 2 feet, except where sufficient length is required to allow withdrawal of instruments for maintenance or calibration without disconnection of conduit or cord assemblies.

E. LEVEL (PRESSURE) TRANSMITTER:

1. Coordinate replacement with the Owner. Provide fittings and connect "H" high pressure sensor connection in place of existing transmitter. Demonstrate accuracy of level reading.

3.02 FIELD TESTS AND INSPECTIONS

A. DELIVERY INSPECTION:

The Contractor shall notify the Owner's Representative upon arrival of any material or equipment to be incorporated into the work. The Contractor shall remove protective covers or otherwise provide access in order that the Owner's Representative may inspect such items.

B. INSPECTION AND INSTALLED TESTS:

Refer to Section 17030 – Process Instrumentation and Control System Testing.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 17030

PROCESS INSTRUMENTATION AND CONTROL SYSTEM TESTING

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies Contractor and Systems Integrator performance in testing and documentation of process instrumentation and control system materials and equipment (PICS). Additional specific testing has been added to Paragraph 3.03 per Navajo Area Indian Health Service – Technical Provisions for Motor Control Center and Tank Control Panel.

The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.

Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all testing with Sections 01660 and 16030:

- A. Factory Acceptance Testing (FAT)
- B. Pre-Operational Performance Testing Sequence:
 - 1. Telemetry PLC Control Panel
 - 2. Wiring Testing
 - 3. Telemetry Communications
 - 4. Instrumentation Calibration
 - 5. Loop Testing
- C. Functional Testing Sequence:
 - 1. Process Control Strategy Testing
 - 2. Control System Closed Loop Commissioning
 - 3. Functional Checkout

D. Operational Testing:

1. System Acceptance Testing (SAT)

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents with additional references listed in Section 17000. All references shall be to the current edition of the document unless specifically stated otherwise. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no bids). If referenced documents have been discontinued by the issuing organization, reference to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ISA S51.1	Process Instrumentation Terminology

B. PROJECT LABELING

The items specifying project labeling herein shall include the following as a minimum: Owner's name, facility name, project name, and project number.

1.03 SUBMITTALS

Submittal material, to be submitted in accordance with Section 01300, shall consist of the following:

A. PRE-TESTING SUBMITTAL:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole.

If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. A marked copy of specification section 01660.
3. Control descriptions per paragraph 17030-2.02 C.
4. I/O Interface Summaries per paragraph 17030-2.02 D.
5. Testing status spreadsheets per paragraph 17030-2.02 A. 3.
6. Test procedures per paragraph 17030-3.01 D.
7. Proposed test forms per PART 3 of this Section 17030, detailed for each test for this project.
8. Certified Factory Calibration Reports for Instruments.

B. FAT:

1. FAT schedule of tests and demonstrations, and location.

PART 2--PRODUCTS

2.01 GENERAL

Provide test forms, documentation, and records as specified in the following paragraphs.

2.02 TESTING DOCUMENTATION

A. NOT USED

B. NOT USED

C. CONTROL DESCRIPTION

Provide a control description outlining operation for each process area's system. The Control Description Specification Sections 11825, 11830, and 17900 may be used as a basis.

D. I/O INTERFACE SUMMARY

Provide I/O spreadsheets for each process area's system. Spreadsheets to include the following for each I/O point:

1. Signal number/tag
2. Annotation description that may be logically abbreviated and that is subject to approval.
3. Complete physical I/O channel designation and addressing or communication I/O register designation.
4. True/False status designations for digital I/O.
5. Process range; engineering units and any multipliers; and raw signal range count for analog I/O.
6. Signals: Fixed point and scaled at the Controller with minimum four significant implied digits of scaling. E.g.: 0 to 1400 at Controller for a pH range of 0 to 14 at Operator Interface.
7. Provide Operator Interface scaling to display decimal digits required.

2.03 PRODUCT DATA

Provide the following product data submittal after completion of testing.

The following information shall be provided in accordance with specification Section 01300:

1. Completed test forms per PART 3.
2. List of factory calibrated items and calibration certificates.
3. Record of radio modem readings per PART 3.

PART 3—EXECUTION

3.01 GENERAL

A. GENERAL REQUIREMENTS:

Materials, equipment, and construction included under this specification shall be inspected in accordance with this section and subsequent sections of this division. Testing shall be performed by the Contractor in accordance with this and subsequent sections of this division.

No required test shall be applied without prior notice to the Construction Manager. Between 60 and 70 days before the commencement of any testing activity, the Contractor shall provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.

Provide detail assistance to the Contractor in generating form 01660-A, customized for this project. Submit detailed form prior to testing per the requirements of Section 01660.

B. TECHNICIAN QUALIFICATIONS:

Field instruments and analyzers shall be calibrated and set up by a certified instrument technician qualified to calibrate the instrumentation.

Technicians shall be qualified by completion and certification from training courses offered by The Instrumentation, Systems, and Automation Society (ISA), the instrumentation and analyzer manufacturer's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

C. TEST EQUIPMENT AND MATERIALS:

Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three times greater than the component under test.

Test instruments shall have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Certified calibration reports traceable to the National Institute of Standards and Technology shall be included with the final test report.

Provide buffer solutions and reference fluids for tests of analytical equipment.

D. FIELD TEST PROCEDURE DOCUMENTATION:

Test procedures submitted for approval within 60 days prior to the start of testing.

Test procedures for each analog and discrete loop in the process control system shall be organized and assembled in separate volumes for each process area. Final test records shall be submitted in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.

Test procedure documentation shall include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.

Test report forms for each loop, including forms for wiring, piping, and individual component tests, shall be included with the test procedure documentation. The actual test results shall be recorded on these forms and a final test report assembled as specified in paragraph 17030-3.05.

Test report forms shall be preprinted and completed to the extent possible prior to commencing testing. Test report forms that document the field test procedures shall include the following information:

1. Project name
2. Process area associated with the equipment under test.
3. Instrument loop description.
4. Instrument loop identification number.
5. Instrument nameplate data.
6. Instrument setup and configuration parameters.
7. Time and date of test.
8. Inspection checklist and results.
9. Reference to applicable test procedure.
10. Expected and actual test results for each test point in the loop including programmable controller data table or register values.
11. Test equipment used.

12. Space for remarks regarding test procedure or results, unusual or noteworthy observations, etc.
13. Name, date, and signature of testing personnel.
14. Test witness' name and signature.

E. PERFORMANCE DEVIATION TOLERANCES:

Tolerances shall be specified in Division 17. Where tolerances are not specified, refer to the manufacturer's published performance specifications.

Overall accuracy requirements for loops consisting of two or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Tolerances for each required calibration point shall be calculated and recorded on the associated test report form.

F. INSTALLED TESTS:

Equipment and System Performance and Operational Testing - Section 01660 specifies testing of the mechanical, electrical, instrumentation and HVAC systems. The Contractor's Quality Assurance Manager shall coordinate, manage, and supervise the quality assurance program that includes:

1. Testing plan with the sequence for the test work.
2. Calibration program for all instruments and analyzers.
3. Documentation program that records tests results.
4. Performance testing program systems.

Test forms provided shall conform to the requirements of reference forms 17000-A through 17000-M included in Section 01999. Additional or detailed forms shall be developed as necessary to suit complex instrumentation. Usage of terms used on test forms shall comply with ISA S51.1.

G. WITNESSING:

The Owner reserves the right to observe factory and field instrumentation testing and calibration procedures. The Owner shall be notified prior to testing, as specified herein.

3.02 FACTORY TEST

A. FACTORY ACCEPTANCE TEST (FAT):

Process Instrumentation and Control System Testing
17030-7

Contract 2
Bid Issue

1. GENERAL: Control system equipment shall be subject to a Factory Acceptance Test with the factory acceptance tests and subsequent retests witnessed by the Construction Manager and Owner. Control system panel programmable logic controllers shall be loaded with the PLC software, Operator Interface software and the programming and graphic configuration application software at the control system equipment supplier's factory prior to the FAT.

Equipment, panel instruments, panels, or cabinets shall be inspected with factory testing performed. Provide written notice to the Owner thirty working days before the commencement of the FAT activity and include:

- a. Schedule for the FAT.
- b. Location of the FAT.
- c. Testing equipment used.
- d. Detailed test procedure with forms for the recording of test results.
- e. Sign-off spaces for the individuals performing and witnessing the tests.

2. FACTORY ACCEPTANCE TEST PROCEDURES: Panels provided shall be interlocked or networked as applicable, operated, and checked-out by the equipment supplier prior to the FAT. Submit certification indicating that the panels are ready for the FAT.

The FAT shall include the following:

- a. Visual inspection of equipment, instruments, control panels, and graphic displays.
- b. Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs.
- c. Validation shall include:
 - 1) Monitoring state changes on operator interface screens based on the inputs state change.
 - 2) Observation of online PLC programming application software with the associated PLC outputs state change.
 - 3) Outputs triggered by operator interface software devices (pushbuttons, sliders, manually-entered values, etc.)

- 4) Calibration and operation of instruments on or in the control panels.
- d. Repair of loops which do not pass validation.
- e. Retest of the FAT at no additional cost.

Panels that pass the FAT may be shipped to the site upon shipping schedule and storage accommodation approval by the Construction Manager.

3.03 PRE-OPERATIONAL PERFORMANCE TESTING

A. GENERAL REQUIREMENTS:

In general, tests shall be performed in the following order:

B. TELEMETRY PLC CONTROL PANEL:

Perform the following, witnessed by the Owner and Programmer. Test form 17000-L:

1. Review dimensions, component layout, and wiring.
2. Examine cabinets and components to determine that specified hardware has been installed.
3. Examine wiring and panel assembly against specification requirements for quality of workmanship.
4. Inventory all panel parts and appropriate documentation.

C. WIRING TESTS:

Electrical power and signal cable ring-out and resistance testing. Conducted in accordance with Sections 16000 and 16030. Wiring tests shall not be conducted until cables have been properly terminated, tagged and inspected.

1. Power and Control: Per Section 16030.
2. Signal: Test form 17000-A.

D. TELEMETRY COMMUNICATIONS:

Perform the following, witnessed by the Owner and Programmer. Test form 17000-M:

Process Instrumentation and Control System Testing
17030-9

1. Examine antenna/cable assembly for quality of workmanship. The cable connection to the antenna shall be sealed with tape, then covered with vulcanizing rubber and sealed with tape.
2. Provide laptop PC for radio-modem configuration. After complete radio and transmission system installation, connect specified cable from radio to PC. Perform the following:
 - a. Perform VSWR test. Record reflected power reading and submit as Product Data. The system will not be accepted with a reflected power of > 0.2 watts at 1 watt rated output. Test to be performed with radio timeout timer and frequency hopper functions temporarily disabled.
 - b. Record radio system address.
 - c. Verify radio antenna alignment to the other specified radio location.
 - d. Record RSSI readings after antenna alignment is complete.
 - e. Verify unit is set for master mode if tank site, remote mode for wells. If configured for master, check for long polling (Modbus messaging).
 - f. Verify radio setting Buff = On.
 - g. Verify radio to PLC communication settings:
 - i. Baud Rate = 1200
 - ii. Data Bits = 8
 - iii. Parity = Even
 - iv. Stop Bits = 1
3. Transmission line or antenna related fault or trouble conditions shall be investigated and resolved to the satisfaction of the Owner. Replace damaged transmission line or related components, lightning protectors, poles, towers, or connectors that were installed improperly. Re-align antennas as required for maximum signal strength.
4. Inventory all panel parts and appropriate documentation.

E. INSTRUMENTATION CALIBRATION:

1. Instruments and final elements shall be field calibrated in accordance with the manufacturer's recommended procedures and tested in accordance with the Contractor's test procedure.
2. Individual Component Calibration and Testing shall not commence until Instruments and Component Inspections are completed and documented to the satisfaction of the Owner.
3. Analog instrument calibrated at 0, 10, 50, 90, and 100 percent of the specified full scale range. Each signal sensing trip and process sensing

Process Instrumentation and Control System Testing

switch shall be adjusted to the required setting. Test data recorded on test forms as specified herein

4. Final element alignment tested and adjusted to verify that each final element operates smoothly over the full range in response to the specified process control signals
5. Test data shall be entered on the applicable test forms at the time of testing: Alarm trips, control trips, and switches shall be set to initial values specified in Section 17200 Instrument Index at this time. Final elements shall be checked for range, dead-band, and speed of response.
6. Any component that fails to meet the required tolerances shall be repaired or replaced by the manufacturer. Repeat the specified tests until the component is within tolerance.
7. Install a calibration sticker on each instrument following successful calibration that indicates the date of calibration, the name of the testing company, and personnel who calibrated the instrument.
8. Test forms 17000-C through 17000-I.

9. **CERTIFIED TEST REPORTS:** Field test and inspection activities include verification of instrument parameter setup, verification of instrument zero, and performance at three operating points within the instrument range. Instrument which fail to demonstrate proper performance shall be returned for re-calibration or replaced as agreed depending on the impact to the project as determined by the Construction Manager.

Where instrument field calibration is not feasible, certified factory calibration reports may be submitted that includes the name and address of the laboratory that conducts the calibration testing. Certified factory test reports may be submitted for the following instrument types in lieu of field calibration:

TABLE-A. FACTORY CALIBRATION INSTRUMENT LIST

Instrument Identification	Instrument Section	Description
FPM	-	Propeller flow meter
LST	-	Submerged diaphragm level transmitter

F. **LOOP TESTING:**

Process Instrumentation and Control System Testing
17030-11

Contract 2
Bid Issue

1. Loop Testing shall not commence until the Individual Component Calibration and Testing has been completed and documented to the satisfaction of the Owner.
2. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to the vendor panel or the Plant Control System Operator Interface Station. Test signals shall be injected at the process impulse line connection where the measuring technique permits, and otherwise at the most primary signal access point.
3. Testing of loops with an interface to a programmable logic controller shall include verification of the programmable logic controller input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the programmable logic controller memory to verify proper operation.
4. If the output control or monitoring device fails to indicate properly, corrections to the loop circuitry or device shall be made. The test shall be repeated until devices and instruments operate as required.
5. Correct loop circuitry and repeat the test until the instruments operate properly.
6. Test form 17000-J.

3.04 FUNCTIONAL TESTING

A. PROCESS CONTROL STRATEGY/FUNCTIONAL TESTING:

1. Control Strategy Testing shall not commence until the Loop Testing has been completed and documented to the satisfaction of the Owner.
2. Control Strategy Testing is performed by the Programmer and Contractor and consist of installing and debugging the PLC control logic program, verifying the interface points between the PLCs and field devices and equipment, and exercising the control strategies. Control Strategy Testing will be performed on one PLC at a time.
3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing. Failure of the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete Control Strategy Testing.

B. CONTROL SYSTEM CLOSED LOOP TESTING:

1. Closed-Loop Commissioning shall not commence until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Owner
2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.
3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping, unless otherwise specified.
4. The loop response to a step disturbance shall be provided for each loop. Two graphs shall be made for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.
5. Control loops with "batch" features shall be adjusted to provide optimum response following start-up from an integral action saturation condition.
6. Graph recording shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.
7. Where a loop is controlled under the direction of a programmable logic controller, the Owner will perform the necessary adjustment of loop tuning parameters and setpoints; Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.

C. FUNCTIONAL CHECKOUT:

Conducted to verify the operation of discrete and hardwired control devices, refer to Section 01660. Exercise the operable devices and energizing the control circuit. Operate control element, alarm device, and interlocks to verify the specified action occurs.

3.05 OPERATIONAL TESTING

System Acceptance Test (SAT) shall be performed after component and subsystem tests have been completed. The test of the completed system shall be performed in full operation and shall demonstrate that all functional requirements of this specification have been met. SAT shall demonstrate the following:

1. Each component of the system operates correctly with all other components of the system.
2. Analog control loops operate in a stable manner.
3. Hard-wired and software equipment interlocks perform correctly.
4. Process control sequences perform correctly.
5. PLC application program performs monitoring and control functions correctly.
6. Operator interface graphics represent the monitoring and control functions correctly.

****END OF SECTION****

SECTION 17110

INSTRUMENT AND CONTROL PANELS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies requirements for Telemetry PLC units.

Provide Telemetry PLC units as specified in Paragraph 17000-1.01 B. Panels shall be arranged to separate control and instrument devices from power wiring. Panel shall be arranged for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label.

Provide telemetry units per details from NTUA Technical Provisions 4.0 for Motor Control Center and Tank Control Panel. Additional warranty requirements have been added herein per that document.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents that are part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid or on the effective date of the Agreement if there were no Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
EIA RS-310C	Racks, Panels, and Associated Equipment
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels

B. LISTED PRODUCTS:

Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 16000 or UL recognized.

The control panels shall have factory applied UL 508A labels. Where intrinsic safety barriers are used within a control panel, provide UL 698A factory applied label as required by UL.

C. FACTORY TESTING:

Prior to shipment, the manufacturer shall test the functional operation of the control panel as described in the control description Section 17030.

D. WARRANTY:

In addition to the guarantee specified in the General Conditions, the equipment, components, and assemblies provided shall be warranted against defects in materials and workmanship of a period of 1 year from the date of completion of all testing specified in Section 17030. Provide warranty service when requested. Provide all costs for transportation, labor, and replacement parts associated with a service call required under the warranty. Cost reimbursement will be provided for the service call and any repair work if it is determined that the control system was damaged by vandalism or an Act of God. Cost reimbursement will also be made if the call was due to a non-functioning device which was not part of the Contract installation, or for blown fuses or tripped circuit breakers.

E. TELEMETRY PLC DRAWINGS:

1. The drawings included in the project manual are functional in nature and do not show exact locations of equipment or interconnections between equipment. The Contractor's Systems Integrator shall prepare detailed installation drawings as specified below.

2. Drawings prepared in AutoCAD version 2010 or later, with borders and title blocks identifying the project, system, revisions to the drawing, and type of drawing. Each revision of a drawing shall include the date and description of the revisions. Drawing prints shall be 11" x 17" with a minimum lettering size of 1/8".

Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers in compliance with panel wiring, to permit cross-referencing between contract documents and the drawings prepared by the Contractor. Drawings:

- a. Cover sheet with site name.
- b. Discrete I/O wiring.
- c. Analog I/O wiring.
- d. Power Distribution.
- e. Backplane layout with bill of materials.
- f. Communication cable pinouts.

1.03 SUBMITTALS

Submittals and transmittal procedures for submittals are defined in Section 01300. Submit In accordance with the procedures set forth in Sections 00710 and 01300 that include drawings, information and technical data for equipment and as required in Section 17000. Submittal information shall be included in one complete submittal.

A. SHOP DRAWINGS:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owners Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the*

marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A marked copy of specification section 17000.
3. A copy of the contract document Process and Instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
4. A copy of the contract document Instrumentation Drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
5. A copy of the contract document NTUA Technical Provisions 4.0 for Motor Control Center and Tank Control Panel drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
6. Catalog cuts of equipment, devices, and materials for products to be provided. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc. Catalog cuts shall be edited to show only the items, model numbers, and information which apply. Submit catalog cuts for the following:
 - a. Radio components.
 - b. PLC and modules.
 - c. Touchscreen
 - d. Power supplies.

- e. SCADA Network components
- 7. Manufacturer's installation manual excerpts, as to be used for this project:
 - a. Installation details/drawings.
 - b. Electrical connection diagrams
 - c. Calibration procedures.
- 8. Telemetry PLC drawings and diagrams generated in CAD for the telemetry equipment specified in paragraph 1.02 E. and 17000-1.01 B. similar to those included in the drawings.
- 9. SCADA Network Cabinet drawings generated in CAD for the telemetry equipment specified in paragraph 1.02 E. and 17000-1.01 B. similar to those included in the drawings:
 - a. Backplane layout with bill of materials.
 - b. Block diagram of components and interconnections.
- 10. List of miscellaneous items, cables, spare and replenishment parts, and chemicals to be provided, including MSDS information.
- 11. Nameplate engraving schedule:
 - a. Indicate engraving by line
 - b. Character size
 - c. Nameplate size
 - d. Panel and equipment tag number and description

1.04 ENVIRONMENTAL CONDITIONS

Refer to Section 17000.

PART 2--PRODUCTS

2.01 FABRICATION

Instrument and Control Panels
17110-5

Contract 2
Bid Issue

A. GENERAL:

Panels shall be designed for the seismic requirements of Section 17000. Structures, equipment, and devices shall be braced to prevent damage from specified forces. Equipment panels shall be capable of operation following a disturbance.

Nameplates with tag number and equipment description shall identify face-mounted instruments. Instruments shall be mounted for access to components and ease of removal. Cutouts for future equipment shall be blanked off with suitable covers. Instrument tag numbers shall be identified on the panel rear.

Face-mounted equipment shall be flush or semi-flush with flat-black escutcheons. Face-mounted instruments that are more than 6 inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be supported underneath at the rear by a 1-inch x 1/8-inch thick steel angle.

Panels less than 60 inches high shall be provided with floor stands to raise the top of the panel to 60 inches above the floor or work platform. Panels that weigh less than 100 pounds may be wall mounted.

Panels with specified requirements including stainless steel or aluminum mounting requirements that are indicated on the project drawings or on the project details take precedence over the panel types or panel features indicated herein.

2.02 PANEL AND COMPONENTS

Equipment material shall be new, free from defects, and industrial-grade, as specified. Each type of equipment, component, accessory, and device used throughout the work shall be manufactured by one firm, where possible.

Equipment and components shall be as specified on the drawings referenced in Paragraph 1.01 A, and in this Section where not specified on the drawings.

2.03 NOT USED

2.04 NAMEPLATES

External door-mounted components and the panel description shall be identified with plastic nameplates. Machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The machine engraved laminated black phenolic nameplates with white lettering shall be provided for panel-mounted equipment. Nameplate engraving shall include the instrument tag number and description in 3/32-inch minimum size lettering.

The machine embossed metallic adhesive labels shall identify tag number of instruments inside panels. Nameplates shall be attached to panel surfaces, not to instruments.

The nameplates shall be attached to the panel with a minimum of two self-tapping 316 stainless steel screws. Provide RTV sealant for nameplates for NEMA-4X stainless steel panels.

The nameplate wording may be changed without additional cost or time prior to commencement of engraving. Submit nameplate legend with the panel submittal.

2.05 PANEL FEATURES

A. INTERCONNECTION WIRING:

Panel Interconnecting Wiring:

1. Panel control wiring: Single conductor stranded copper NFPA No. 70 Type MTW No. 18 AWG minimum, with an exception for factory supplied PLC wiring harnesses that are U.L. approved.
2. Panel instrument wiring: Twisted No. 18 AWG shielded pair or tri conductors.
3. Panel power wiring: Conductors specified in Division 16 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.
4. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame retardant plastic wiring channels.
5. Wiring channels shall comply with UL 94, Type V.
6. Wiring channel fill shall not exceed 50 percent.

B. CONDUCTOR IDENTIFICATION:

Wiring shall be tagged at terminations with machine printed plastic sleeves with three-part wire numbers for instrument and control panel internal conductors:

1. Part-1: Prefix of the wire number shall be the instrument loop number or equipment tag number.
2. Part-2: Code letter and wire colors per the following tables.

3. Part-3: Number that identifies individual circuit conductor [Rung Number] [Terminal Number].

Code	120 Vac Conductor	Color
L	Power	Black
C	Control	Red
N	Neutral	White
PG	Ground	Green

Code	V dc Conductor	Color
PS	24 Vdc Power	Violet
PS	24 Vdc Control	Blue
PS	24 Vdc Common	Brown
S+	Signal (+)	White
SG	Signal Ground	Black
EG	Equipment Ground	Green
FV	Panel Foreign Voltage	Yellow

C. CONDUCTOR INSTALLATION AND PROTECTION:

1. Power and control wiring shall be carried in covered channels separate from low voltage signal circuits. An interior steel barrier shall be provided between AC control devices and the electronic equipment.
2. Terminal blocks shall be strap screw type rated for 600 volts. Each terminal trip shall have a unique identifying alphanumeric code at one end and a vinyl-marking strip running the entire length of the terminal strip with a unique number for each terminal. Numbers shall be machine printed and 1/8 inch high.
3. No more than two connections shall be made to one terminal.
4. Wire connectors shall be locking fork tongue or ring tongue insulated crimp type terminals.
5. Terminal blocks shall be;

- a. Buchanan 0621-1
- b. Allen-Bradley 1492-HM1 600 V 30-amperes, finger-safe terminal block.
- c. Allen-Bradley 1492-CD3 600 V 35-amperes with #8 screw terminal block for ring or spade terminals.
- d. Phoenix Contact or Weidmuller equal products.

D. FIELD WIRING:

Field wiring shall be connected to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel.

E. FUSE AND FUSE HOLDERS:

1. Fuses for 120 Vac circuits shall have a minimum of 12,000-amperes interrupting capacity and blown fuse indicators.
2. Fuses for 24 Vdc circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 mA loops.
3. Fuses for 24 Vdc circuits shall be 1/2 amp for the power supply to individual instruments.
4. Fuse holders shall be tip-out or draw-out type.
5. Provide Phoenix Contact or equal products.

F. CONTROL POWER:

120 Vac control power source: Single power source for all control and DC power. Dual power sources, one for control power and one for DC power. Dual power sources, one for PLC and DC power and one for PLC output [and input] control power.

1. Provide control power transformers, as required for the load.
2. Provide direct current power supplies, as required for the load.
3. Provide UPS for PLC and derived loop power as defined above, as required for the load.

G. PANEL POWER:

Panel power source:

1. Provide a 120 Vac circuit for the panel receptacle, heating, and control load as required.

H. ACCESSORIES:

1. Include GFCI convenience receptacle.
2. Print pocket.

2.06 SURGE PROTECTION

Surge protectors shall be multi-stage, plug-in type selected to protect the equipment. Surge protectors shall be removable without changing the impedance of the circuit. Surge protector product manufacturers shall be:

1. Circuit Components Inc: Din Rail SDD-400 Series for Data or Analog Signals.
2. Circuit Components Inc: SPD-Series at the 120 AC incoming power.
3. Joslyn Model 1663-08
4. Taylor 1020FA
5. Phoenix Contact
6. Telematic
7. Edco
8. Or equal.

2.07 PANEL GROUNDING

- A. Each panel shall be provided with two copper ground bars.
 1. One bar (NEC required) shall be bonded to the panel or panel frame or back-plate and to the facility grounding system.
 2. Second (signal) ground bar shall be mounted on insulated stand-offs and shall be bonded to the panel ground bar only at one point.
- B. Signal circuits, signal cable shields, and low-voltage DC power supply commons shall be bonded to the signal ground bar.

- C. Field analog wiring shields shall only be grounded at the signal ground bar. Test to verify that single ground point at panel signal ground bar.
- D. Surge protectors and separately derived AC power supplies shall be bonded to the frame ground bar.
- E. Panels exceeding 36-inches width shall contain ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel interior at the bottom of the panel.

2.08 PANEL DRAWING PROTECTION

Provide wiring diagrams in accordance with Section 01300. Provide a panel-wiring diagram and schematic for each panel in a plastic bag or plastic container to avoid water damage and aging.

2.09 RADIO COMPONENTS

- 1. Radio: Provide GE MDS EL805-MD9X1AFCS0WN, spread-spectrum 928/952 MHz. The model 9810 shown on drawings is obsolete.
- 2. Transmission Line: Times Microwave LMR-300, 3', with type N connectors.
- 3. Radio to PC configuration cable, GE MDS 03-3246A01.

2.10 SCADA NETWORK COMPONENTS

- 1. Fiber Optic Switch: Provide Ciena Z33.
- 2. Ethernet Switch: Siemens Rugged-Com RX1501-L3-RM-HI-L3SECL3HW-FG52-CG01-6TX01-6TX01-6TX01-XX-XX-6GK6015-OBM23-ODC0-Z-A03+B00+C02+D01+E01+F01+G00. Provide two: 6GK6000-8FB51-0AA0.
- 3. Cabinet, climate controlled with power distribution:
_____.
- 4. Provide the above completely assembled, with interconnecting Ethernet patch cables and power connections. Generate layout drawings per paragraph 1.01 E. and submit.
- 5. Initiate request for information (RFI) to confirm above part numbers prior to shop drawings submittal. Manufacturer model numbers and availability subject to change.

2.11 SPARE PARTS

The following spare parts shall be provided:

1. Ten each of each type of light bulb used in the panels.
2. Five each of each type and rating of fuse used in the panels.

2.12 PRODUCT DATA

The following data shall be provided in accordance with Section 01300:

1. Manufacturer's operation and maintenance information as specified in Section 17000.
2. Test results as specified in Section 17030-Part 2.

PART 3--EXECUTION

3.01 GENERAL

All conduit shall enter the panels from the bottom. Provide Myers hub for rigid steel conduit entry.

Field panels and cabinets shall be mounted in compliance with paragraph 17000-3.01 B.

Provide panels with the Record As-built schematic, connection, and interconnection diagrams located in a print pocket on the inside of the door. Place documentation in a water proof clear bag in the panel document holder.

3.02 NOT USED

3.03 PANEL POWER SUPPLY

Power supply and conditioning equipment shall be mounted and connected in compliance with the manufacturer's instructions.

Line side disconnect switches shall be provided for power supply and conditioning equipment. Line and load side overcurrent protection shall be provided for power supply and conditioning equipment in compliance with NFPA 70. Disconnect switches shall comply with Section 16175.

Small power supply and conditioning equipment may be mounted in the panel served. Larger units shall be mounted adjacent to the equipment served. Where unconditioned power is brought into control panels, it shall be enclosed in metallic raceways within the panel.

Power supply and conditioning equipment larger than 5 kVA load capacity supported from surfaces other than concrete shall be provided with sound isolators.

Final raceway connections shall be a flexible conduit in compliance with Division 16.

3.04 FACTORY TESTING

The control panel shall be assembled, interconnected, and functionally tested at the assembly shop prior to shipment. The Owner/Engineer shall have the option of witnessing the functional shop test. The Contractor shall notify the Owner/Engineer at least two (2) weeks in advance prior of the scheduled functional shop test.

3.05 FIELD TESTING

Field verify the following for Instrument and Control Panels:

1. Control circuits grounded with one terminal of each load device connected to the grounded conductor.
2. Control contacts installed in the ungrounded side of the circuit.
3. Signal and control wiring installed in separate wireways.
4. Barriers between the power wiring and the signal and control wiring.
5. Connected to the plant grounding system, as specified.
6. Center-line of wall-mounted panels shall be 48 inches above the floor.
7. Inner door contains a copy of the Record elementary and wiring diagrams.
8. Inner door contains a protected drawing holder.
9. Drawings enclosed in a transparent, protective jacket.
10. Functions as specified.
11. Mounted with stainless steel unistrut, fittings, and fasteners.
12. Tested in accordance with Section 16030 and Section 17030.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 17900

CONTROL SPECIFICATIONS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies the control specification strategies for the Navajo Nation Lower Greasewood and Ganado Water Systems that are based on Programmable Logic Controller (PLC) based Telemetry systems.

Telemetry System Programming and Touchscreen Graphics Development responsibilities: Refer to Section 17000.

The Control Specification strategies describe sequential and interlocking control functions, analog control functions, and color-graphic video display operator interfaces including alarm and event logging. The generic term used herein shall be Telemetry.

The Contractor shall provide all necessary labor and equipment to test the control strategies per Section 17030.

B. LOWER GREASEWOOD SYSTEM:

Refer to the General Notes on Drawing I-001 for a brief overview of the water system tank level control. The Filter PLC controls the wells and water treatment, refer to Sections 11825 and 11830.

C. GANADO SYSTEM:

Refer to the General Notes on Drawing I-002 for a brief overview of the water system Ganado South tank level control. The Telemetry PLCs control tank level.

1.02 QUALITY ASSURANCE

B. TELEMETRY PROGRAMMING WORKSHOP:

A one day coordination meeting in Fort Defiance, AZ shall be scheduled before submittal of the Telemetry system programming. The meeting shall include the Construction Manager, the Engineer, the NTUA telemetry programmer, and the Telemetry System programmer. The Telemetry System programmer shall provide the agenda. Topics to include:

1. Touchscreen graphics, setpoint presentations. NTUA to provide examples.
2. PLC programming language, functions, and approach. NTUA to provide examples.
3. Radio telemetry communications register assignments, analog signal resolution and ranges, communications polling and timeout settings. NTUA to provide examples.
4. SCADA network communications Treatment Plant PLC network addressing, register assignments, analog signal resolution and ranges. NTUA to provide direction.
5. Expectations/needs of NTUA telemetry programmer for existing PLCs, as specified in Paragraph 17000-1.01 B. Detail by site, process, and network communications.
6. Confirmation of use of Schneider Unity Pro version 11 and Magellis Vijeo Designer version 6.2 software for programming.

C. FILTER PROGRAMMING WORKSHOP:

A one-half day coordination meeting in Fort Defiance, AZ shall be scheduled before submittal of the Spec. 11830-1.04 B filter control system programming. The meeting shall include the Construction Manager, the Engineer, the NTUA telemetry programmer, the Telemetry System programmer, and the Filter PLC programmer. The Filter PLC programmer shall provide the agenda, and coordinate program, operator interface, and control signals with the Telemetry System Programmer.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

A. TELEMETRY SYSTEM PROGRAMMING:

Submit the following prior to the programming coordination meeting per Spec. 17900-1.01 B and after review of Shop Drawing submittal.

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number

Control Specifications
17900-2

in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. A copy of this specification Section, with addendum updates that apply to the equipment in this section, indicate requested deviations from specification requirements. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. A copy of the contract document Process and Instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
4. A copy of the contract document Instrumentation Drawings relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required". *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*
5. Annotated PLC program printout hardcopy or in .pdf format.
6. List of Radio telemetry communications register assignments, analog signal resolution and ranges for each PLC, including existing PLCs to be programmed by NTUA.
7. List of SCADA network communications Treatment Plant PLC register assignments, analog signal resolution and ranges, and network addressing.
8. Color prints of operator interface touchscreen screens.

B. TELEMETRY SYSTEM TRAINING:

Control Specifications
17900-3

Contract 2
Bid Issue

Submit agenda 30 days prior to training specified in part 3 of this Section.

PART 2--PRODUCTS

2.01 PRODUCT DATA

The following product data shall be provided in accordance with Section 01300:

1. Copies of the as-programmed/ready for field testing PLC and operator interface touchscreen re-loadable programs on CD-ROM disks. Provide two copies, labeled with Owner name, project name, "Preliminary PLC and Operator Interface programs".
2. Training certification Form 11000-B as specified in part 3 of this Section.
3. Copies of the as-built final PLC and operator interface touchscreen re-loadable programs on CD-ROM disks. Provide three copies, labeled with Owner name, project name, "As-Built PLC and Operator Interface programs". One additional copy shall be placed each telemetry panel by the Contractor.

PART 3--EXECUTION

3.01 INTERLOCKS

Interlocks (I) shutdown and prevent equipment from operating:

1. Hardwired interlocks are effective whether the PLC system is in operation or not, and in hand and auto modes unless noted.
2. Software interlocks are provided by the PLC, and are usually only effective when the equipment is operating in auto mode unless noted.

The following describe general interlock features for all systems:

I1 – MOTOR PROTECTION

Equipment motor protection includes overload and/or VFD or RVSS fault or Motor Protection Relay alarm, hardwired only. Manual reset required at the starter, VFD, or RVSS.

3.02 GENERAL CONTROL STRATEGIES

Control Strategies (CS) define common equipment operations performed by the PLC and displayed by the Telemetry system. Hardwired control strategies are effective for equipment control whether the PLC system is in operation or not, and in hand and auto modes unless noted.

Control Strategies unique to each process system are defined beginning in paragraph 3.10 below. The following describe general control features for all systems:

CS1 - EQUIPMENT RUN TIME TOTALIZATION

Equipment run time totalization will be calculated and maintained by the PLC based on equipment run status. Totalize in hours from 0 to 9999.

TELEMETRY: Display total in hours.

CS2 - FLOW TOTALIZATION

Flow totalization will be calculated and maintained by the PLC whenever flow signals exceeds 2-1/2 % of full scale value and analog signal has not failed (refer to CS10). Totalize in gallons times 1,000 (kGal) or gallons times 1,000,000 (MGal) as shown on the P&ID. Totalize from 0 to 9999.

TELEMETRY: Display total in kGal or MGal as shown on P&ID.

Previous 24 hour day flow totalization will also be calculated and maintained by the PLC.

TELEMETRY: Summary display of previous day totals in kGal or MGal as shown on P&ID.

CS3 - PROCESS ALARM(S), SELF-RESETTING

Process alarms as shown on the P&ID will be determined and maintained by the PLC:

1. Low-Low Alarm: Point value is equal to or less than a predetermined alarm value.
2. Low Alarm: Point value is equal to or less than a predetermined alarm value.
3. High Alarm: Point value is equal to or greater than a predetermined alarm value.
4. High-High Alarm: Point value is equal to or greater than a predetermined alarm value.

An analog point which is in alarm status will not be changed to normal status until the point value changes by the predetermined deadband value for the point, initial setting of 5% of full scale range. PLC alarm setpoints are provided in paragraph 17200-3.03 instrument index.

TELEMETRY: Display alarms. Display active and cleared-but-unacknowledged alarms in the alarm summary.

CS7 - PROCESS ALARM(S), MANUAL RESET FROM TELEMETRY REQUIRED

Process alarms as shown on the P&ID will be determined and maintained by the PLC:

1. Low-Low Alarm: Point value is equal to or less than a predetermined alarm value.
2. Low Alarm: Point value is equal to or less than a predetermined alarm value.
3. High Alarm: Point value is equal to or greater than a predetermined alarm value.
4. High-High Alarm: Point value is equal to or greater than a predetermined alarm value.

An analog point which is in alarm status will not be changed to normal status until reset by the Telemetry Operator and the point value changes by the predetermined deadband value for the point, initial setting of 5% of full scale range. PLC alarm setpoints are provided in paragraph 17900-3.03.

TELEMETRY: Display alarms. Display active and cleared-but-unacknowledged alarms in the alarm summary. Telemetry allows Operator reset of alarms.

CS9 - DISCRETE POINT STATUS

The status of each discrete input point will be maintained in the PLC.

The status of each logical discrete point will also be maintained in the PLC. Logical points are points which depend upon the status of one or several discrete input points.

TELEMETRY: Display the status of all discrete and logical discrete status points.

CS10 - ANALOG POINT STATUS

Analog input points will be checked by the PLC for the following status conditions:

Failed: Point value is less than or greater than the specified value range

typically less than 3.6 milliamps (mA) and greater than 21.6 mA. Where the PLC module cannot read outside the 4-20 mA range, use discrete alarm bits available from the module or PLC status function block.

TELEMETRY: Display alarm. Display active and cleared-but-unacknowledged alarm in the alarm summary

CS11 - GENERAL EQUIPMENT DISCREPANCY

The failure of driven equipment to respond will be monitored by the Telemetry system. Equipment will be considered to be in discrepancy under the following conditions:

1. The equipment is in AUTO and the Telemetry system attempts to operate the equipment and it does not respond within a defined time period, typically 15 seconds.
2. The equipment is in AUTO and running and for whatever reason other than the Telemetry system requesting the equipment to "STOP," the equipment stops.

CS12 - TELEMETRY INPUTS AND OUTPUTS STATUS

The PLC will monitor status of each individual input, output, and communication module, and all processor statuses available.

TELEMETRY: Display racks with status for each module, using descriptive terms for alarms. Display processor battery status. Display alarms. Display active and cleared-but-unacknowledged alarm in the alarm summary

CS16 - TREND PLOTS

TELEMETRY workstations will graphically plot trends of all process variables (pressure, flow, temperature, level, analytical, electrical kW and Power Factor) in real-time and from historical data. The plant operator will be able to select the plotting interval, within the limits of the actual data collection. Four trends per display view will be possible.

In addition to the plotted data, a trend will include:

1. Time
2. Date
3. Tag number
4. Plotting interval
5. Time at start
6. Time at latest value.
7. Range and units

CS17 – COLOR NOTATION FOR DYNAMIC OBJECTS ON CONTROL GRAPHIC DISPLAY SCREENS

All dynamic objects on control graphic display screens will be provided with multiple-color display with high performance graphics to identify status as tabulated below:

Equipment	Status	Required color
Motor	Running	Dark Grey
Motor	Ready or Off	Light Grey (Neutral)
Valve	Opened position	Light Grey
Valve	Closed position	Dark Grey
All	Power on	Light Grey
All	Abnormal condition	Amber (Yellow)
All	Advisory, Control Mode	Blue

CS18 - DIGITAL ALARM SYSTEM

Alarms as shown on the P&ID will be determined and maintained by the PLC, whether or not specific control strategies are provided. Digital inputs can be from field instruments (level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).

TELEMETRY: Display alarms. Display active and cleared-but-unacknowledged alarms in the alarm summary.

CS19 - DATA ARCHIVING HISTORIAN AND HISTORICAL FUNCTIONS

None. These are provided by the separate Regional SCADA System.

CS20 - DIGITAL STATUS SYSTEM

All digital input status will be displayed on Telemetry screens as required by the reference drawings and specifications regardless whether or not specific control strategies are provided. Each digital input will be shown in its appropriate process screen and/or equipment status screen. Digital inputs can be originated from field instruments (motorized actuators, HVAC related air handling units, power management related contact inputs, level switches, pressure switches, etc.), local control panels (relay outputs, alarm module outputs, switches), and packaged systems (designated terminals with packaged units).

CS24 - DATA TRANSFER REQUIREMENTS BETWEEN THE PLCs AND THE TELEMETRY SYSTEM

Digital inputs and analog inputs to the Telemetry system and the software logic generated alarms will be displayed or annunciated at the Telemetry touchscreen as specified on the Drawings and in this Section.

The Telemetry system will generate separate alarms if communication is lost with any PLC.

Data displayed on the Telemetry installed on this project will be available to the existing Regional SCADA System.

For the Lower Greasewood Telemetry System, the Regional SCADA System RTU is located at the Lower Greasewood Tank.

For the Ganado Telemetry System, the Regional SCADA System RTU is located at the Ganado Tank.

CS51 – ALTERNATION - SOFTWARE

Equipment run-time equalization by alternating the lead/follow/2nd follow/etc. assignment of two or more pumps, PLC. Alternation occurs when all of the pumps in that group stop.

3.03 CONTROL STRATEGY –LOWER GREASEWOOD TANK LEVEL

A. P&ID: P-100, I-001

B. GENERAL DESCRIPTION:

The existing Lower Greasewood Tank level is maintained by existing Well 1, Well 2, and Well 3 using the Treatment Plant Telemetry PLC and the System Interconnection Valve from Ganado Pressure Zone 7. A common treatment plant and chlorination system is provided for all three wells.

C. CONTROL STRATEGY OVERVIEW:

The Treatment Plant Telemetry PLC periodically requests the tank level signal from the Lower Greasewood Tank Telemetry PLC. The Treatment Plant Telemetry PLC sends the level signal to the Filter PLC. Start/stop setpoints for each Well are Operator adjustable at the Filter PLC Touchscreen.

The Filter PLC initiates one or more discrete Start/Stop signals to the Treatment Plant Telemetry PLC including:

1. Start/Stop Well 1 based on tank level and setpoints
2. Start/Stop Well 2 based on tank level and setpoints
3. Start/Stop Well 3 based on tank level and setpoints
4. Open System Interconnection Valve based on Operator Touchscreen selection

The Treatment Plant Telemetry PLC initiates the Well Start/Stop signals based on the Lower Greasewood Tank level. The Well PLCs send Well status and well flowrates to the Treatment Plant Telemetry PLC.

The Filter PLC confirms well operation by monitoring filter flow. The Filter PLC will receive well status and flowrate data from the Wells via the Treatment Plant Telemetry PLC, and will send filtered flow totalization data to the Treatment Plant Telemetry PLC.

In the event that wells and filtration equipment capacity cannot maintain Lower Greasewood Tank level due to high demands or if filtration equipment or wells are not operational, the Treatment Plant Telemetry PLC opens the System Interconnection Valve based on a discrete Open System Interconnection Valve signal from the Filter PLC and modulates the System Interconnection Valve based on internal flow set points. The Treatment Plant Telemetry PLC sends System Interconnection valve open/closed status and flow rate to the Regional SCADA RTU at the Treatment Plant.

The Treatment Plant Telemetry PLC forwards Well status and flowrates, System Interconnection valve open/closed status and flow rate, Well Start/Stop signals, Filter flow and alarms, and Lower Greasewood Tank Level to SCADA.

D. LOCAL CONTROL:

1. Field - Tank:

Reservoir Mechanical Level indication

2. Field - Well:

Well Discharge Pressure indication

Well Discharge Flow indication

3. Well MCC:

HAND-OFF-AUTO selector switch inside RVSS Panel

4. Interlocks per 17900-3.01:

II – MOTOR PROTECTION

E. REMOTE OR AUTOMATIC CONTROL:

1. Control Strategy, per above and including:

CS1 - EQUIPMENT RUN TIME TOTALIZATION

CS2 - FLOW TOTALIZATION

CS11 - GENERAL EQUIPMENT DISCREPANCY

CS16 - TREND PLOTS

2. Software Interlocks per 17900-3.01: None.

3. TELEMETRY - TANK:

Tank Level indication

Touchscreen indication of Telemetry from/to the Wells

4. TELEMETRY - WELL:

RUN status

Soft Start FAULT alarm

Soft Start HIGH TEMPERATURE alarm

Soft Start OVERCURRENT alarm

AUTO status

Pump Motor Amps indication

Well Level indication

Flow and Total indication

Control Specifications

17900-11

Well HMI HAND-OFF-AUTO, Hand status
Well HMI HAND-OFF-AUTO, Off status
Well HMI HAND-OFF-AUTO, Auto status
Telemetry Communications Health

5. TELEMETRY – WTP PLC

START/STOP Well 1 signal
START/STOP Well 2 signal
START/STOP Well 3 signal
System Interconnection valve (open/close) status and flow rate

6. TELEMETRY – FOR REGIONAL SCADA:

The Telemetry signals above and the Water Treatment Telemetry signals below are all available at the Treatment Plant Telemetry PLC for Ethernet access by the Regional SCADA RTU.

3.04 CONTROL STRATEGY – LOWER GREASEWOOD CHLORINATION

A. P&ID: P-100 through P-104, I-001

B. GENERAL DESCRIPTION:

The existing Lower Greasewood Tank level is maintained by existing Well 1, Well 2, and Well 3. A common chlorination system is provided for all of the wells at the Treatment Plant, replacing the individual well chlorinators.

C. CONTROL STRATEGY OVERVIEW:

The Treatment Plant Telemetry PLC periodically requests tank level indication from the Lower Greasewood Tank Telemetry PLC.

Start/stop setpoints for the chlorine booster pumps are associated with the well START/STOP signals.

Open/close control of chlorination solenoid valves is based on well run signal/status and flow meter reading. After the discrete Well Start/Stop signals are sent, well operation is confirmed by the signal from the wells and flowmeter. The Filter PLC opens the solenoid valves on the rotameter panels that correspond to the well(s) in operation.

Settings:

Well 1 running, valve 1 (treatment and residual) opens.

Well 2 running, valve 2 (treatment and residual) opens.

Well 3 running, valve 3 (treatment and residual) opens.

The Filter PLC does receive well status and flowrate data from the Wells via Ethernet connection established between Filter PLC and Treatment Plant Telemetry PLC.

Final effluent chlorine residual is monitored by an analyzer, which is wired to the Filter PLC. The Filter PLC sends a scaled word, integer, or real number signal to the Treatment Plant Telemetry PLC indicating final effluent chlorine residual. The Filter PLC may also be locally controlled to switch the three-way solenoid valve and temporarily monitor chlorine residual of filter effluent.

Chlortainer weight is monitored by the Filter PLC, which sends a scaled word, integer, or real number signal to the Treatment Plant Telemetry PLC indicating Chlortainer Scale Weight.

Chlorine Gas leakage is monitored by a leak detector, which is wired to the Filter PLC. In the event of a gas leak detection, the Filter PLC sends a discrete signal to the Treatment Plant Telemetry PLC indicating a gas leak alarm. A flashing alarm beacon at the entry to the building is activated.

The Filter PLC forwards via the Treatment Plant Telemetry PLC the final effluent chlorine residual, Chlortainer Scale weight to SCADA. The Filter PLC also forwards any Chlorine Gas leak alarm signals to SCADA.

D. LOCAL CONTROL:

1. Field:

Chlorine weight scale indication
Chlorine leak alarm beacon

2. MCC:

HAND-OFF-AUTO selector switch

3. Interlocks per 17900-3.01: None.

E. REMOTE OR AUTOMATIC CONTROL:

1. Control Strategy, per above and including:

CS1 - EQUIPMENT RUN TIME TOTALIZATION
CS2 - FLOW TOTALIZATION
CS11 - GENERAL EQUIPMENT DISCREPANCY

Control Specifications
17900-13

CS16 - TREND PLOTS

2. Software Interlocks per 17900-3.01: None.
3. TELEMETRY:

Chlortainer Scale weight
Chlorine Analyzer effluent reading
Chlorine Leak alarm

3.05 CONTROL STRATEGY – LOWER GREASEWOOD WATER TREATMENT

- A. P&ID: P-100 through P-104, I-001
- B. GENERAL DESCRIPTION:

The existing Lower Greasewood Tank level is maintained by existing Well 1, Well 2, and Well 3 using the Treatment Plant Telemetry PLC. A common treatment plant to remove iron and manganese and organic carbon is provided for all of the wells.

- C. CONTROL STRATEGY OVERVIEW:

The Treatment Plant Telemetry PLC periodically requests tank level indication from the Lower Greasewood Tank Telemetry PLC.

Start/stop control of treatment is based on well run signal and flow meter reading. Treatment system starts in accordance with well START/STOP signals. Well operation is confirmed by the signal from the flowmeter showing flow through the filtration system. The Filter PLC modulates the rate of flow control valve(s) to target flow set points that correspond to the well(s) in operation. The Filter PLC receives well status and flowrate data from the Wells and sends flow totalization data to Treatment Plant Telemetry PLC via Ethernet connection established between Filter PLC and Treatment Plant Telemetry PLC. The Filter System internally tracks flow totalization between each backwash cycle for purposes of backwash timing.

The Filter System also sends scaled word, integer, or real number signals to the Treatment Plant Telemetry PLC that includes the following:

1. Filter A flow
2. Filter B flow
3. Backwash Reclaim Tank Level

The Treatment Plant Telemetry PLC forwards Filter flow rates and Backwash Reclaim Tank Level to SCADA.

If the treatment system encounters a deleterious problem and must stop operation, it initiates the following discrete Filter System Failure signal to the Treatment Plant Telemetry PLC. The Treatment Plant Telemetry PLC forwards the Filter System Failure alarm to SCADA.

Treatment control strategy is defined in Sections 11825 and 11830. The Treatment Plant Telemetry PLC monitors treatment status and alarms as specified herein.

D. LOCAL CONTROL:

1. Field: None.
2. MCC: None.
3. Interlocks per 17900-3.01: None.

E. REMOTE OR AUTOMATIC CONTROL:

1. Control Strategy, per above and including:

CS1 - EQUIPMENT RUN TIME TOTALIZATION
CS2 - FLOW TOTALIZATION
CS11 - GENERAL EQUIPMENT DISCREPANCY
CS16 - TREND PLOTS

2. Software Interlocks per 17900-3.01: None.

3. TELEMETRY - TREATMENT:

Filter Vessel A Flow / Filter Vessel B Flow
Filter Vessel B Flow Filter System Failure alarm / Filter Vessel A Filter
System Failure alarm
Backwash Reclaim Tank Level indication

3.06 CONTROL STRATEGY – GANADO SOUTH TANK LEVEL

A. P&ID: I-002

B. GENERAL DESCRIPTION:

The existing Ganado South Tank level is maintained by existing booster pump station, wells and new Well N0. Well N0 has a chlorination system.

C. CONTROL STRATEGY OVERVIEW:

The Ganado Tank Telemetry PLC periodically requests via radio the status and alarm data, and sends the tank level signal to the existing Well Telemetry PLCs.

Control Specifications
17900-15

Contract 2
Bid Issue

The Ganado Tank Telemetry PLC also receives tank level from the Ganado South Tank. The Ganado Tank Telemetry PLC forwards this tank level signal to the Well N0 Telemetry PLC.

Start/stop setpoints for each Well are Operator adjustable at the Well Telemetry PLC Touchscreen. The start stop set points should match the Ganado South Booster Pump Station, field verify.

D. LOCAL CONTROL:

1. Field - Tank:

Reservoir Mechanical Level indication
2. Field - Well:

Well Discharge Pressure indication
Well Discharge Flow indication
3. Well MCC:

HAND-OFF-AUTO selector
4. Interlocks per 17900-3.01:

I1 – MOTOR PROTECTION

E. REMOTE OR AUTOMATIC CONTROL:

1. Control Strategy, per above and including:

CS1 - EQUIPMENT RUN TIME TOTALIZATION
CS2 - FLOW TOTALIZATION
CS11 - GENERAL EQUIPMENT DISCREPANCY
CS16 - TREND PLOTS
2. Software Interlocks per 17900-3.01: None.
3. TELEMETRY - TANK:

Tank Level indication
Touchscreen indication of Telemetry from the Wells
4. TELEMETRY - WELL:

RUN status

Soft Start FAULT alarm
Soft Start HIGH TEMPERATURE alarm
Soft Start OVERCURRENT alarm
AUTO status
Pump Motor Amps indication
Well Level indication
Flow and Total indication

5. TELEMETRY – FOR REGIONAL SCADA:

The above Telemetry signals are all available at the Well Telemetry PLC for Ethernet access by the Regional SCADA RTU.

3.07 TRAINING

A minimum of two sets of 2 hours of training on operations of the telemetry system from touchscreens shall be provided, conducted on one day. Training shall be certified on Form 11000-B specified in Section 01999. Training to include water system operations overview, touchscreen navigation, Filter status and alarms, well control to maintain tank level, and treatment of well flows.

****END OF SECTION****

THIS PAGE LEFT INTENTIONALLY BLANK