Contract Documents For Construction Of The Chichiltah-Vanderwagen Water Supply Project

The Navajo Nation

VOLUME 2
Technical Specifications

April 2024

** See Volume 1 for Contract Documents, Appendices, and Exhibits*

VOLUME 2

Technical Specifications

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1.2 CONTRACT DESCRIPTION

A. Work of the project consists of construction of 1.1 miles of 4" diameter waterline, 0.6 miles of 2" diameter PVC, site improvements for 5 existing water wells, one (1) 225,000-gallon welded steel water storage tank and chlorination building site, site piping, valves, electrical, and appurtenances.

B. Perform Work of Contract on a unit cost basis with Owner in accordance with Conditions of Contract.

1.3 SPECIAL CONSIDERATIONS

A. Contractor shall abide by all permit stipulations and requirements, including but not necessarily limited to Bureau of Indian Affairs (BIA) and Navajo Nation environmental and archaeological stipulations, utility pipeline encroachment agreements, McKinley County, BIA-NRO Department of Transportation road crossing permits, and Navajo Nation Water Code Administration permits, regardless of whether such permits are obtained by the Owner, Engineer or Contractor.

1. Navajo Nation's environmental and cultural stipulations for the pipeline is provided in Appendix C. Road permits, if obtained by the Owner or Engineer, are included in Appendix C. Contractor shall comply with all of these stipulations, terms and conditions. Said compliance shall be considered incidental to the cost of the project.

B. It is the Contractor's responsibility to apply for and obtain all permits required for the Work that have not already been obtained by the Owner or Engineer. No additional compensation will be provided for obtaining permits and all costs will be considered incidental to the

Project. It is anticipated the Contractor will need to obtain, at a minimum, a Low Threat General Permit from U.S. EPA for pipeline flushing on Navajo Lands, and/or an Individual Discharge Permit for pipeline flushing on non-Navajo Lands. Contractor is wholly responsible to determine what additional permits may be required.

C. Contractor is responsible for compliance, including notifying Owner, Engineer and utility companies prior to crossings. Contractor shall adhere to all requirements of the electrical power line crossing permits, if required, and any special notes provided in design drawings, including notification requirements.

D. Cultural Resources Requirements:

1. Contractor must be familiar with and abide by the cultural resource stipulations included in Appendix C of the Contract Documents.

2. Contractor must allow archaeologist and/or Owner's representative to have access to the project site for examination of cultural resources. Contractor must allow archaeologist and/or Owner's representative to halt work, as necessary, to examine cultural resources in spoils and/or trenches. Contractor may move equipment to another location while archaeologist completes his/her examination of cultural resources. Contractor shall not request additional compensation for any delays caused by archaeological examinations. However, such delays may be considered excused delays and not count toward Contractor's deadline for substantial completion, provided Contractor requests additional time within one (1) week of the delay.

3. Contractor is advised of the presence of designated "Culturally Sensitive Areas" in the project area, which are indicated on the Drawings. Contractor shall notify the Engineer at least 5 working days prior to any ground disturbing activity within 100 feet of any restricted area as designated on the Drawings to allow time for flagging to be erected and/or a permitted archaeological monitor to be scheduled on-site. Ground disturbing activities include equipment mobilization/ storage, vehicular traffic and vegetation removal. The archaeological flagging and monitoring will be provided by the Owner at no cost to the Contractor. Note that temporary construction easements are truncated near these areas and the Contractor shall not encroach beyond established easements. No work shall be performed within 100 feet of any restricted area unless barricades and/or flags are up.

   a. Sites indicated on the Drawings as requiring flagging will require temporary flagging to be installed prior to any ground disturbing activities. The flagging will be installed by the Owner's archaeologist and/or surveyor and must remain in place during the life of the project. No vehicular traffic, personnel or construction activities shall be allowed past the flagging.

      1) After flagging has been installed, the Contractor is responsible for erecting orange construction fencing along ROW.

   b. In addition to the flagging, certain sites indicated on the Drawings will also require archaeological monitoring. Contractor shall not perform any ground disturbing activities within 100 ft of these areas at any time without the Owner's archaeologist physically present at the site.

4. Archaeological Discovery in the Presence or Absence of Archaeological Monitoring: During surface-disturbance actions within the vicinity of the culturally sensitive areas, if an any previously unidentified historic or prehistoric cultural

resources are discovered, then all work within 100 feet of the discovery will be suspended and the discovery promptly reported to the Engineer and the appropriate agency—Navajo Nation Historic Preservation Department (for Navajo lands). If the discovery is evaluated as being significant, treatment of the discovery may be required prior to allowing the project to proceed. Further damage to significant cultural resources will not be allowed until any required treatment is completed.

E. Biological Resources Requirements:

1. The Contractor shall notify the Engineer at least 10 workdays prior to commencing ground disturbing activities, and is responsible to coordinate scheduling with the wildlife biologist to perform the pre-construction surveys.
2. The Owner will provide, at no cost to the Contractor, a qualified wildlife biologist to conduct pre-construction survey(s) for migratory bird nests if work is to be performed during the active bird breeding seasons identified in Appendix C.
    a. Navajo Lands: March 1–August 15 requiring field surveys.
3. In the event an active bird nest or species habitat is discovered, the Owner's wildlife biologist will flag the required buffer zone around the nest. The buffer zone is typically a 165 ft radius around the nest.
4. The Owner's wildlife biologist will monitor the nest and notify the Contractor when work may commence within the buffer zone.
5. The Contractor shall not encroach within the flagged buffer zone until notified by the Owner's wildlife biologist.
6. The Owner will provide, at no cost to the Contractor, a qualified wildlife biologist to conduct pre-construction survey(s), avoidance and mitigation (including transplanting) measures for species identified in Appendix C.
    a. The Contractor's coordination with the Owner-provided biologist to schedule this work with respect to the Contractor's work is incidental.

F. At all wash crossings, the contractor will adhere to all Clean Water Act Section 404 General Conditions, Regional Conditions, and Conditional Section 401 Certification for all approved Nationwide Permits, as well as any Special Conditions that may be determined by the U.S. Army Corps of Engineers.

G. Storm Water Pollution Prevention Plan (SWPPP): Contractor shall be wholly responsible for the preparation and implementation of the SWPPP, and any erosion / sediment practices described therein. Such implementation shall include, but not necessarily be limited to, obtaining any required National Pollution Discharge Elimination System (NPDES) permit(s) and submitting the contractor's Notice of Intent (NOI) to competent agencies prior to construction, implementation and maintenance of all Best Management Practices (BMPs) specified in the SWPPP, inspection of entire project site as specified in the SWPPP, maintaining and providing all documentation required in the SWPPP (including keeping up-to-date project maps and as-builts before, during and after construction), filing of a Notice of Termination (NOT) upon completion of the project and removal of BMPs upon the required time interval after completion of the project.

H. No reports or drawings relating to Hazardous Environmental Conditions at the site are known to the Owner.

I. Exhibit B to the Contract Documents contains geotechnical reports, *Subsurface Exploration and Geotechnical Engineering Report, Chichiltah-Vanderwagen CWS Project, Chichiltah, NM, Dated April 12th, 2024, by Inberg Miller Engineers*, which include in-situ soil moisture measurements, and Standard Proctor test results (including optimal moisture content) from test holes at various locations within the project area. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions adjacent to the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions adjacent to the test holes. Moreover, in-situ moisture content varies with time, and the Owner makes no representation that the in-situ moisture at the time the measurements were taken will be the same at the time of construction. The results of the Proctor and in-site moisture tests are provided for Contractor's convenience only; they are not considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his/ her bid.

1. The Contractor is entitled, however, to rely upon the soil bearing capacity and other geotechnical design criteria for the construction of tank and chlorinator building foundations. Moreover, the Contractor shall be required to follow the recommendations of the geotechnical report and the foundation design shown in the drawings for the chlorinator building foundation design, sub-foundation, and over excavation. The Contractor shall also be required to follow the recommendations of the geotechnical report for the tank foundation design, sub-foundation, and over excavation.

J. Contractor is advised that if there is subsurface rock present requiring specialized equipment to remove, as defined in Section 31 23 18 - Rock Removal, Contractor shall notify Engineer prior to commencement of rock removal work each time such rock is encountered, and await approval from Engineer before proceeding. Furthermore, the Contractor and Engineer must agree on rock quantity at the end of each work day, and both parties must sign off on the quantity of rock in the corresponding Owner's Resident Project Representative (RPR) daily field report, and Contractor will be compensated for such work per Article 1.2.A of Section 31 23 18, which establishes the basis of measurement and payment for trench rock removal.

1. Data in Exhibit C - Soil and Rock Potholing Information identifies the results of the 'potholing' that was performed at various locations along the waterline alignment. Contractor is advised that test potholes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. The results of the potholing are provided for Contractor's convenience only; they are <u>not</u> considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his/ her bid. Contractor shall not make any claims due to differing sub-surface conditions based on the information provided in Exhibit C.

2. Excavated rock may be disposed of within the ROW as long as the conditions stipulated in Section 31 23 17 – Trenching, Article 3.8, are met.

K. Contractor is solely responsible for providing all water for the construction of the project and no guarantees are made by the Owner or Engineer as to the availability of any particular water sources. All costs associated with purchase, permits, hauling, etc. for construction water shall be considered incidental. For informational purposes only,

previous phases of the project, the contractor was able to obtain water from the City of Gallup.

L. Contractor may assume for bidding purposes, that the potable water supply needed for filling, flushing, hydrostatic testing, and disinfection will be provided by one or more of the groundwater wells and power will be available at the well site and tank site.

M. The contractor is advised that a Water Import Permit is required for any construction water brought onto the Navajo Nation. The water import permit can be acquired from the Navajo Nation Water Code Administration. The import permit fee is a one-time fee.

N. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Water Code Administration for more information.

O. Contractor may use the flush valves designed in the proposed pipeline, as well as tank floor drains, to flush water out of the system. Flushed water may be disposed of in the natural waterways adjacent to the flush valves and drains, provided the rate of flushing does not damage the surrounding environment (i.e. by flooding, erosion, etc.). Do not flush water from designated flush valves prior to installing riprap at the flush valve outlets. Water chlorinated to levels above those normally associated with drinking water shall be neutralized prior to discharge.

1. Contractor shall obtain a Low Threat General Permit from U.S. EPA for pipeline flushing on Navajo Lands, and/or an Individual Discharge Permit for pipeline flushing on non-Navajo Lands from U.S. EPA, as required, and shall abide by all stipulations of said permits.

P. All hydrostatic pressure tests must be witnessed by NTUA personnel. Contractor is responsible for coordination of testing schedule with NTUA to allow representatives to be present.

Q. NTUA will not be the owner's RPR for the project; however, NTUA will be on the job site periodically to inspect work.

R. Contractor is responsible for coordination with NTUA of final project inspection by NTUA personnel prior to NTUA acceptance and the issuance of the Affidavit of Punch List Completion of project to NTUA. NTUA typically requires 21 days notice prior to final inspection. NTUA requires that all bacteriological samples be obtained with passing results within 30 days or less prior to system issuance of Affidavit of Punch List Completion. Any bacteriological tests performed more than 30 days prior to final acceptance and signature of the Affidavit of Punch List Completion by NTUA shall not be considered valid and shall be re-tested at no additional cost to the Owner.

S. No dedicated borrow area for fill material has been pre-determined for this project. Material may be borrowed from within the designated ROW, provided all conditions set forth in the specifications are met

T. Contractor is advised that compaction requirements shall be strictly enforced. In the event that the contractor is unable to meet compaction requirements for pipe embedment using select material, the Contractor shall have the option to use soil cement at no additional cost to the Owner.

U. Contractor is advised that the trench widths shown in the Drawings are minimum widths only. In the event that the Contractor is unable to meet pipe embedment and compaction specifications using the minimum trench width and needs to increase trench width in order to meet these specifications, such increase in trench width shall be provided at no additional cost to the Owner.

V. Contractor is advised that pipeline line and grade specifications will be strictly enforced. See Section 33 11 00 of the Technical Specifications for horizontal and vertical pipeline and grade.

W. Contractor is advised that a 30' wide permanent right-of-way (ROW) easement is established along the proposed pipeline alignment, 15' to each side of the centerline. The Contractor must limit all construction activities within available established easement.

1. Contractor shall not encroach beyond the established workspace.
2. All pipe, valves and other appurtenances must remain within the permanent ROW.
3. Contractor is permitted to use any area within the approved ROW for staging and storage, provided such use does not disturb other land users or areas outside the ROW and that the staging areas are restored to their original condition prior to final completion.
    a. Contractor is wholly responsible for location, set-up, security, and any required temporary utilities associated with staging and storage areas.
    b. All staging and storage areas within the project area must be approved in advance by the Owner.
4. All areas disturbed during construction shall be reclaimed in accordance with the Contract Documents, regardless of whether they are part of the permanent ROW.

X. At fence crossings, where the contractor removes a fence, the contractor shall restore fences to original condition or better , and shall install 10-ft wide lockable 'rancher-style' gates with H-braces on both sides within pipeline ROW at all fence crossings. Each post shall be embedded in 3,000 psi concrete 36-inch deep, 12-inch diameter. Attach wire to the H-braces prior to cutting the fence to prevent slacking of wire. Contract shall repair all gates and fences in a timely manner to prevent livestock ingress / egress.

Y. Restore all open-cut driving surfaces, including parking lots, roads and driveways, to original condition or better, including replacement of base course, gravel or pavement as needed. Dirt roads and driveways shall be restored with compacted backfill as indicated in the drawings and specifications, plus surface material as specified. All restoration work for which no bid item is given shall be considered incidental.

Z. Contractor is responsible for providing schedule and plans with locations for lane and shoulder closures to the Engineer, McKinley County, New Mexico Department of Transportation (NMDOT), and BIA-NRO Department of Transportation prior to starting work. Contractor shall obtain any required supplemental permits from the relevant agencies.

AA. Excess dirt from cutting may be disposed of on-site, provided the finished grade and compaction meet specifications and are approved by the Engineer.

BB. For the present Project, Bidding Documents in electronic media format are furnished to bidding contractors for the sole purpose of preparing bids, and not for construction. The

selected construction Contractor shall not rely on files provided in electronic media format for construction but rather hard copies of such data provided by the Engineer or Owner upon award of the Contract.

CC. Prior to beginning construction activities, the Contractor will furnish pre-construction full-coverage photo or video documentation of the entire construction site per requirements set forth in Section 33 11 00 of the Technical Specifications.

DD. Drawings in CAD format related to earthwork required at the sites are available from Souder, Miller & Associates at www.soudermiller.com. Any Bidder interested in obtaining access to the files must complete an 'Electronic Data File Transfer and Sharing Agreement' and submit to the office of the Engineer, Souder, Miller and Associates, attention Wacey Jodie, Project Manager Assistant, at wacey.jodie@soudermiller.com. Upon submittal of the attached form, the Bidder will receive instructions on how to access the files.

EE. Upon request, CAD files for the plan and profile sheets will be made available to the winning Contractor after Notice of Award. However, neither the Owner nor Engineer shall assume any liability for their use, nor shall use of any electronic files relieve the Contractor of his/her responsibility to meet the conditions of the Contract Documents, including the published Drawings. Contractor must submit an Electronic Data File Transfer and Sharing Agreement to the Engineer prior to receiving CAD files.

FF. In the event that a Navajo Nation Forestry Department (NNFD) tree cutting permit becomes required, any fees directly charged by NNFD may be covered under the testing allowance.

GG. The plan and profile sheets show horizontal angles with DI ell(s) called out. The contractor is responsible for installing the specified fittings at each location. In addition to the specified fitting(s), use joint deflection to achieve the specified horizontal angle. If a location is shown without specifying a fitting, use joint deflection to achieve the horizontal angle.

HH. For PVC and Ductile Iron pipelines on both the mainline and site piping, Contractor has the option of using thrust blocking, joint restraint systems (bell restraint harnesses and mechanical joint restraints), or a combination to mitigate the movement of valves and fittings at all locations indicated on DT-11. Carrier pipe installed inside of casings shall be restrained with joint restraint systems to allow for future removal and replacement.

II. Contractor shall provide two (2) copies of the safety plan to the Engineer prior to commencing construction (one shall be for Owner's files). Neither the Owner nor Engineer shall approve or comment on the Contractor's safety plan, nor shall the Owner or Engineer assume any responsibility for assuring compliance on the part of personnel on site, other than Owner's or Engineer's employees and representatives, as stipulated in Paragraph 7.12.D of the Standard General Conditions and Navajo Nation Supplemental Conditions (EJCDC C-700 NN).

JJ. All materials must comply with Buy America Domestic Procurement Preference [Pub. L. No. 117-58, §§ 70901-52]. As required by Section 70914 of the Bipartisan Infrastructure Law (also known as the Infrastructure Investment and Jobs Act), P.L. 117-58, on or after May 14, 2022, none of the funds under a federal award that are part of Federal financial assistance program for infrastructure may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States, unless subject to an approved waiver. The requirements of this section

must be included in all subawards, including all contracts and purchase orders for work or products under this program.

For further information on the Buy America preference, please visit www.doi.gov/grants/BuyAmerica. Additional information can also be found at the White House Made in America Office website: www.whitehouse.gov/omb/management/made-in-america/.

KK. The Contractor shall complete construction staking and as-built survey of the actual placement of work under the direction of a Licensed Professional Surveyor.

1. Construction staking shall establish easements, centerline alignment, PI locations, grading, elevations, lines, slope staking, and levels and certify elevations and locations of the Work conforming with the Contract Documents. Construction staking shall denote the ROW and/or limits of construction. Construction staking is incidental to work.
2. As-built survey to include elevations at top of pipe, northing and easting of top of pipeline or new utility at intervals not to exceed 100 feet and at all fittings, valves, vaults, discharge structures, tracer wire test stations, electronic marker devices, building corners, concrete pad corners, electrical systems, pipe transitions and other appurtenances as well as finished grade elevations at each location cited above, and at the top of flange or top of nut (specify on drawing point description) of all hydrants.
3. All survey information and electronic CAD drawings shall be tied to established survey control as provided on plan set survey control sheet.
4. Contractor shall present the credentials of the Surveyor for the project at the Preconstruction Conference for review and approval by the Engineer.
5. The Surveyor shall establish additional benchmarks and as-built information in accordance with the National Society of Professional Surveyor (NSPS) Model Standards and any applicable State Licensing Board requirements.

1.4 WORK BY OWNER

A. Owner-provided Archaeologist:

1. If applicable, the Owner shall provide the services of a qualified archaeologist at no cost to the Contractor. The Owner's archaeologist will provide site flagging and monitoring at "Culturally Sensitive Areas" as designated on the Drawings. Refer to foregoing section for Contractor's responsibilities in these areas.

B. Owner-provided Wildlife Biologist:

1. The Owner shall provide the services of a qualified wildlife biologist at no cost to the Contractor. The Owner's wildlife biologist will perform pre-construction bird nest survey(s), delineate the required avoidance buffer around any discovered nests, and monitor any active nests until the nests are vacated. Refer to foregoing section for Contractor's responsibilities in these areas.

1.5 CONTRACTOR'S USE OF PREMISES

A. No work shall be done before 7:00 A.M. or after 7:00 P.M., local time on a working day, on Sundays, or on legal holidays, except as necessary for the proper care and protection of

work already performed, or during emergencies. Any deviations from this specification shall require prior written approval by the Owner.

B. The Contractor shall make every effort to minimize noise caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise.

C. The Contractor shall restrict his operations as nearly as possible to the immediate site. Unnecessary cutting of vegetation adjacent to the site is prohibited. Every effort shall be made to minimize erosion during and after construction and the site shall be returned to its original condition, except where improvements are indicated or required.

D. The Contractor shall take affirmative action to prevent the misuse of the natural environment, wasting of natural resources, or destruction of natural values.

E. The Contractor shall conform to all requirements set forth in the latest edition of the "New Mexico Standard Specifications for Public Works Construction" with latest revision, and "Occupational Safety and Health Administration Regulations" for trenching, shoring and excavation.

1.6 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

B. The Contractor shall furnish all materials, labor, plant and equipment necessary to complete the contract work as called for by the Technical Specifications and as indicated on the Drawings. Material and work, either expressed or implied, necessary for the satisfactory completion of the contract work shall be considered an integral part thereof.

C. All standards incorporated herein by reference shall be the latest edition, unless otherwise specified. The abbreviations and applicable standards are described below:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
ANSI	American National Standards Institute, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CID	Construction Industries Division of the NM Regulation and Licensing Department
EJCDC	Engineers Joint Contract Documents Committee
EPA	Environmental Protection Agency
ISO	International Organization for Standardization
MSJC	Masonry Standards Joint Committee
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators
NFPA	National Fire Protection Agency

NMDOT	New Mexico Department of Transportation
NMED	New Mexico Department of Environment
NNOLR	Navajo Nation Office of Labor Relations
NTUA	Navajo Tribal Utility Authority
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coatings
IBC	International Building Code

1.7 MINIMUM WAGE RATE DETERMINATION

A. The Navajo Nation prevailing wage rates will apply to this project. The wage rate determination provided by the Navajo Office of Labor Relations (NOLR) is provided in Appendix B to the Contract Documents. It is wholly the responsibility of the Contractor to inform him/herself of and abide by all regulations and requirements set forth by the NOLR.

B. The Federal Davis-Bacon Act and the New Mexico Public Works Minimum Wage Act do not apply to the present project.

1.8 TESTING AND INSPECTION ALLOWANCES

A. Testing Allowance: The bid schedule includes a predetermined sum to cover the cost of testing and inspection services as required in the Contract Documents.

B. Costs Included in Allowance: Fees charged by testing firm performing the testing, including field and laboratory costs for compaction, and concrete testing only.

C. Costs Not Included in Allowance:

1. Incidental labor and facilities required to assist testing or inspection firm, such as preparation of test pits, surface preparation, provision of safe access for testing personnel, and other work performed by the Contractor to facilitate testing.
2. Work performed by the testing laboratory that is not part of actual testing.
3. Cost of disinfection of waterlines, chlorine tests, or bacteriological tests.
4. Costs of hydrostatic pressure testing or testing of material welds as called for in the Contract Documents.
5. Costs of tank weld testing.
6. Costs of steel piping weld testing.
7. Costs of failed tests as determined by Engineer.
8. Any other tests not specifically authorized in advance by the Engineer.

D. Costs will be drawn from testing allowance and paid based on invoice(s) submitted to Contractor by testing or inspection firm(s).

1.9 SCHEDULE OF VALUES

A. Submit schedule on EJCDC Form C-620, or on other form provided by Engineer. Contractor's standard form or electronic media printout will be considered.

B. Base structure of Schedule of Values on Bid Schedule with identical item numbering, quantities, and values.

C. Submit Schedule of Values in duplicate at least 15 days prior to first Progress Meeting.

1.10 APPLICATIONS FOR PAYMENT

A. Application for Payment is synonymous with Partial Payment Estimate.

B. Submit copies of each application on the Partial Payment Estimate form provided in the Contract Documents, together with updated Schedule of Values identifying fully the list of items in the Application for Payment.

C. The Application for Payment form shall be submitted to the Engineer and RPR electronically 15 days prior to the monthly progress meeting electronically as an Excel spreadsheet. Submit up-to-date revisions of the following documents every month with Application for Payment. Application for Payment will not be processed without these updated documents.

1. Record Drawings
2. Construction Schedule, including overall project schedule and look-ahead schedule
3. All relevant documentation of testing performed during the pay period, such as concrete testing, compaction testing, weld x-rays, holiday and other coating testing, and any other testing specified in the Contract Documents
4. Any Stored Material Invoices

D. Payment Period: Monthly

1.11 CHANGE PROCEDURES

A. All Change Orders shall be prepared on the form provided in these Contract Documents.

B. Unit Price Change Order: For pre-determined unit prices and quantities, Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work not pre-determined, refer to Article 11 - Change of Contract Price; Change of Contract Times, of the Standard General Conditions (EJCDC C-700 NN Standard General Conditions and Navajo Nation Supplemental Conditions of the Construction Contract).

1.12 UNIT PRICES

A. Engineer will take measurements and compute quantities accordingly. The Contractor will assist in taking of measurements and determination of work completed prior to preparation of corresponding Application for Payment.

1.13 ALTERNATES

A. Any alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.

B. Coordinate related Work and modify surrounding Work as required.

1.14 COORDINATION

A. Coordinate scheduling, submittals, and Work of various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Abide by Traffic Control Plan provided by Engineer and coordinate all lane closures and other traffic control activities with relevant agencies, as described above.

D. Contractor shall obtain permits from Mckinley County, NMDOT and BIA-NRO Department of Transportation prior to encroaching on any county or BIA roads, except for permits already obtained by the Owner or the Engineer.

1. Contractor shall notify the Mckinley County and the Engineer at least five (5) working days prior to working within the ROW of any county road.

E. Contractor shall coordinate with the Well Driller (Stewart Brothers Drilling Company), the Well Pump supplier (TP Pump/OTC of Albuquerque), and NTUA where indicated regarding the following, as further detailed in the Drawings and Technical Specifications. Note that as of the bidding of this project, well pitless adapters and downhole pumping equipment have not been installed by the well driller, but will be before or during the course of the Project.

1. Coordinate finished grade of site (incl. surfacing material) with installed height of pitless adaptor (by Well Driller) to ensure minimum 2.0 ft height of pitless flange below well cap above finished grade, and ensure drainage away from wellhead, as required on Drawings.
2. Verify compatibility of the Variable Frequency Drives (VFD) with installed submersible well pumps and motors with the well pump supplier and with NTUA (for conformance with NTUA standards) prior to or during the submittals review process.
3. Confirm acceptability of the water metering equipment manufacturer, model numbers and sizes with NTUA regarding current NTUA standards for metering equipment prior to or during the submittals review process.
4. Coordinate startup of all well pumping equipment with Well Driller, Pump Supplier, NTUA and Engineer.

F. Contractor is responsible for coordination with NTUA of final project inspection by NTUA personnel prior to NTUA acceptance and the issuance of the Affidavit of Punch List Completion of project to NTUA. NTUA typically requires 21 days notice prior to final inspection. NTUA requires that all bacteriological samples be obtained with passing results within 30 days or less prior to system issuance of Affidavit of Punch List Completion. Any bacteriological tests performed more than 30 days prior to final acceptance and signature of the Affidavit of Punch List Completion by NTUA shall not be considered valid and shall be re-tested at no additional cost to the Owner.

G. Contractor must notify the Engineer at least five (5) working days prior to performing work within 100 feet of any culturally or paleontologically sensitive area, as designated on the Drawings.

H. The Contractor is responsible for obtaining all applicable local, county, state and tribal building and development permits not previously obtained by Engineer or Owner. This includes permits from the Construction Industries Division of the Regulation and Licensing Department of the State of New Mexico, and any other regulatory agency having jurisdiction.

I. Contractor is responsible for timely scheduling of any pertinent inspections with local, county, state and tribal agencies with jurisdiction, and as required by the permits.

J. Coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.

K. All notices, demands, requests, instructions, approvals, proposals and claims must be in writing or email. Official email address(es) for notices will be designated during the pre-construction conference. Documents requiring written notice will be delineated at the pre-construction conference.

1. Any notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement or to the official contact email address designated at the pre-construction conference.

2. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Owner at the address stated on the signature page of the Agreement, and a copy shall be delivered to the Engineer at P.O. Box 519, Window Rock, AZ 86515.

3. Any such notice shall be deemed to have been given as of the time of actual delivery, in the case of mailing, when the same should have been received in due course of post, or in the case of telegrams, certified mail, or telephone facsimiles, at the time of actual receipt as the case may be.

L. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNAD re-vegetation requirements and stipulations, provided in Appendix C of the Contract Documents.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.15 SUSPENSION OF WORK

A. The Owner may order suspension of work due to seasonal or other conditions unsuitable for construction work.

B. Maintenance during suspension: Prior to suspension for any cause, the Contractor shall take necessary precautions to protect the work during the period of suspension from any factors which would contribute to its deterioration.

C. Time elapsed during suspension of the work shall not count as contract time. The Contractor shall make no claim for damages due to delay, additional mobilization charges, nor any additional costs that may be incurred solely due to suspension of work.

D. Requests for additional time to be added after the “contract completion date” due to delays or extra work shall be made to the Owner in writing by the Contractor within ten (10) days after the time of the occurrence of the delay or receipt of a Change Order for extra work. Such requests shall set forth the justification for the additional time.

E. Upon approval, the additional contract time shall then be in full force and effect, the same as though it were the original date for completion and will be shown as the completion date plus an amount of additional working days. Any time required to complete the work beyond the contract time or additional contract time will result in the assessment of

liquidated damages, as specified in the Contract Documents. Failure to make such requests within the above limits will be considered as a waiver on the part of the Contractor as to the need for additional contract time.

1.16 FIELD ENGINEERING

A. Establish elevations, lines, and levels and certify elevations and locations of the Work conforming with the Contract Documents.

B. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

C. From the information provided by the Owner, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, easement alignments, stakes for pipe locations and other working points, lines, elevations and cut sheets.

1.17 PRE-CONSTRUCTION CONFERENCE

A. Engineer will schedule Pre-Construction Conference after Notice of Award for affected parties.

B. The Contractor, or his duly authorized representative, and subcontractor representatives will attend the meeting.

1.18 PROGRESS MEETINGS

A. Schedule in coordination with the Engineer at maximum monthly intervals and attend all Progress Meetings throughout progress of the Work.

B. The purpose of the meetings will be to review the following:

1. Work progress since previous meetings.
2. Field observations, problems, conflicts.
3. Problems which impede construction schedule.
4. Corrective measures and procedures to regain projected schedule.
5. Revisions to construction schedule.
6. Plan progress and schedule during succeeding work period.
7. Coordination of schedules.
8. Off-site fabrication and delivery schedules.
9. Maintenance of quality standards.
10. Proposed changes, construction schedule and completion date.
11. Coordination of separate contracts.
12. Record or “as-built” drawings of completed work.
13. Other business as required.
14. Regulatory requirements including OSHA, New Mexico Board of Labor, and others as applicable.

15. Funding requirements as applicable.

C. During each meeting, the Contractor is required to present any issues which may impact his Work, with a plan to resolve these issues expeditiously.

D. Together with each payment application, Contractor must present the current as-built drawings reflecting all work performed to date.

1.19 CUTTING AND PATCHING

A. Submit written request in advance of cutting or altering elements with possible detrimental effects.

B. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

C. Restore Work with new products according to requirements of Contract Documents.

D. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

E. Refinish surfaces to match adjacent finishes.

1.20 SUBMITTAL PROCEDURES

A. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

C. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

D. Revise and resubmit submittals as required by the Engineer; identify changes made since previous submittal.

E. Submit number of hardcopies Contractor requires, plus two hardcopies Engineer will retain, at a minimum, unless otherwise indicated at the Pre-Construction Conference. In addition, Contractor shall provide all submittals electronically in PDF format, unless otherwise directed by the Engineer.

F. Transmit each submittal with Engineer accepted form.

G. Provide a separate submittal for each item. Do not combine multiple distinct items into a single submittal without prior approval of Engineer. Improperly combined submittals shall be rejected.

H. Provide updated submittal log with each submittal. If multiple submittals are submitted concurrently, only one updated log needs to be provided with submittal package.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

1.21 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within fifteen [15] days after date of Owner-Contractor Agreement for Engineer review.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission. Interim applications for payment shall not be processed without updated schedules.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

1.22 PROPOSED PRODUCTS LIST

A. Upon submittal of Bid Form, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.23 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit copies and distribute in accordance with Submittal Procedures article.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1.24 SHOP DRAWINGS

A. Shop Drawings:

1. Submitted to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

2. Include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

3. Design calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

4. After review, provide copies and distribute in accordance with Submittal Procedures article and for record documents purposes as specified.

5. Except as may otherwise be indicated herein, the Engineer will return copies of each submittal to the Contractor with comments noted thereon, within 30 calendar days following their receipt by the Engineer.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.

1.25 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.26 MANUFACTURER'S INSTRUCTIONS AND CERTIFICATES

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. When specified in individual specifications sections, submit certifications by manufacturer to Engineer, in quantities specified for Product Data.

D. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.27 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.28 TOLERANCES

A. Monitor fabrication and installation tolerance control of installed products over suppliers, manufacturers, products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply fully with manufacturer's tolerances.

1.29 REFERENCES

A. Conform to reference standards by date of issue current as of date of Contract Documents.

B. When specified reference standard conflict with Contract Documents, request clarification from Engineer before proceeding.

1.30 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, require material or product suppliers or manufacturers to furnish qualified staff personnel to observe site conditions and to initiate instructions when necessary.

B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturer's written instructions.

1.31 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify utility services are available, of correct characteristics, and in correct location.

C. Contractor is solely responsible for utility location, protection and verification. Contractor must notify New Mexico One Call System Inc., at 811, and all local utility providers (including NTUA's Call before you dig program 928-729-5721), at least three (3) days before starting utility line construction. Additional notice may be required for certain utilities, as noted on the Drawings and Specifications.

D. It shall be the responsibility of the Contractor to become acquainted with the location of all underground structures which may be encountered, or which may affect the Work hereunder.

1.32 TEMPORARY SERVICES

A. Provide, maintain and pay for suitable quality water service as required.

B. Maintain uninterrupted water and electric service to all properties adjoining the Work, including existing NTUA customers, at all times, except where specifically approved by the authority having jurisdiction. Services damaged by the Contractor shall be immediately and permanently repaired or replaced at the expense of the Contractor. Give a minimum of 48-hour advance notice to occupants of adjacent properties, including all existing NTUA customers, before interrupting any service. Any interruption of service shall be kept to the minimum length of time possible.

1. Contractor shall take necessary measures, including provision of temporary tanks and piping, to maintain uninterrupted water service until new tanks can be put back into service. Such temporary tanks, if needed, shall be provided at no additional cost to the Owner.

C. Until final inspection and approval of the Work and issuance of the Certificate of Substantial Completion, the Contractor is responsible for all Work directly or indirectly affected by the Contractor's activities. Such responsibility continues for all Work detailed on the punch list that may accompany the Certificate of Substantial Completion, until satisfactorily completed by the Contractor and approved by the Owner and Engineer.

D. Furnish, install and maintain any temporary water storage structures, electrical connections, meters, wiring, outlets, switches, lamps, etc., as necessary for the work. The Contractor shall provide such temporary heat as may be necessary for the prevention of injury to the work or material through dampness or cold. All temporary connections, installations, facilities and supplies furnished or installed as specified in this paragraph, shall be removed prior to the completion of the Contract, and the premises left perfectly clean and satisfactory to the Owner.

E. Maintain ambient temperature above freezing in enclosed/occupied areas where construction is in progress, unless indicated otherwise in specifications.

F. Provide and maintain required sanitary facilities and enclosures in clean and sanitary condition.

G. All temporary power costs/bills shall be borne by the Contractor until final project acceptance and signature of the Affidavit of Punch List Completion by NTUA.

1.33 ACCESS ROADS

A. The project ROW may be used for construction traffic. Do not construct any new roads. All trafficked areas must be restored to original condition prior to final completion of the project.

B. Existing on-site roads, designated by the Owner, may be used for construction traffic, provided the roads are not damaged and access to roads by local land users is not affected. Existing roads must be restored to original condition prior to final completion of the project.

1.34 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Maintain new and existing structures free of dust and construction debris at all times.

C. Remove waste and surplus materials, rubbish, and construction facilities from site. Restore all job sites and adjoining areas, including roads and driveways, to a condition equal to or better than the original status. Special attention will be made to not disturb unimproved roads by placing any excavated material to the sides of these roads when water lines are located along the right-of-way.

D. Brush and trees shall be felled parallel to the ROW to minimize damage to trees and structures on adjacent property. All brush, tree tops, stumps and other debris shall be removed from the ROW and disposed of by the Contractor, subject to and in conformity with the special provisions applying to the tract of land involved (if any). The Contractor shall not destroy nor remove any trees, shrubbery, nor any other improvements, without permission of the Owner.

E. The Contractor shall not dispose of debris, refuse or sanitary wastes in an open dump or in a natural watercourse, whether on public or private property, or in such places that undesirable wastes can eventually be exposed or carried to a natural watercourse.

F. Removal of obstructions required for completion of the project, whether specifically listed or not, shall be considered incidental to the work.

1. The Contractor shall remove and supply all usable materials to the Owner at a site designated by the Owner.

2. The Contractor shall remove and dispose of all unusable materials in accordance with relevant environmental regulations.

1.35 PROJECT IDENTIFICATION

A. Project sign requirements: None.

B. The Contractor shall not erect or permit the erection of advertising signs. Only minimal identification and direction signs shall be permitted on the site. Unnecessary or obnoxious posters, pictures, signs, symbols, drawings or writing on work, material or equipment, resulting from vandalism or other causes, shall be covered or removed by the Contractor.

1.36 BARRIERS AND FENCING

A. Provide barriers or fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

1.37 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Contractor shall remain wholly responsible for protection of all stored materials and installed work until final acceptance of the project by the Owner and signed Affidavit of Punchlist Completion by NTUA.

1.38 SECURITY

A. Provide security and facilities to protect Work and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Security of Contractor’s equipment, stored materials, work, and staging areas shall be entirely the responsibility of the Contractor. The Owner assumes no liability for any damage, vandalism, or theft of Contractor’s property.

1.39 WATER CONTROL

A. Provide erosion control.

B. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Contractor must abide by all stipulations and requirements within the Storm Water Pollution Prevention Plan (SWPPP) to be provided by the Contractor throughout all construction phases, including all proposed pollution prevention and sediment control measures. This shall be done in accordance with the National Pollution Discharge Elimination System (NPDES) general permit requirements for all construction activities and shall include all required reporting. If the Bid Form does not include an item for preparation and implementation of the SWPPP, the cost thereof will be considered incidental to related work.

D. The Contractor shall conduct his operations to minimize damage to natural watercourses, and shall not permit petroleum products, volatile fluid wastes, or any other wastes which are prohibited by local ordinances, or excessive amounts of silt, clay, or mud to enter any drainage system. The bed of natural watercourses or man-made irrigation ditches shall be restored to normal gradient and cross-section after being disturbed.

E. Do not fill in any natural washes or drainages or impede natural water flow unless otherwise indicated in the plans or specifications.

1.40 POLLUTION AND ENVIRONMENTAL CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Provide dust control, erosion and sediment control, noise control, pest control and rodent control to allow for proper execution of the Work. Motor equipment shall be kept in repair and equipped with anti-pollution devices, if possible, to cut down on exhaust emissions. Burning as a method of cleaning or disposal will not be permitted without approval of the proper authorities. Short term effects of dust produced by equipment will be mitigated by sprinkling traffic areas with water.

C. Comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act of 1970 (42 U.S.C. 1251 et seq.) as amended. Violations shall be reported to the New Mexico Environment Department.

D. The Contractor shall be responsible for the reporting and the cleanup of spills associated with project construction and shall report and respond to spills of hazardous materials such as gasoline, diesel, motor oil, solvents, chemicals, toxic and corrosive substances, and other materials which may be a threat to the public health or the environment.

E. The Contractor shall be responsible for reporting past spills encountered during construction and of current spills not associated with construction. Reports shall be made to the New Mexico State Police at 575-289-3443 or 505-334-6622, or call the New Mexico Environment Department Emergency Response Team at 505-827-9329 and to the Owner's Resident Project Representative .

F. The Contractor shall clean up any unreported spills associated with project construction identified after construction.

G. Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain or within 100 ft of any wash and must have a secondary containment system to prevent spills.

H. Do not change or add oil, hydraulic fluid, or other petrochemical-based fluids to any piece of machinery within the 100-year floodplain or within 100 ft of any wash.

I. Appropriate spill clean-up materials such as brooms and absorbent pads must be available where materials are stored or equipment is working at all times.

1.41 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion review.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.42 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by the Contract Documents.

C. Provide interchangeable components of same manufacture for components being replaced.

1.43 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Deliver, handle, store, and protect Products in accordance with manufacturer's instructions.

1.44 SUBSTITUTIONS

A. Substitutions will only be considered when Product becomes unavailable through no fault of Contractor.

B. Specific manufacturers may be required for certain items in order to maintain consistency with the Owner's existing inventory. In such cases, substitutions may not be allowed.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. Submit three [3] copies of request for Substitution to the Engineer for consideration. Limit each request to one proposed Substitution.

1.45 CLOSEOUT PROCEDURES

A. Submit written certification Contract Documents have been reviewed, Work has been inspected, and Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Price, previous payments, and amount remaining due.

C. Project closeout submittals shall include, but not limited to:

1. Affidavit of Punch List Completion
2. Project Record Documents
3. Operations and Maintenance Data
4. Spare Parts and Maintenance Materials
5. Extended Warranties
6. Release of Liens
7. Consent of Surety
8. Certification of Labor Standards
9. Complete packages of all testing results, start-up reports and data logs, including: manufacturer's testing data, line purge records, bacteriological tests, pressure tests, concrete tests, compaction tests, weld x-rays, cathodic protection start-up reports, and other quality control/ quality assurance documentation required in the Specifications.

D. Affidavit of Punch List Completion must be signed by NTUA prior to Final Completion.
1. Final payment will not be processed until Affidavit of Punch List Completion is accepted by NTUA.
2. Warrantee period shall commence upon execution of Affidavit of Punch List Completion by NTUA.

1.46 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Upon completion of the work under this contract, thoroughly clean and make any needed repairs caused by damage during construction to any existing utilities or other structures on the site.

C. Notify the Engineer in writing once final cleaning is complete. The final payment will not be made until the Contractor has complied with all requirements set forth and the Engineer has made his final inspection of the entire work and is satisfied that it is properly constructed and the site properly cleaned.

D. All costs related to cleaning shall be considered incidental to the project.

1.47 STARTING OF SYSTEMS

A. Provide at least seven [7] days notification prior to start-up of each item. Contractor shall coordinate scheduling of such start-up services with the manufacturer and Engineer.

B. Ensure each piece of equipment or system is ready for operation.

C. Execute start-up under supervision of responsible persons in accordance with manufacturer's instructions.

D. Submit written report stating equipment or system has been properly installed and is functioning correctly.

1.48 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six [6] months.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

1.49 TESTING, ADJUSTING, AND BALANCING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Owner retains the right to appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

C. Contractor will cooperate with independent firm; furnish assistance as requested.

D. Re-testing required because of non-conformance to specified requirements will be charged to Contractor.

1.50 PROTECTING INSTALLED CONSTRUCTION

A. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

C. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

D. Prohibit traffic from landscaped areas.

1.51 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.

B. Record actual revisions to the Work. Record information concurrent with construction progress.

C. Specifications: Legibly mark and record at each Product section description of actual Products installed.

D. Record Documents and Shop Drawings (As-Built Drawings):

1. Legibly mark each item to record actual construction.

2. Deliver two (2) sets of As-Built Drawings with redlines to the Owner upon completion of the Project.

E. The Contractor shall submit electronic survey information of the actual placement of lines and appurtenances. including elevations at top of pipe, northing and easting of top of pipeline or new utility at intervals not to exceed 100 feet and at all fittings, valves, vaults, discharge structures, trace wire test stations, electronic marker devices, building corners, concrete pad corners, electrical systems, pipe transitions and other appurtenances as well as finished grade elevations at each location cited above, and at the top of flange or top of nut (specify on drawing point description) of all hydrants. Submittals to be a combination of electronic survey point files with copies of survey field book information and/or electronic CAD drawing files including relevant survey point file and field book information. All survey information and electronic CAD drawings to be tied to established survey control as provided on plan set survey control sheet. Survey and as-built drawing information shall be prepared under the direction of a Licensed Professional Surveyor.

1. The Surveyor shall establish additional benchmarks and as-built information in accordance with the National Society of Professional Surveyor (NSPS) Model Standards and any applicable State Licensing Board requirements

F. Submit updated record documents to Engineer together with claims for interim Application for Payment. Interim and final applications for payment shall not be processed without updated record documents.

G. All mapping and other documentation requirements associated with the Contractor's SWPPP shall be the responsibility of the Contractor.

1.52 OPERATION AND MAINTENANCE DATA

A. Submit 3 sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, 3 D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

C. Internally subdivide binder contents with permanent page dividers, logically organized.

D. Contents:

1. Part 1: Directory

a. List names, addresses, and telephone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system:

a. Equipment summary, operational procedures, preventive maintenance procedures and schedules, parts list, shop drawings, safety issues.

3. Part 3: Project documents and certificates.

a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

1.53 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed by Engineer; obtain receipt prior to final payment.

1.54 WARRANTIES

A. Contractor warrants to Owner that all materials and workmanship covered by this Agreement, collectively referred to as the Work, supplied or performed by the Contractor, Contractor's sub-contractors, or Contractor's suppliers, will conform with the specifications, drawings, and other descriptions supplied or adopted by Owner and will be new, fit, and sufficient for the purposes for which they are intended as evidenced in this Agreement and in the drawings and specifications referred to therein, of good material, design and workmanship, free from defects, and will fulfill satisfactorily the operating conditions specified herein.

B. Contractor shall execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers for all products with extended warranties beyond one (1) year.

C. Contractor shall submit all warranty documentation prior to final Application for Payment.

D. All warranty periods shall commence upon the date of final acceptance of the work and execution of the Affidavit of Punch List Completion by NTUA.

E. If during the warranty period, any Work fails to conform with the foregoing guarantees, the defective Work shall be promptly repaired or replaced per these specifications and to the satisfaction of the Owner, at no cost to the Owner, including but not limited to prepayment of all packing and transportation costs; the cost of excavation, removal, and replacement of the defective material and all other adjacent materials affected by these actions; the cost of bedding and compaction and all required testing; as well as the costs of construction oversight, management and testing of materials by the Engineer.

F. Contractor will not be chargeable for repairs made by Owner to correct such failure within the foregoing warranty unless Contractor has been given written notice of such failure and thereafter has failed to take prompt and effective action to correct the failure in accordance with the foregoing.

1.55 RESIDENT PROJECT REPRESENTATIVE

A. The Owner shall provide a Resident Project Representative (RPR) to observe construction of the project.

B. The RPR shall:

1. Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.
2. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, assist in providing information regarding the intent of the Contract Documents.
3. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
4. 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.
5. 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.
6. 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.
7. During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications 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.
8. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and preparation of punch lists.
9. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final list of items to be completed and deficiencies to be remedied.

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.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03 05 00

BASIC CONCRETE MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes formwork, reinforcement, accessories, cast-in-place concrete, transporting, placing, finishing, curing, and other pertinent items of construction.

B. Concrete and Standards - Except as noted or modified in this section, all concrete materials, transporting, placing, finishing, curing, and sealing shall conform to requirements as follows:

1. American Institute of Concrete (ACI)

a. 301 - Specifications for Structural Concrete.

b. 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.

c. 306 - Cold Weather Concreting.

d. 308.1 - Standard Specification for Curing Concrete.

2. American Society for Testing and Materials (ASTM)

a. ASTM C31 - Practices for Making and Curing Concrete Test Specimens in the Field.

b. ASTM C33 - Specifications for Concrete Aggregate.

c. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens.

d. ASTM C94 - Specification for Ready-Mixed Concrete.

e. ASTM C143 - Test Method for Slump of Hydraulic Cement Concrete.

f. ASTM C150 - Specification for Portland Cement.

g. ASTM C156 - Test Methods for Water Retention by Concrete Curing Materials.

h. ASTM C227 - Test for Potential Alkali Reactivity of Cement- Aggregate Combinations.

i. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.

j. ASTM C441 - Test for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to Alkali-Aggregate Reaction.

k. ASTM C494 - Specification for Chemical Admixtures for Concrete.

1.2 QUALITY ASSURANCE

A. Inform Engineer at least 48 hours in advance of time at which Contractor intends to place concrete.

B. When required by any applicable permits, such as CID permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

C. Construct and erect concrete formwork in accordance with ACI 301 and ACI 347.

D. Concrete tests shall be in accordance with requirements of ACI 301, Chapter 16 - Testing, except as noted or modified in this Section.

1. Strength test:

a. Mold and cure 5 cylinders from each sample.

b. Test one at 7 days and one at 14 days for information and two at 28 days for acceptance.

E. Samples:

1. Collect the following minimum samples for each 28-day strength concrete used in the work for each days placing. No sample shall be required for thrust blocks nor fence posts.

Quantity	Number of Samples
50 cubic yards or less	1
50 to 100 cubic yards	2
100 cubic yards or more	2 plus 1 sample for each additional 100 cubic yards

2. Sampling should be in accordance with ASTM C172.
3. Forming cylinders in accordance with ASTM C31.
4. No sample shall be required for thrust blocks nor fence posts.
5. Hold fifth cylinder for future considerations. Deliver to Owner upon determination of substantial completion and prior to final payment.

6. Sample marking.

a. Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.

b. Identify location in work where concrete represented by cylinders was placed.

c. Identify delivery truck or batch number, air content and slump.

7. Slump test:

a. Conduct test for each strength test sample and whenever consistency of concrete appears to vary.

8. Air content:

a. Conduct test from 1 of first 3 batches mixed each day and for each strength test sample, in accordance with ASTM C231, 138 or 173.

9. Temperature:

a. Conduct test in accordance with ASTM C1064.

F. Coordinate concrete placement with the Engineer to ensure proper testing in compliance with the Drawings and Specifications. The cost of all tests shall be covered by the Testing Allowance provided for in the bid schedule, except for new analyses required due to failed tests.

G. The Contractor is free to take additional specimens for his own information, at his own expense, not reimbursable from the Testing Allowance.

H. Acceptance of Concrete: Strength level of concrete will be considered satisfactory so long as average of all sets of 3 consecutive strength test results equal or exceeds specified 28-day strength and no individual strength test result falls below specified strength (fc′) by more than 500 psi when specified compressive strength is 5000 psi or less; or by more than 0.10fc′ when specified compressive strength is more than 5000 psi.

I. Failure of Test Cylinder Results: Upon failure of test cylinder results, Engineer may require Contractor, at his expense, to test remaining cylinder after curing for a period of time specified by Engineer. If strength level of this cylinder is not greater than specified 28-day strength, Engineer may require Contractor to obtain and test at least three 2-inch diameter cored samples from an area in question.

1. Conform to ASTM C42.
2. Concrete will be considered adequate if average of 3 cores is at least 85 percent of, and if no single core is less than 75 percent of, specified 28-day strength.
3. Upon failure of core test results, Engineer may require Contractor, at his expense, to perform load tests as specified in ACI 318.
4. Fill all core holes as specified for repairing defective concrete.

J. Completed Work

1. Completed concrete work which fails to meet 1 or more requirements, but which has been repaired to bring it into compliance, will be accepted without qualification.
2. Completed concrete work which fails to meet 1 or more requirements and which cannot be brought into compliance shall be rejected as provided in these Contract Documents. In this event, modifications shall be required to assure that concrete work complies with requirements. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

K. Perform concrete reinforcing and cast-in-place concrete work in accordance with ACI 301.

L. The maximum deviation of the top surface of curb and gutter shall not exceed 1/8" in 10' nor shall the inside face deviate more than 1/4" in 10' from a straight line. Prior to or during final inspection, curb and gutter shall be water flow tested as directed by the Engineer. All areas with standing water will be rejected.

PART 2 PRODUCTS

2.1 FORM MATERIALS AND ACCESSORIES

A. Steel Forms: Symons “Steel-Ply”, Simplex “Industrial Steel Frame Forms”, Universal “Uniform”. Forms shall be clean, straight and true, without surface defects.

B. Plywood Forms: Product standard PS-1, waterproof, resin-bonded exterior type Douglas Fir or Larch. Forms shall be clean, straight and true, without surface defects.

C. Lumber: Douglas Fir or Larch, straight, uniform width and thickness, clean and free from offsets, holes, dents and other surface defects.

D. Chamfer Strips: Clean white pine, surface against concrete planed.

E. Form Release Agent: Colorless mineral oil not capable of staining concrete or impairing natural bonding characteristics of coating intended for use on concrete.

2.2 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615, deformed. Reinforcement bar, size and spacing as indicated on the Drawings.

B. Welded wire fabric reinforcement shall conform to the requirements of ASTM A1064 and the details shown; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.

C. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for support of reinforcing; plastic tipped or non-corroding for supports in slabs where supports are exposed to weather.

D. Concrete blocks used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

E. Fabricate concrete reinforcing in accordance with ACI SP-66.

2.3 CONCRETE MATERIALS

A. Cementitious Materials:
1. Portland Cement: ASTM C150 Type I.
2. Fly Ash: ASTM C618, Class F or C.
3. Slag Cement: ASTM C989, Grade 100 or 120.
4. Silica Fume: ASTM C1240.
5. Metakaolin: ASTM C618, Class N.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: ASTM C1602/C1602M, Clean and not detrimental to concrete.

D. Chemical Admixtures (when applicable): Compatible with each other and free of intentionally-added chlorides.
1. Air Entraining Admixture: ASTM C260.
2. Water-Reducing Admixture: ASTM C494, Type A.
3. Mid-Range Water-Reducing Admixture: ASTM C494, Type A.
4. High-Range Water-Reducing Admixture: ASTM C494, Type F.
5. Accelerating Admixture: ASTM C494, Type C or E.
6. Retarding Admixture: ASTM C494, Type B or D.
7. Workability-Retaining Admixture: ASTM C 494, Type S.
   a. Shall retain concrete workability without affecting time of setting or early-age strength development.
8. Alkali-Silica Reaction Inhibiting Admixture: ASTM C494, Type S
   a. Shall contain a nominal lithium nitrate content of 30 percent.

2.4 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94.

B. Retempering of prepared concrete will not be permitted.

C. Furnish concrete of the following strength:

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement W/C per CY (94# sacks)	Maximum Ratio (by wt.)
Slabs on grade, footings floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Site work concrete such as fence posts, thrust blocks, valve collars, etc.	3,000	1	5.0	0.50

D. Proportioning:

1. Proportion ingredients to produce a well-graded mix of high-density maximum workability consistent with approved mix design.

2. Entrained air - all concrete:

   a. Five (5) percent, plus or minus one (1) percent, for concrete in the forms. Concrete samples for air content tests shall be taken at the end of the concrete truck chute or the output of the concrete pump, whichever applies. A reduction in air content of pumped concrete should be expected. Contractor shall be responsible to coordinate with the concrete supplier to provide the specified air content of the in-place concrete.

   b. Refer to Table 3.4.1 of ACI 301 for further requirements.

3. Fly ash, silica fume, and slag cement:

   a. Fly ash: The mineral admixture Class F fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4 and not less than 25 per cent of the total cementitious material. Portland cement concrete submitted under this specification shall be proportioned with Class F fly ash, unless a variance is authorized by the Engineer. Alternatively, lithium-based admixture can be used in lieu of Class F fly ash to mitigate ASR. The Contractor shall provide the Engineer with chemical and physical analysis of the fly ash.

   b. Silica fume: Silica fume may be added to the mix and shall be proportioned by weight of cement to provide a silica fume to Portland cement ratio not less than 1:25 and no greater than 1:7. Portland cement concrete using silica fume shall follow ASTM C1240 standards.

4. Slag cement: Slag cement may be added to the mix and shall be proportioned by weight of cement to provide a slag cement to Portland cement ratio of no greater than 80 percent. Slag cement can consist of Grade 100 or grade 120. Portland cement concrete using slag cement shall follow ASTM C989 standards.

5. Aggregates supplied under this Specification shall be assumed to be "alkali-silica reactive", ASR. Variance from this position for a particular aggregate source

may be authorized by the Engineer. Application for a variance may be made to the Engineer.

a. An aggregate may be classified non-alkali-silica reactive if, when tested in accordance with ASTM C227, using low alkali cement demonstrates an expansion at one (1) year not greater than 0.05%, and the rate of expansion is negative decreasing, based on test measurements at 1 month, 3 months, 6 months, 9 months, and 15 months, as authorized by the Engineer.

b. Portland cement concrete design mixes using non alkali-silica reactive aggregates will not be required to be proportioned with Class F fly ash.

E. Batching and Mixing Equipment: Conform to ACI 304.

F. Slump:

1. Keep as low as possible consistent with proper handling and thorough compaction.

2. Shall not exceed 4 inches unless otherwise authorized by Engineer.

2.5 CEMENT GROUT

A. Portland Cement: ASTM C150, Type I and II.

B. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts.

C. Fine Aggregate:

1. Washed natural sand.

2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.

3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2. Water content shall be such that the grout can be readily spread, yet not wet enough to cause trouble with surface water or laitance, or failure to stay in place after screeding. All grout mixes and mixing procedures shall be submitted in accordance with submittal requirements, and shall be subject to review and approval by the Engineer prior to commencing the grouting operations.

E. The minimum compressive strength at 28 days shall be 4000 psi.

F. Procedures for Grout placement shall be approved by the equipment supplier, to insure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

A. Erect formwork, shoring and bracing to achieve design requirements.

B. Erect forms substantially and sufficiently tight to prevent leakage of mortar and braced or tied to maintain desired position, shape and alignment before, during, and after concrete placement.

C. Carefully remove forms only after concrete is able to support all dead and live loads and curing requirements are met. Apply curing compound to all formed surfaces immediately after form removal.

D. Camber slabs and framing to achieve ACI 301 tolerances.

E. Provide bracing to ensure stability of formwork.

F. Clean forms as erection proceeds, to remove foreign matter.

3.2 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

A. Provide formed openings where required for work to be embedded in and passing through concrete members.

B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install concrete accessories straight, level, and plumb.

D. Install water stops continuous without displacing reinforcement.

3.3 REINFORCEMENT PLACEMENT

A. Place reinforcement, supported and secured against displacement.

B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings

3.4 PLACING CONCRETE

A. Do not place concrete during rain, sleet, or snow unless adequate protection is provided and Construction Observer approval is obtained. Do not allow rainwater to increase mixing water or damage surface finish.

B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.

C. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material. Limit chute length to less than 20 feet with maximum slope of 1 vertical to 2 horizontal.

D. Maximum height of concrete free fall is 4 feet.

E. Place concrete continuously between predetermined expansion, control and construction joints. Do not break or interrupt successive pours creating cold joints.

F. On large volume pours, concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the

forms on exposed faced in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work.

G. Where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrink grout.

H. Screed slabs-on-grade and concrete base for toppings level.

3.5 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Remove formwork progressively and in accordance with code requirements.

3.6 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R.

B. Uniformly spread, screed, and float concrete.

C. In areas with floor drains, maintain floor level at walls and slope surfaces uniformly to drains.

D. Provide surface conforming to proper elevation and contour with all aggregates completely embedded in mortar by screening.

E. Provide an initial float as soon as concrete has stiffened sufficiently for proper working.

F. Provide a second floating at time of initial set.

G. Apply a broom finish.

3.7 CURING

A. Immediately after placement, protect concrete from premature drying.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, for not less than ten (10) days in warm to hot weather and fourteen (14) days in cold weather after placing, unless otherwise indicated by the Engineer, in accordance with the methods specified herein for the different parts of the Work.

1. Cold weather is defined as when the temperature reaches or goes below 35 degrees F for one (1) hour during any 24-hour period during the curing period.

C. Use a pre-approved concrete curing method. Acceptable curing methods, as detailed in ACI 308R-01, are as follows:

1. Water Curing Methods:

a. Ponding/Immersion.

b. Fogging/Sprinkler.

c. Burlap/Cotton Mats/Absorbent Material.

d. Wet Sand Curing.

e. Straw/Hay.

f. Plastic Film.

g. Reinforced Paper.

2. Liquid Membrane-Forming Compounds.

D. The covering used, if applicable, must be overlapped adequately to ensure 100% coverage, and must not be allowed to become dry at any point during the curing period. Place and anchor covers, mats, and/or sheeting to ensure continuous contact with the concrete surfaces.

E. When using one of the water curing methods, keep the concrete structures thoroughly and continuously moist and covered during the entire curing period.

3.8 FIELD QUALITY CONTROL

A. Three (3) Concrete Test Cylinders: Taken for every 75 or less cubic yards of each class of concrete placed.

B. One (1) Additional Test Cylinder: Taken during cold weather concreting, and cured on job site under same conditions as concrete incorporated into the Work.

C. One (1) Slump Test: Taken for each set of test cylinders taken.

D. One (1) Air Content Test: Taken for each set of test cylinders taken.

E. One (1) Concrete Temperature Measurement: Taken for each set of test cylinders taken.

F. One (1) Ambient Air Temperature Measurement: Taken for each set of test cylinders taken and at the beginning of each day that concrete is being placed.

3.9 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by Engineer.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes wall, and roof framing; built-up structural members; shop fabricated trusses; wall and roof sheathing; preservative and fire retardant treatment, sill gaskets, flashings; and roof curbs and cants; blocking in wall and roof openings; wood furring and grounds; electrical panel back boards, concealed wood blocking.

1.2 SUBMITTALS

A. Shop Drawings: Indicate framing system, loads and cambers, bearing details, and framed openings.

B. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware shown.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by NIST PS 20.

2. Plywood Grading Agency: Certified by APA/The Engineered Wood Association.

B. Conform to IBC for loads, seismic zoning and other governing load criteria unless more stringent requirements are contained in these specifications or shown in the Drawings.

C. Prefabricated wood trusses shall be designed by or under the direct supervision of a Professional Engineer registered in the State of New Mexico and experienced in the structural design of wood trusses of the type used in this project.

D. Standard framing and spacing shall be used per applicable code requirements.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber Grading Rules: Lumber shall be graded in accordance with the "Standard Grading and Dressing Rules No. 16", of the West Coast Lumber Inspection Bureau (WCLIB) or in accordance with "Grading Rules for Western Lumber", published by Western Wood Products Association, as specified herein.

B. Grade Marking: Each piece of lumber shall bear the official grade mark of recognized grading agencies, using one of the above-mentioned grading rules.

C. Size Dressing: All lumber, except as otherwise shown or specified herein, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise shown.

D. Drying: All lumber incorporated in the work, except where otherwise specified, shall be air or kiln dried to a moisture content of not more than 19% and not less than 1%.

E. All wood nailing blocks, sills and plates resting on or embedded in concrete or masonry within 18-inches of grade shall be pressure-treated in accordance with American Wood Preservers' Association Manual of Recommended Practice, Standard for Preservative Treatment by Pressure Process-All Timber Products, Cl. Preservative shall conform to American Wood Preservers Assn. and American Wood Preserves Bureau Standard Specifications referenced in Paragraph entitled, "References Specifications, Codes and Standards". Creosote shall not be used.

F. Wherever necessary to cut, notch, dap, drill or frame treated lumber, newly cut or bored surfaces shall be treated with two heavy coats of the same preservative used in the original treatment. The minimum penetration depth shall be 1/4-inch.

2.2 SHEATHING MATERIALS

A. Plywood Roof and Wall Sheathing: Plywood shall conform to the requirements of U. S. Product Standard PS 1, as specified herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type and grade in compliance with the applicable commercial standard. Except as otherwise specified below or shown, plywood shall be Douglas Fir, Exterior, C-D, SlS.

B. Telephone and Electrical Panel Boards: Plywood.

2.3 SHOP FABRICATED TRUSSES

A. Except where more restrictive requirements are shown on the Drawings, listed below or contained in the local building code, metal-plate-connected wood roof trusses are to be designed in accordance with the applicable provisions of the latest edition or revision of "Design Specification for Metal-Plate-Connected Wood Trusses", published by the Truss Plate Institute.

B. Manufacturers:

1. J.D. Adams Company
2. Alpine Engineered Products, Inc.
3. Gang-Nail Systems, Inc.
4. Hydro-Air Engineering, Inc.
5. Substitutions: Permitted if approved by Engineer.

C. Design Roof Live Load, Roof Snow Load and Dead Load: as shown on drawings.

D. Truss Type: Plate connected.

E. Verify dimensions and site conditions prior to fabrication.

F. Fabricate steel connector plates to size, configuration and thickness required to properly transfer member loads.

G. Cut members accurately to length to achieve tight joint connections.

H. Jig trusses during fabrication to assure accurate configuration.

I. Press connectors into lumber, both sides of joint simultaneously.

2.4 ACCESSORIES

A. Fasteners: Galvanized steel for exterior, high humidity, and treated wood locations, plain finish elsewhere.

B. Die Stamped Connectors: Minimum 20 gauge (0.036 inches thick), galvanized steel.

C. Structural Framing Connectors: Galvanized steel, sized to suit framing conditions.

D. Rough Hardware: The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry or brick masonry; and similar items employed in erection and construction of the rough carpentry work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the Engineer. All hardware items shall be steel unless specified or shown otherwise.

E. Building Paper: ASTM D226 No. 15 asphalt felt.

PART 3 EXECUTION

3.1 FRAMING

A. Erect wood framing members in accordance with applicable code. Place members level and plumb. Place horizontal members crown side up.

B. Rough carpentry shall be as shown, specified and as necessary to complete work. The Contractor shall verify drawing dimensions with actual field conditions and shall inspect related work and adjacent surfaces and shall report to the Engineer all conditions that could prevent proper execution of this work.

C. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105 of the Timber Construction Manual of the American Institute of Timber Construction.

D. Strength Considerations: Structural wood framing member shall not be spliced between bearing points or supports. Place framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true and even support. Wedges or shims shall not be used to correct faulty work. Wood members, which have been split or otherwise damaged to such an extent as to impair their strength, shall be removed and replaced. Members shall not be cut, notched nor bored more than 1/4 of their depth without adequate and approved reinforcing.

E. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling register, grilles and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood

blocking (backing) to receive sheathing, siding, metal lath and gypsum board shall be provided wherever necessary for securing the facing materials.

F. Place full width continuous termite shield and sill flashing on foundations.

G. Place sill gasket directly on sill flashing.

H. Frame double joist headers at ceiling openings. Frame rigidly into joists. Frame double joists under wall studding.

I. Bridge framing in excess of 8 feet span at mid-span members. Fit solid blocking at ends of members.

J. Curb roof openings except where curbs are provided. Construct curb members of single pieces for each side.

3.2 SHEATHING

A. Secure wall sheathing with ends staggered, over firm bearing.

B. Place building paper over wall sheathing, weather lap joints and end laps, staple in place.

C. Install electrical panel backboards with plywood sheathing material where required. Size backboard by 12 inches beyond size of electrical panel.

3.3 SHOP FABRICATED TRUSSES

A. Verify that supports and openings are ready to receive trusses.

B. Verify that sufficient end bearing area exists.

C. Install trusses in accordance with the applicable provisions of "Commentary and Recommendations for Handling and Erecting Wood Trusses" of the Truss Plate Institute.

D. After trusses have been placed leveled, aligned and plumbed and temporary bracing is in place, reset, in accordance with manufacturer's directions, any connection plates that may have been loosened.

E. Bracing:

1. Before applying any superimposed loads, place permanent bridging, bracing and anchors.

2. Unless other bracing is shown on the Drawings, provide bracing in accordance with the applicable provisions of "Bracing Wood Trusses: Commentary and Recommendations" of the Truss Plate Institute.

F. Do not field-cut trusses or remove any truss members.

G. Place headers and supports to frame openings required.

H. If, in the opinion of the Engineer, any damaged trusses cannot be satisfactorily repaired, the damaged trusses shall be removed from the project and replaced with trusses acceptable to the Engineer.

3.4 SITE APPLIED WOOD TREATMENT

A. Treat site-sawn cuts. Brush apply two coats of preservative treatment on untreated wood in contact with cementitous materials and roofing and related metal flashings.

B. Allow preservative to cure prior to erecting members.

END OF SECTION

SECTION 08 11 14

BULLET-RESISTANT STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Works included:

1. All labor, material, equipment, and services necessary to furnish and install bullet-resistant primed-finish steel doors and doorframes to be located as shown on the construction drawings or as noted in the door and window schedules.

B. Related Sections:

1. Section 08 71 00 Door Hardware

1.2 REFERENCES

A. Underwriters Laboratory

1. UL 752, Current Edition, Standard for Bullet-Resisting Equipment.

1.3 QUALITY ASSURANCE

A. Ballistic Performance: Certification shall be furnished indicating that all materials have been tested in accordance with the appropriate test procedures.

B. Obtain bullet-resistant components through one source from a single manufacturer.

1.4 SUBMITTALS

A. Shop Drawings shall be submitted for approval prior to the fabrication of materials. The drawings shall include plan views, elevations, sections, and details of the proposed installation including attachment methods.

B. Shop Drawings shall indicate dimensions, component profiles, and material finishes.

C. Manufacturer’s warranty and product data, glazing product information, and installation instructions shall be included with the submittal package.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Pack bullet-resistant doors/frames in wood crates for shipment. Glazing should be crated separately, unless doors are factory glazed.

B. All items shall be delivered, stored, and handled in a manner that will not damage or deform.

C. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection. Damaged items that cannot be restored to like-new condition shall be replaced.

D. Store crated components in a dry location on platforms or pallets that are adequately ventilated, free of dust, water, and other contaminants, and stored in a manner that permits easy access for inspection and handling.

1.6 JOB CONDITIONS

A. Field Measurements: Contractor shall verify frame openings by field measurement prior to fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: If field measurements cannot be made without causing a delay, establish opening dimensions and proceed with fabrication of bullet-resistant frames without field measurements. Coordinate construction to ensure that the actual opening dimensions correspond to the established dimensions.

PART 2 PRODUCTS

2.1 STEEL DOORS AND FRAMES

A. Manufacturers:

1. North American Bullet Proof, Shotgard Series.
2. U.S. Bullet Proofing.
3. Substitutions: Permitted with prior written approval by Engineer.

2.2 MATERIALS

A. Bullet-Resistant Primed-Finish Steel Doors and Doorframes:

1. Bullet-Resistant SDR Primed-Finish Steel Door and Primed-Finish Steel Doorframe
2. Frames, doors, and glazing shall be supplied to provide a complete assembly.
3. Ballistic Resistance Performance Level: U.L. 752, Level 4.
4. SDR integral door/frame system to provide ballistic overlap protection.
5. SDR Primed-Finish Steel Door to be constructed of 10-gauge steel skins over tube-steel skeleton with mitered, continuously welded corners.
6. SDR Primed-Finish Steel Doorframe to be constructed of 12-gauge steel with mitered, continuously welded corners.
7. Frame Profile: 2” x 5½” bolt-in frame, lined with steel as required for ballistic protection level.
8. View Window (when shown on drawings): 10” x 10” visual opening; performance level of the glazing to match the performance level of the door.
9. Door to be pre-hung with 1100-lb. rated continuous-gear hinge with security pins.
10. Door and frame to be prepped for mortise lock and standard strike.
11. Testing: Independently tested to U.L. 752 to level specified.

2.3 SDR COMPONENTS

A. Hinge: The SDR steel door shall be supplied pre-hung, with an 1100-lb. rated continuous-geared hinge with tamper-resistant dogging pins.

B. Silencers: Silencers shall be provided at the strike-jamb stop.

C. View Window Glazing: Glazing material shall be factory-fabricated units designed to be bullet-resistant to the specified test standard. Glazing material shall be glass-clad polycarbonate with a low-spall protected interior face. Low-spall interior face shall meet or exceed requirements for spall resistance defined in U.L. 752.

D. Setting Blocks: provide 1/4" x 1" x 4" rubber setting blocks for installation at the sill.

E. Anchor-hole Plugs: Provide decorative plugs to cover anchor-access holes.

F. Anchors and Sealants to be provided by installer.

G. Floor door closers (where shown on drawings):

1. Manufacturers:

a. ASSA ABLOY Rixson Model L27

b. Substitutions: Approved Equal

2. Heavy duty, floor-mounted door closer

3. Rated to wind speed of 90 mph

4. Rated to weight of bullet-resistant door

5. Built-in positive dead stop to prevent door from opening beyond maximum opening degree of 105°.

6. Shall feature separate and independent valves for closing speed, latch speed and backcheck.

H. Top Jamb door closers (where shown on drawings):

1. Manufacturers:

a. Norton Model 7500 Industrial Series

b. Substitutions: Approved Equal

2. Rigid, Heavy duty, top jamb-mounted door closer

3. Non-adjustable arm

4. Opening degree of 180°.

I. Heavy duty cane bolt and gate stop assembly to hold open doors:

1. 5/8" diameter, 36" long, black steel cane bolt.

a. Bolt must be able to be kept in the 'up/unengaged' position, such that operator need not hold the bolt up as door is opened or closed.

2. Minimum 6" throw, or more to allow full engagement with the gate stop set into concrete porch or driveway.

3. Gate stop shall be a field type gate center stop (set in concrete porch or driveway), part number HS 015 913-34 (custom) as by Hardware Specialties of Albuquerque, OAE

a. 3"x5" rectangular cold-plate steel formed with 7/8" wide, 3" long, 1" deep at center concave channel.

b. 5/8” diameter, 5” long cold rolled steel bar affixed to bottom center of plate.

2.4 FABRICATION

A. General: Fabricate bullet-resistant components to comply with indicated standards. Include a complete system for assembly and installation of bullet-resistant components.
1. Provide doors that are capable of being reglazed from the secure side without dismantling the threat side of the frame.
2. Prepare doors for glazing in the field, unless preglazing at the factory is indicated.
3. Steel shall be free of scale, pitting, coil breaks, and finish work shall be neat and free of defects.

B. Framing: Miter corners the full depth of the frame. Continuously weld and dress smooth. No body fillers to be used.
1. Install armor inside the frame in the thickness necessary for the ballistic resistance level indicated.
2. Prep frame for standard 4⅞” ANSI strike at 40 inches above finished floor.
3. Provide spreader at bottom of doorframe for protection during shipping, and for easier, cleaner installation.

C. View Window Stops: Provide a one-piece removable glazing stop, two-inch depth, made from 12-gauge steel, on the secure side of the frame attached with machine screws.
1. Corners are to be mitered, welded, and dressed smooth.
2. Stops shall be installed in a location appropriate for the glazing thickness.
3. Finish glazing stops to match door finish.
4. The threat-side glazing stop shall be welded-in-place 3/8” ballistic steel.

D. SDR: Fabricate steel doors with 10 gauge steel door skins.
1. Proprietary adhesive to be used to bond door skins to door structure.
2. Prep door for lockset to line-up with strike.
3. Hinge reinforcement: Provide 3/16” steel continuous hinge reinforcement, welded to door edge.

E. Hardware: Templates are to be provided to the door manufacturer by the hardware contractor. The installing contractor shall perform drilling and tapping for surface mounted hardware at the jobsite.

F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

G. Any openings in glazing for are to be factory-cut.

H. No field alterations to the construction of the units fabricated under the specified standards shall be allowed unless approved by the manufacturer.

2.5 FINISHES

A. Provide shop-applied primer after fabrication:

1. Prior to shop painting, surfaces shall be cleaned with solvents to remove any grease or oil, and with power wire-brushing or sandblasting to remove loose rust, loose mill scale and other foreign substances.

2. Primer: Rust inhibitive paint suitable as a base for finish coating.

B. Door manufacturer shall provide finish powder coating of the surfaces of the door prior to shipment, per coating manufacturer's instructions, color to be selected by Owner.

C. Steel Sheet: Shop finished galvanized to ASTM A653/A653M A40.

D. Finishes: ANSI A156.18; furnish following finishes unless otherwise noted.

1. Hinges:

a. BHMA 630 and 626, satin finish.

2. Typical Exterior Exposed and High Use Interior Door Hardware:

a. BHMA 630, satin finished stainless steel.

3. Typical Interior Door Hardware:

a. BHMA 626, satin chromium plated brass or bronze.

4. Thresholds: Finish appearance to match door hardware on exterior face of door.

a. BHMA 628, satin aluminum, clear anodized.

5. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

2.6 LABELING

A. Bullet-resistant components shall be plainly and permanently labeled. The label shall be compatible with finishes. The label shall be visible only on the secure side, after installation, and shall include:

1. Manufacturer's name or identifying symbol.

2. Model Number.

3. Date of manufacture by month and year. This may be done through use of lot number or other traceable code.

4. Correct mounting position including threat side and secure side.

5. Code indicating bullet-resistant rating and test standard used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to commencing installation, examine all areas to receive the bullet-resistant doors and frames to ensure that they are ready for installation. Components shall be checked

and corrected for racking, twisting, and other malformation prior to installation. All surfaces and connections shall be examined for damage prior to installation.

B. Verify that the doors and frames comply with indicated requirements for type, size, and location.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. The Contractor shall field verify dimensions of the finished openings. SDR bolt-in frames must be installed in a plumb, level, and square finished opening. The finished opening must be 1/4" larger in width and in height than the doorframe.

3.3 INSTALLATION

A. Install: Place the frame in the opening, centered on wall. Mark the anchor holes. Remove the frame and drill the anchor holes. Install the frame and shim for plumb/level. Secure with anchors. Note: all anchors provided by installer.

B. Test: Test the door for proper fit and operation. If required, remove the unit, adjust the shims, and reinstall. Install the anchor-hole plugs.

C. Finish: Seal all joints in and around the frame. Sand and finish the frame. Wait until all sealants and paint are cured before operating.

D. Glazing: Identify the secure and threat sides of the glass. Remove any protective cover from the glazing. Apply butyl tape to the view widow stops. Place the rubber setting blocks in the opening. Install glazing, making sure it fits properly. Install the removable stop using the screws provided with the window. Apply sealant over butyl tape.

E. Cane bolt and gate stop assembly to hold open doors:

1. Cane bolts must be factory welded to doors for pre-fabricated buildings.

2. If cane bolt assembly welded to door in field, touch-up paint and door finish as needed after welding.

3. Weld cane bolt assembly to steel door so as to allow 6" of throw, or more if needed to ensure bolt fully engages the field type gate center stop when bolt is in 'down' position. Bottom of bolt shall be held flush or slightly above bottom of door when disengaged.

4. After building is in place with doors and cane bolts installed, set gate stop in wet concrete so that plate is flush with finished surface and channel is perpendicular to door's swinging path when fully open. Before the concrete sets verify that angle and position of gate stop will allow bolt to fully engage the gate stop at the center of the gate stop.

3.4 ADJUST AND CLEAN

A. Use care and follow instructions for cleaning the glazing.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes hardware for steel doors.

1. Provide door gaskets, including weather-stripping and seals, and locksets.

B. Related Sections:

1. Section 08 11 13 Steel Doors and Frames
2. Section 08 11 14 Bullet Resistant Steel Doors and Frames

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI A156.2 - Bored and Preassembled Locks and Latches.
2. ANSI A156.3 - Exit Devices.
3. ANSI A156.4 - Door Controls - Closures.
4. ANSI A156.5 - Auxiliary Locks and Associated Products.
5. ANSI A156.6 - Architectural Door Trim.
6. ANSI A156.7 - Template Hinge Dimensions.
7. ANSI A156.8 - Door Controls - Overhead Holders.
8. ANSI A156.12 - Interconnected Locks and Latches.
9. ANSI A156.13 - Mortise Locks and Latches.
10. ANSI A156.14 - Sliding and Folding Door Hardware.
11. ANSI A156.15 - Closer Holder Release Devices.
12. ANSI A156.16 - Auxiliary Hardware.
13. ANSI A156.18 - Materials and Finishes
14. ANSI A156.19 - Power Assist and Low Energy Power Operated Doors.
15. ANSI A156.23 - Electromagnetic Locks.
16. ANSI A156.24 - Delayed Egress Locks.
17. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:

1. BHMA Directory of Certified Products.

C. National Fire Protection Association:

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories Inc.:

1. UL 10B - Fire Tests of Door Assemblies.
2. UL 305 - Panic Hardware.
3. UL - Building Materials Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by applicable authorities.

1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:

1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts.
2. Submit manufacturer's parts lists.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.7 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.

1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

B. Sequence installation to accommodate required utility connections.

C. Coordinate Owner's keying requirements during course of Work.

1.8 WARRANTY

A. Furnish five year manufacturer warranty for locksets and door closers.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers:

1. Bommer Industries, Inc.
2. Hager Companies.
3. Substitutions: Permitted.

B. Lockset Manufacturers:

1. Yale.
2. Substitutions: Permitted.

C. Closers Manufacturers:

1. Yale.
2. Norton.
3. Substitutions: Permitted.

2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
    a. Finish: Match hardware item being fastened.
4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.

5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.

2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1 unless otherwise indicated.

4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1 unless otherwise indicated.

C. Latch Sets: Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.

2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

D. Exit Devices: ANSI A156.3, Grade 1 concealed vertical rod type, with cross bar, unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, with dust-proof floor strikes.

1. Types: Suitable for doors requiring exit devices.

2. Coordinators: Furnish overhead concealed in frame type at pairs of doors.

E. Cylinders: ANSI A156.5, Grade 1, pin type removable cylinders.

1. Keying: Key to existing keying system.

2. Provide eight (8) original keys to Owner.

2.3 ACCESSORIES

A. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.

1. Do not use through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.

1. Typical Exterior Exposed and High Use Interior Door Hardware:

a. BHMA 630, satin finished stainless steel.

2. Typical Interior Door Hardware:

   a. BHMA 626, satin chromium plated brass or bronze.

3. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as instructed by manufacturer.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights from Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.

1. Locksets: 38 inch.
2. Push/Pulls: 42 inch.
3. Dead Locks: 48 inch.
4. Push Pad Type Exit Devices: 42 inch.
5. Cross Bar Type Exit Devices: 38 inch.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit adjacent work to damage hardware or hardware finish.

3.5 SCHEDULES

A. Hardware Set 1: Fire rated.

1.	Lock:	Mortise lock, Classroom Function.
2.	Closer:	Surface mounted as specified.
3.	Kickplate:	16 inch high, push side only.
4.	Gaskets:	Fire and smoke rated gaskets as specified.
5.	Floor Stop:	Dome type as specified.

END OF SECTION

SECTION 09 92 00

PROTECTIVE ANTI-GRAFFITI COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Materials and methods specifications for the following:

1. GRAFFITI PROOFER® GPA-300 (Anti-graffiti top coat)
2. Sealer Prime SCS-002SP (Concrete primer)

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 04 20 00 - Unit Masonry

C. Section 08 11 13 - Steel Doors and Frames

D. Section 08 11 14 - Bullet-Resistant Steel Doors and Frames

E. Section 08 33 23 - Overhead Coiling Doors

1.3 SUBMITTAL REQUIREMENTS

A. General: Submit in accordance with Division 01 00 00.

B. Before any materials are delivered to the job site, the Contractor shall submit a complete list of all materials proposed to be furnished and applied under this section.

C. For each product, the Contractor shall provide the manufacturer's specific application instructions.

1.4 QUALITY ASSURANCE

A. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

1. Steel Structure Painting Council Specifications (SSPC).
2. National Association of Corrosion Engineers Standards (NACE).
3. Applicable Standards of American National Standards Institute, Inc. (ANSI).
4. Occupational Safety and Health Act regulations (OSHA).

B. Painter's Qualifications. The Contractor shall cause the work specified under this section to be performed by or under the supervision of a qualified painter. The Contractor shall be prepared to document the painter's experience, competence and ability to comply with the requirements of these specifications and to complete the work in a timely manner.

C. Standard Products. All materials, supplies and articles provided shall be the standards products of recognized, reputable manufacturers. All coatings shall be the products of a single manufacturer. The Contractor shall also minimize the number of suppliers.

D. The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the satisfaction of the Engineer they are equal in composition, durability, usefulness and convenience for the purpose intended.

1.5 DELIVERY AND STORAGE

A. All materials shall be delivered to the job site in their original, unopened containers bearing the manufacturer's name, brand, batch number, date of manufacture, and any special directions. Only the approved material shall be stored at the job site and stored only in designated areas restricted to the storage of paint materials and related equipment. All coatings shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored to conform with state and local safety codes. Materials shall be protected from freezing. Materials exceeding storage life recommended by the manufacturer will be subject to rejection and, if so rejected, removed from the site.

1.6 MANUFACTURER REPRESENTATION

A. Require the manufacturer to make available a qualified technical representative to visit the job site for technical support if necessary, in order to resolve field problems attributable to or associated with the manufacturer's products furnished under this contract.

1.7 PROTECTION OF SURFACES NOT TO BE COATED

A. Protect surfaces and equipment which are not to receive coatings during surface preparation, cleaning and painting operations.

B. Conduct spraying of coatings under controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from spray operations.

PART 2 PRODUCTS

2.1 ANTI-GRAFFITI COATING AND PRIMER

A. Products:

1. Anti-graffiti coating: GRAFFITI PROOFER® GPA-300

a. PERFORMANCE CRITERIA:

1) ASTM D6578 - Graffiti Resistance Test (Level 10)

2) ASTM D4587 - Accelerated Weathering

b. TECHNICAL DATA:

1) STORAGE & HANDLING: Store between 40°F (4°C) to 90°F (32°C) in a cool, dry, well-ventilated area, out of direct sunlight and moisture.

2) Keep unused material tightly closed at all times. KEEP FROM FREEZING

2. Primer: Sealer Prime SCS-002SP
    a. PERFORMANCE CRITERIA:
        1) Water Absorption
            a) ASTM C 67 and 642-90: 4% max. after 24hr./75F
        2) Water Vapor Transmission Rate
            a) ASTM E 96-56:11.82 Perms
        3) Water Vapor Transmission
            a) ASTM D1653-93: 4.97 grains/hr/ft2
        4) Household Chemicals
            a) ASTM D1308-97: Pass
    b. TECHNICAL DATA:
        1) STORAGE & HANDLING: Store between 40°F (4°C) to 90°F (32°C) in a cool, dry, well-ventilated area, out of direct sunlight and moisture.
        2) Keep unused material tightly closed at all times. KEEP FROM FREEZING

B. Manufacturer:
    1. SEI Industrial Chemicals
    2. Substitutions: None

PART 3 EXECUTION

3.1 SYSTEM 1 - COATING OF EXTERIOR METAL

A. Area of Application: All exterior metal doors/metal components on the sides of the pump station buildings (areas susceptible to graffiti).

B. Protective coating required:
    1. Two coats of GRAFFITI PROOFER® GPA-300

3.2 SYSTEM 2 - COATING OF SPLIT FACE CONCRETE BLOCK

A. Area of Application: All exterior exposed split face concrete block surfaces.

B. Protective coatings required:
    1. Two coats of Sealer Prime SCS-002SP
    2. Two coats of GRAFFITI PROOFER® GPA-300

3.3 SURFACE PREPARATION

A. ALL SURFACES:

1. The surface is to be dry, clean and free of any foreign matter including corrosion, hydrocarbons, moisture, ice, efflorescence, silicones, fluoro-products, etc.
2. Always test the coatings adhesion and performance before a full application.
3. To help achieve greater coverage rates when applying to a porous substrate, first apply SEI Industrial's SCS-002SP in accordance with manufacturers' suggested application guidelines.
4. Allow porous substrates to dry for a minimum of 72 hours after pressure washing.
5. After rain, allow 48 hours to dry.
6. New concrete should be allowed to cure for 28 days.
7. All caulking and finishing should be done before Graffiti Proofer application.
8. Prior to application, protect all glass, vehicles and surrounding surfaces from overspray.
9. Always apply to a test area before proceeding with entire application.

B. SURFACE TEMPERATURE:

1. 40°F (4°C) to 100°F (38°C).
2. Surface should be dry (at least 5°F (3°C) above the dew point) with no damp or frozen moisture within the substrate.
3. This product will cure slower in lower temperatures.

3.4 COATING APPLICATION

A. TYPICAL COVERAGE RATES:

1. Anti-graffiti coating: GRAFFITI PROOFER® GPA-300

Surface	Square Feet per Gallon	Surface	Square Feet per Gallon
Concrete	125 - 200	Wood	150 - 200
Brick	125 - 175	Rough Painted	175 - 225
C.M.U.	125 - 175	Smooth Painted	225 - 300
Split-Faced Block	125 - 150	Metal(s)	225 - 300
Stucco	150 - 225		

2. Primer: Sealer Prime SCS-002SP

Surface	Square Feet per Gallon	Surface	Square Feet per Gallon
CMU - Fluted	35 - 65	Rough Wood	50 - 80
CMU - Split face	30 - 60	Smooth Wood	80 - 125
CMU - Smooth	80 - 100	Wood Shingles	70 - 90
Rough/cracked	30 - 60	Smooth Stone	100 - 125
Exterior Brick	60 - 80	Metal(s)	150 - 300
Concrete	80 - 100	Smooth Painted	150 - 170
Concrete Block	80 - 100	Rough Painted	100 - 150
Stucco	60 - 80		

B. CURING TIMES:

1. Anti-graffiti coating: GRAFFITI PROOFER® GPA-300

a. CURING TIMES @ 75°F (24°C):

1) To Touch: 2 - 3 hours

2) Full Cure: 4 - 5 hours (Full moisture and graffiti protection)

3) To Recoat: 30 min. - 2 hours

2. Primer: Sealer Prime SCS-002SP

1) CURING TIME: 75F (24C):

a) Dry Time: 45min. - 1 hour

b) To Recoat: 30 minutes

C. APPLICATION LIMITATIONS:

1. LIMITATIONS:

a. Product application must not be initiated during inclement weather or when precipitation appears to be imminent.

b. Product must not be applied to wet, frozen or dirty surfaces.

c. Product must not be applied when conditions are windy as over spray is a hazard and environmental contaminants dispersed from windy conditions can land in the coating during curing.

d. Always apply test area before proceeding with entire application.

D. GRAFFITI PROOFER GPA-300

1. GENERAL INFORMATION:

a. For optimum performance, allow individual coats to fully cure before applying the next application.

2. MIXING:

   a. Mix well by shaking the product container. After mixing, ensure the product is clear in appearance, consistent in thickness and that there is no settled/cured material within the container. Any cured or foreign material must be removed, by pouring the product through a paint strainer, prior to application.

3. POT LIFE & THINNING:

   a. Do not thin. Pot life can vary dependent upon temperature and humidity. Application time should not exceed 8 hours after the product has been opened.

4. EQUIPMENT:

   a. Apply via HVLP, airless sprayer, pump sprayer, aerosol can, roller or brush. Use a flood coat and apply liberally.

5. ROLLER:

   a. Use a ½" synthetic nap roller. Apply to porous substrates from the bottom up. To help ensure the product penetrates porous substrates, saturate the roller and apply slowly, allowing excess product to build on top of the roller.

6. SPRAY:

   a. Use a clean, independent line when spraying and use a .011 -.021" spray tip. Apply from top to bottom, chasing runs, and back-roll if needed. This will typically provide a 6 MIL WFT and 2 MIL DFT. Product can be applied wet-on-wet or wet-on-dry. For optimum performance allow the first coat to fully dry and cure before applying the second coat.

7. CLEANUP:

   a. Flush and clean all equipment immediately after use. MEK (Methyl Ethyl Ketone) is the preferred cleaning solvent, but mineral spirits may also be used. If flushing with mineral spirits, extreme care must be taken to ensure that ALL product is removed from spray lines.

8. APPLICATION TIPS:

   a. Ensure primer is fully cured before applying Graffiti Proofer.

   b. Ensure coverage is uniform by standing 2"- 3" away from the substrate while standing parallel to the surface (looking across the substrate at a 180° angle). The applied film should appear shiny across the entire surface. Reapply the Graffiti Proofer to any areas that are visually dull in appearance.

   c. Once cured, use a dry cloth to rub back and forth across the Proofer's surface. If this causes the Proofer to ball up and release from the surface, a second coat should be applied, allowed to cure and retest again. If rubbing the dry film with a dry cloth does not remove the Proofer from the substrate, proceed with the next step to test graffiti removal performance.

The Dry Film Thickness (DFT) must be 2 mils or greater (6 mil WFT) to ensure proper graffiti removal performance.

9. Upon completion of all coating activities, the Contractor shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other coating-related damage.

E. SEALER PRIME SCS-002SP

1. GENERAL INFORMATION:

   a. SCS-002SP is designed for above grade use only.

   b. Take special care to saturate joints, cracks and large pores.

   c. When first applied, the emulsified resins appear milky white. The micro emulsions will then coalesce drying clear and colorless. The milky appearance should last no longer than approximately 30 minutes.

   d. When applying the SCS-002SP for use a prime coat, always test an inconspicuous area to determine how fast the sealer is absorbed into the substrate. After the test application, let dry for 30-60 minutes and then feel the dry film on the substrate. Press your thumb firmly against the dry film and pull back slowly; one should feel a sticky sensation. If this is not experienced the SCS-002SP has not provided a sufficient film and an additional coat should be applied.

2. WATER BEAD TEST:

   a. Spray water onto the dry film with a trigger spray bottle. Water will either bead on the surface or darken/wet out the underlying substrate, which indicates absorption and an additional coat should be applied. If the water beads and does not absorb or darken the substrate the film is providing some moisture protection. For further and more in depth technical testing use a Rilem Tube to test the film's moisture resistance. If the SCS-002SP has passed the Water Bead and/or Rilem Tube test(s), the coating is intact and ready for an application of a topcoat.

3. MIXING:

   a. Mix well by shaking the product. Ensure there is no settled/cured material on the film or within the container. Cured or foreign matter must be removed prior to application.

4. POT LIFE & THINNING:

   a. Do not thin. Pot life can vary depending temperature and humidity but typically open product can be used for up to 1 month if sealed and stored according to specification.

5. APPLICATION EQUIPMENT:

   a. Mix or shake well before application. Ensure product is consistent in thickness after stirring. Apply via HVLP, airless sprayer, pump sprayer, roller or brush. Use a flood coat and apply liberally.

b. Roller:

1) Use ½" synthetic nap roller. To a porous substrate apply from the bottom up. Excess buildup of product can accumulate on roller. Allow the product to saturate and flood the top of the roller and apply slowly as this will allow product to penetrate the substrate.

c. Spray:

1) Apply with low pressure using a tip size ranging from .011-.021". Back roll if needed. Apply from top to bottom chasing runs. Product can be applied wet on wet or wet on dry. For optimum performance allow the first coat to fully dry and cure before applying the second coat.

2) Hold spray tips 4-12 inches from the surface depending on application and substrate, start at the top and work down the substrate chasing the run with an overlapping horizontal spray pattern.

6. CLEAN UP:

a. Flush and clean all equipment immediately after using warm soapy water.

7. STORAGE & HANDLING:

a. Must be stored and handled in compliance with all current local regulations for flammable liquids. Store in cool, dry, well-ventilated areas, out of direct sunlight and moisture.

8. GENERAL APPLICATION NOTES:

a. Allow a minimum of 2 hours to cure before proceeding with water-bead testing as described below.

b. Spray water via a hand-pump or trigger sprayer onto the application area to determine if any substrate darkening occurs. If a sufficient amount of SP has been used, the substrate should not darken and the water will bead up on the surface. Water may also be sprayed onto an uncoated area to determine the highest level of darkening to compare against. If an unacceptable amount of darkening occurs on the SP applied area, and water does not simply bead up and run off the surface, an additional coat of SP should be applied, allowed to cure and the surface should be retested for darkening via the same water test method. If a second coat of SP prevents the substrate from darkening when using the water test method, it may be possible to decrease the coverage rates for the first coat of SP to alleviate the need for applying a second coat.

c. Substrate areas that have received concrete patching material may have increased absorbency and may require more SP to be applied while carrying out the initial product application.

9. Upon completion of all coating activities, the Contractor shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other coating-related damage.

3.5 TESTING

A. GRAFFITI PROOFER GPA-300

1. A minimum of 24 hours curing time is ideal before testing graffiti removal performance.

2. When testing the Proofer's cured film for graffiti removal performance, apply spray paint to a small inconspicuous area and allow the spray paint to fully cure before proceeding with its removal.

    a. Not allowing the spray paint to fully cure before removing it, may damage the Proofer's film.

3. A dry cloth is an acceptable means of testing for removing graffiti from the cured film; however, dampening the cloth with water will allow it to slide across the protective coating much easier. If the coating film is of proper thickness, spray paint should be easily removed.

3.6 REMOVAL OF GRAFFITI

A. Remove graffiti as soon as possible after surface has been vandalized.

B. If the coating has been damaged or removed, make sure the surface is clean and dry and reapply as described in the Application section.

C. Always test chemical cleaners before moving into a full application.

D. Options for removing graffiti:

1. Dry rag or cloth

    a. To remove markers always use a dry cloth first.

2. Pressure washer with pressure setting of less than 1000 psi.

3. Water and no more than 10% detergent with a rag or cloth.

4. SEI's TWL-200 Graffiti Remover Towels

5. SEI's Graffiti Remover GR-SYS-P

E. Flush the coating with water after chemical cleaning to ensure the integrity of the coating.

F. For removing graffiti over large areas, or for removing graffiti from rough surfaces:

1. Use a cold-water pressure washer with a 25 - 40° nozzle and a pressure setting of 1,000 psi or less.

2. Start the flow of water away from the removal area and then reposition the nozzle at a slight angular distance of 4"- 6" from the Graffiti Proofer coated surface.

3. Move the pressure washing wand in a continuous back and forth motion, so as not to focus the nozzle in one location during the graffiti removal.

    a. Focusing the nozzle in one location may damage the Proofer's film.

END OF SECTION

SECTION 09 97 14

WATER STORAGE TANK PAINTING

PART 1 GENERAL

1.1 SCOPE

A. The work of this section includes the coating of all interior surfaces, and the painting of all exterior surfaces on new tanks.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Related Sections:

1. Section 33 13 13 Water Storage Tank Disinfection.

2. Section 33 16 19 Welded Steel Water Storage Tank.

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of interior and exterior surfaces and inspection shall conform to the applicable requirements of the Society for Protective Coatings, NACE International, ASTM (American Society for Testing and Materials), AWWA and the manufacturer's printed instructions.

B. American Society for Testing and Materials (ASTM) International:

1. ASTM D520 Standard Specification for Zinc Dust Pigment

2. ASTM D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

3. ASTM E337 Standard Practice Test Method for Measuring Humidity with a Psychrometer

4. ASTM D2200 Standard Methods of Evaluating Degree of Rusting on Painted Surfaces

5. ASTM D5402 Solvent Resistance Rub Test

C. American National Standards Institute (ANSI)

1. ANSI/ASC 29.4 Exhaust Systems
Abrasive Blasting Operations – Ventilation and Safe Practice

D. American Water Works Association (AWWA)

1. AWWA D102 Coating Steel Water Storage Tanks

E. Consumer Product Safety Act, Part 1303

F. Environmental Protection Agency

1. EPA 524.2 Revision 4 Purgeable VOCs by GC/MS

G. National Association of Corrosion Engineers (NACE) International

1.	NACE Publication TPC2	Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
2.	NACE Standard SP0178	Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
3.	NACE Standard SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates (Holiday) Testing of Protective Coatings
4.	NACE Standard RP0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
5.	NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete

H. Occupational Safety & Health Administration (OSHA)

1. 1915.35Standards – 29 CFR – Painting

I. Society for Protective Coatings (SSPC)

1.	SSPC-SP2	Hand Tool Cleaning
2.	SSPC-SP3	Power Tool Cleaning
3.	SSPC-PA-1	Shop, Field and Maintenance Painting
4.	SSPC-PA-2	Measurement of Dry Film Thickness with Magnetic Gages
5.	SSPC-PA-3	Guide to Safety in Paint Application
6.	SSPC-Guide 12	Guide for Illumination of Industrial Painting Project
7.	SSPC-VIS 1-89	Pictorial Surface Preparation Standards for Painting Steel Surfaces
8.	SSPC Paint Spec 36	Two Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based

J. SSPC/NACE Joint Standards

1.	SSPC-SP5/NACE 1	White Metal Blast Cleaning
2.	SSPC-SP6/NACE 3	Commercial Blast Cleaning
3.	SSPC-SP7/NACE 4	Brush-Off Blast Cleaning
4.	SSPC-SP10/NACE 2	Near-White Metal Blast Cleaning

K. NSF International / American National Standards Institute (ANSI)

1. NSF/ANSI 61 - Drinking Water System Components - Health Effects

2. NSF 600 Health Effects – Solvent Criteria

L. The Engineer's decision shall be final as to the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.4 CONTRACTOR QUALIFICATIONS

A. Contractor shall have five years practical experience and successful history in the application of specified product to surfaces of steel water tanks. Upon request, he shall substantiate this requirement by furnishing a list of references and job completions.

B. The personnel performing the work shall be knowledgeable and have the required experience and skill to adequately perform the work for this project, in accordance with SSPC-PA1, “Shop, Field and Maintenance Painting”.

1.5 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Engineer.

B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces: SSPC-VIS 1-89”, ASTM D2200-95, "Standard Methods of Evaluating Degree of Rusting on Painted Surfaces”, ASTM D 4417-91, Method A and/or Method C or NACE Standard RP0287-87. In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard RP0178-91, along with the Visual Comparator, shall be used to verify the surface preparation of welds.

C. Application: No coating or paint shall be applied when: 1) the surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein, 2) rain, snow, fog or mist is present, 3) the surface temperature is less than 5 degrees F above the dew point, 4) the air and steel temperature is below 50°F or above 120°F, the air temperature is expected to drop below the minimum temperature for the products specified within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. If any of the above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

D. Thickness and Holiday Checking: Thickness of coatings and paint shall be checked with a non-destructive, magnetic-type thickness gauge, as per SSPC-PA 2 “Measurement of Dry Film Thickness with Magnetic Gages”. References in SSPC-PA 2 which allow 80% of the minimum thickness specified are not acceptable. Use an instrument such as a Tooke Gauge if a destructive test is deemed necessary by the Engineer.

E. The integrity of interior coated surfaces shall be checked with a low voltage holiday detector in accordance with NACE Standard RP0188. Non-destructive holiday detector shall not exceed 67.5 volts, nor shall destructive holiday detector exceed the voltage recommended by the manufacturer of the coating system. A solution of 1 ounce non-

sudsing type wetting agent, such as Kodak Photo-Flo, or approved equal, and 1 gallon of tap water shall be used to perform the holiday testing. All pinholes and/or holidays shall be marked and repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating. Holiday testing frequency shall be 100%.

F. Inspection Devices: Contractor shall furnish, until final acceptance of coating and painting is accepted, inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates and/or plastic shims, depending upon the thickness gauge used, to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors. Dry film gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.

G. Independent NACE Inspection: Inspection for this project shall include inspections conducted by an independent National Association of Corrosion Engineers (NACE) certified inspector with a minimum of five years documented experience on similar projects.

1. Contractor shall identify and propose an independent NACE certified inspector, who possesses appropriate professional liability insurance and is completely independent of the tank and coating manufacturers, to inspect the work at Contractor’s expense. Contract shall submit name and qualifications of NACE certified inspector to Engineer and Owner for approval prior to commencing work.
2. The NACE certified inspector will identify the testing and test sequencing requirements prior to commencement of the work. The Contractor shall coordinate activities with the Engineer and NACE certified inspector related to the inspection of surface preparations and coatings as well as a holiday inspection, as required by the NACE certified inspector.
3. At a minimum, the inspector shall inspect the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the tank in service. Contractor will ensure that sufficient rigging is in place so that the inspector shall be able to conduct the required inspections.

H. MEK Double Rub Test: After the tank has reached “full cure” in accordance with the recommendations and written published data sheets of the coating manufacturer, the inspector shall perform MEK double rub tests in accordance with ASTM D5402 to verify curing of the interior coating system.

1.6 WARRANTY INSPECTION

A. Warranty inspection shall be conducted during the eleventh month following acceptance of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Engineer and/or Owner.

1. The NACE certified inspector will attend the Warranty Inspection at the Contractor's expense, along with the Contractor, Engineer and Owner Representative.

B. Inspection Procedure:

1. Contractor shall coordinate with Owner, Engineer and NACE Inspector prior to inspection.
2. Owner shall drain the tank prior to inspection, at Owner's expense.
3. Contractor shall provide all equipment and support required to give the NACE Inspector safe access to all interior and exterior surfaces. Such equipment and support may include scaffolding, ventilation, or other safety equipment, as needed.
4. NACE Inspector shall inspect the interior and exterior of the tank for visual defects, holidays, and other criteria deemed necessary by the Inspector.
5. After inspection, Contractor shall immediately repair all defects identified by the Inspector, in accordance with coating manufacturer's recommendations.
   a. In the event that the Contractor is not able to repair all defects immediately and the tank must be refilled prior to repair, Contractor shall be responsible for any subsequent draining and refilling of the tank at Contractor's expense.
6. After all repairs are completed and accepted by the Owner, Contractor shall disinfect the tank at Contractor's expense, in accordance with Section 33 13 13 – Water Storage Tank Disinfection.
7. Water to refill the tank one time shall be provided at no expense to the Contractor.

C. Repair of Coating Failures:

1. Documented coating failures shall be repaired by the Contractor in accordance with the coating manufacturer's recommendations.
2. If the repairs require that the tank be drained, the Contractor shall coordinate the work with the water system operator and provide all equipment, labor and materials, including temporary storage if necessary, to complete the repairs.
3. Upon completion of the repair work, the tank will be disinfected in accordance with AWWA requirements and placed back into service.

1.7 SAFETY AND HEALTH REQUIREMENTS

A. The requirements listed herein are not exhaustive, and nothing in these specifications shall relieve Contractor from full responsibility over all aspects of safety on the project.

B. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site. The Contractor's work forces should comply with the provisions outlined in SSPC-PA-3 "A Guide to Safety in Paint Application".

C. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition,

workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

D. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to a degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

E. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protection devices.

F. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.

G. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer.

1.8 PRODUCT DELIVERY, STORAGE & HANDLING

A. All materials shall be brought to the jobsite in original sealed containers. They shall not be used until the Engineer, or Resident Project Representative, has inspected the contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings and paints must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

PART 2 MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

A. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Company, Inc are listed herein, but equivalent products by other manufacturers of comparable quality may be used. Equivalent products of other manufacturers shall be submitted for review and approval by the Engineer prior to use.

B. Requests for substitution or equal products shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness and product data showing it to be equal the performance criteria of the products specified herein.

C. All requests for product substitution shall be made via submittal.

D. Manufacturer's color charts shall be submitted to the Engineer at least 30 days prior to coating and/or paint application. General Contractor and Painting Contractor shall coordinate work so as to allow sufficient time (normally seven to ten days) for paint to be delivered to the job site.

2.2 GENERAL REQUIREMENTS

A. All materials shall be lead-free as defined by the Consumer Product Safety Act, Part 1303.

B. All zinc dust pigment contained in any zinc-rich material, if used, shall meet the requirements of ASTM D520 Type III as regards zinc content and purity.

C. All materials for the interior of the tank shall meet the requirements of ANSI/NSF Standard 61 for potable water contact to include VOC compliance with NSF 600.

D. All high gloss clear coat products shall incorporate the use of a fugitive dye to aid in the proper application and coverage of such coats.

E. All catalyzed polyurethane products shall meet the minimum requirements of SSPC Paint Specification Number 36, Level 3 Performance Level.

F. No products containing MOCHA shall be allowed.

G. Inorganic zinc-rich primers shall not be utilized as a permanent part of the interior coating system on this project. Inorganic zinc-rich pre-primers, if used, shall be completely blasted and removed prior to installing the coating system on the interior water compartment. All surface preparation shall be to the degree specified herein.

2.3 MATERIAL PREPARATION

A. Mix and thin materials according to manufacturer's latest printed instructions.

B. Do not use materials beyond manufacturer's recommended shelf life.

C. Do not use mixed materials beyond manufacturer's recommended pot life.

2.4 TANK INTERIOR COATING SYSTEM

A. Polyamidoamine Epoxy System:

1. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour.

2. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.

3. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor profile shall be 2.0 to 3.0 mils as per ASTM D4417, Method C or NACE Standard RP0287. Anchor profile shall be primarily angular and irregular, as produced by grit.

4. A brush applied stripe coat shall be applied to all weld seams and irregular edges, corners and crevices prior to spray application.

5. Coating System:

Primer: Tnemec Series 21-1255 Beige Epoxoline, or equal, applied at 4.0 to 6.0 dry mils. Thin only with approved thinner, No. 88 Thinner, or equal.

Finish Coat: Tnemec Series 21-WH16 Off White Epoxoline, or equal, applied at 10.0 to 12.0 dry mils. Thin only with approved thinner, Tnemec No. 88 Thinner, or equal.

Total dry film thickness shall be 14.0 to 18.0 mils per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.

2.5 TANK EXTERIOR COATING SYSTEM

A. Hydrophobic Acrylic Polymer System:

1. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.

2. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be 1.5 to 2.5 mils as per ASTM D4417, Method C or NACE Standard RP0287.

3. A brush applied stripe coat shall be applied to all weld seams and irregular edges, corners and crevices prior to spray application.

4. Coating System:

Primer: Tnemec Series N69-1255, Beige Hi-Build Epoxoline II, or equal, applied at 4.0 to 6.0 dry mils. Thin only with approved thinner, Tnemec No. 4 or No. 60 Thinner, or equal.

Finish Coat: Tnemec Series 1029 Enduratone Finish, or equal, applied at 2.0 to 3.0 dry mils. Thin only with approved thinner, clean tap water.

Total dry film thickness shall be 6.0 to 9.0 per SSPC-PA 2 dry film inspection standards, with exception as noted in this specification.

2.6 Exterior Tank Floor (Underside):

A. Coat underside of floor with 20 mil DFT of coal tar epoxy, Tnemec Series 46H-413.

B. It is not necessary to re-coat the underside of the floor after welding.

2.7 Interior Roof Laps:

A. Interior: Match tank interior coating schedule

B. Seal welds for interior lap joints are required, Sikaflex-1a will not be accepted.

2.8 Above-Ground Pipes:

A. Interior: Match tank interior coating schedule

B. Exterior: Match tank exterior coating schedule

2.9 Buried Pipes and Fittings:

A. Interior: Match tank interior coating schedule

B. Exterior:

1. Surface preparation: SSPC-SP10 Near-White Blast
2. Coal tar epoxy coating, min. 10 mil DFT, Tnemec Series 46H-413.
3. Cold-applied tape coating in accordance with AWWA C209. Minimum overlap of 1-inch and total coating thickness not less than 80 mils. Provide tape coating in addition to coal tar epoxy coating.

PART 3 EXECUTION

3.1 GENERAL

A. All surface preparation, coating and painting shall conform to applicable standards of the Society for Protective Coatings, NACE International and the manufacturer's printed instructions. Materials applied to the surface prior to the approval of the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.

B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be coordinated with the Engineer.

C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign and change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the coating or paint must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

E. Coating and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise approved in writing by the Engineer, prime coating shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the specified finish coat. Any off-site work which does not conform to this specification is subjected to damage during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire-brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted surfaces, blast cleaning may require use of lower air pressure, smaller nozzle and/or abrasive blast particles, or shorter blast nozzle distances from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, the entire item shall be blasted and then coated or painted as directed by the Engineer.

F. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Engineer.

G. Application of the first coat shall follow immediately after surface preparation and cleaning and stripe coat, if applicable, before rust bloom occurs or the same day, whichever is less. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat. Use of dehumidification equipment shall be first reviewed by the Engineer and coatings manufacturer prior to deviating from this provision.

H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

I. If the recoating time window stipulated by the coating manufacturer for any primer or intermediate coat is exceeded, the primer or intermediate coat shall be scarified by sweep blasting per SSPC-SP7/ NACE No. 4 to achieve the surface condition necessary to receive and properly adhere to subsequent finish coats.

3.2 SURFACE PREPARATION

A. The latest revision of the following surface preparation specifications of the Society for Protective Coatings (SSPC) shall form a part of this specification. The summaries listed below are for informational purposes; consult the actual SSPC specification for full detail.

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to a degree specified by hand chipping, scraping, sanding and wire-brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter by power wire-brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5/NACE No. 1): Air blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6 NACE No. 3): Air blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7 NACE No. 4): Air blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to a degree specified.

7. Near-White Metal Blast Cleaning (SSPC-SP10 NACE No. 2): Air blast cleaning until at least 95% of each element of surface area is free of all visible residues.

8. Power Tool Cleaning to Bare Metal (SSPC-SP11): Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil.

B. Slag, weld metal accumulation and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and/or grinding. All sharp edges shall be peened, ground or otherwise blunted as required by the Engineer. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting. Welds shall be prepared as per NACE Standard RP0178 for all interior and exterior surfaces:

1. Butt Welds: Shall be ground smooth and free of all defects, designation "D".
2. Lap Welds: Shall be ground smooth and blended, designation "D".
3. Fillet Welded Tee Joint: Shall be ground smooth and blended, designation "D".

C. All recycled abrasives used in automated shop blasting shall be clean as per SSPC-AB2 "Cleanliness of Recycled Ferrous Metallic Abrasives". All shop blasting utilizing centrifugal-type equipment shall utilize a blend of shot and grit (maximum of 80% shot). In no case shall steel shot alone be permitted. After blast cleaning, the surface of the steel shall appear angular and irregular. Should the surface appear peened or undulating, the steel shall be reblasted to achieve the correct appearance.

D. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed. Blast nozzles shall be venturi-type nozzles with a minimum pressure at the nozzle of 90 psi.

E. Particle size of abrasives used in blast cleaning shall be selected to produce the surface profile specified above or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

F. All shop-primed surfaces shall receive a uniform and thorough sweep-blast as per SSPC-SP7/NACE No. 4. All bare metal areas shall be abrasive blasted as per SSPC-SP10/NACE No. 2 Near-White Blast Cleaned for interior surfaces. All bare metal areas shall be abrasive blasted as per SSPC-SP6/NACE No. 3 Commercial Blast Cleaned for exterior surfaces.

G. If the profile of the blasted steel exceeds the profile specified above, the Contractor shall be required to do one or both of the following:

1. Reblast the surface using a finer aggregate in order to produce the required profile.
2. Apply a thicker prime coat, if possible given the limitations of the products being applied, in order to adequately cover the blast profile

H. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved in writing by the Engineer.

I. During blast cleaning operations, caution shall be exercised to ensure that existing coatings or paint are not exposed to abrasion from blast cleaning.

J. Contractor shall keep the area of his work and the surrounding environment in a clean condition. Contractor shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities or to the surrounding environment.

K. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. All surfaces shall be free of dust, dirt, and other residue resulting from the abrasive blasting operation. No coatings or paint shall be applied over damp or moist surfaces.

L. Brush-Off Blast surfaces coated with zinc-rich materials to remove any contamination prior to subsequent coats, per SSPC-SP7/ NACE No. 4.

M. Pitted areas on the tank interior shall be repaired by welding. Metal components exhibiting excessive pitting, as determined by the NACE Inspector, shall be rejected.

N. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Articles 2.4 and 2.5.

O. Sandblasting waste shall be disposed of off-site at an approved solid waste facility, at the Contractor's expense.

3.3 NON-VISIBLE CONTAMINANTS

A. Chloride, sulfate and ferrous ions (Fe^{2+}) tests shall be performed on the interior metal portions of the tank after sandblasting but prior to the application of coatings.

1. Perform a minimum of two tests per 1,000 square feet.

2. The maximum allowable limit of these non-visible contaminants is:

a. The maximum level of chlorides is 30 milligrams per square meter or 3 micrograms per square centimeter.

b. The maximum level of sulfates is 100 milligrams per square meter or 10 micrograms per square centimeter.

c. The maximum level of ferrous ions (Fe^{2+}) is 50 milligrams per square meter or 5 micrograms per square centimeter.

B. If testing shows amounts present in the test solution to be greater than the limits listed herein, the Contractor shall clean the surface of the entire tank interior with a 5,000 psi water blast with fine entrained abrasive until the levels in the test solutions are below the maximum acceptable level. Alternate cleaning methods may be allowed with prior approval of the Engineer. Surface shall be reblasted as specified in Articles 2.4 and 2.5 at no additional cost to the Owner.

C. Contractor shall provide a written statement from paint manufacturer stating that the maximum acceptable levels are not less than those listed herein. Results of the testing shall be provided to the Engineer before any coatings are applied.

3.4 APPLICATION, GENERAL

A. Coating and paint application shall conform to the requirements of the Steel Structure Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting".

B. Thinning shall be permitted only as recommended by the manufacturer and approved by the Engineer, and utilizing the thinners stated in Articles 2.4 and 2.5.

C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

D. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Report to the Engineer surfaces from which materials cannot be satisfactorily removed.

E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.

F. Film thickness per coat as specified in Articles 2.4 and 2.5 are the minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats as to achieve the specified thickness.
   1. Roller application shall not be used without prior written approval by Engineer.

G. Field-applied primer shall require a minimum 12-hour curing period after application in an environment maintained at between 20% and 40% humidity.

H. All material shall be as specified.

3.5 COATING SYSTEMS APPLICATION

A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Sections 2.4 and 2.5.

B. Care shall be taken so as to eliminate overspray and dry spray on the tank interior. Where such conditions are encountered, the surface shall be cleaned of all over spray and dry spray prior to the application of the succeeding coat.

C. Areas rendered inaccessible after tank erection such as the spaces between roof plates and rafters shall receive the full coating system prior to erection and/or assembly.

D. Full prime coat may be applied directly over stripe coat while stripe coat is wet.

3.6 DISINFECTION

A. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with all the requirements of Section 33 13 13 - Water Storage Tank Disinfection and applicable AWWA standards and regulatory agencies.

B. Disinfection shall be performed after protective coatings have been applied to the interior surfaces and allowed to thoroughly cure.

C. Prior to disinfecting, the complete interior shall be washed down with clean water and thoroughly flushed out.

3.7 SOLVENT VAPOR REMOVAL

A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing tank in operating service.

B. All solvent vapors will be exhausted both during and after coating application as per AWWA D102.

C. Ventilation shall be continued until such time as the coating has reached “full cure” as specified by the coating manufacturer.

3.8 VOC TEST

A. After the tank has reached “full cure” as specified by the coating manufacturer, VOC tests shall be performed on the tank interior coating system. Samples shall be collected for testing by the Owner or his representative. Tests shall be performed in accordance with EPA 524.2 Revision 4 Purgeable VOCs by GC/MS. Total VOCs shall not exceed 100 ppb/100 micrograms per liter for 24 hour and 72 hour intervals.

B. If the limits cited herein are exceeded, Contractor shall take all actions necessary to reduce the total VOCs to the level specified herein. This includes but is not limited to continuing forced air ventilation, steam cleaning the structure, and rinsing the structure with clean potable water.

3.9 CLEAN UP

A. Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Coating or paint spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired or refinished to the satisfaction of the Engineer at no cost to the Owner.

END OF SECTION

SECTION 22 11 05

CHLORINATION FACILITY PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pump house water piping.
2. Unions and flanges.
3. Gate valves.
4. Ball valves.
5. Check valves.
6. Pipe hangers and supports.
7. Sleeves.
8. Water pressure gauges.
9. Air release valves.
10. Pressure relief valves.
11. Hose bibs and sample cocks.
12. Booster pumps.
13. Tapping Saddles

B. Related Sections:

1. Section 03 05 00 - Basic Concrete Materials and Methods: Execution requirements for placement of concrete specified by this section.
2. Section 26 27 33 - Chlorinator Instrumentation and Controls
3. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
4. Section 31 23 23 - Backfill: Requirements for backfill to be placed by this section.
5. Section 33 11 00 - Water Utility Distribution Piping: Product and execution requirements for underground water piping.
6. Section 33 13 00 - Disinfection of Water Distribution: Product and execution requirements for disinfection of water piping.
7. Section 44 44 16 - Chlorination Equipment.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B31.9 - Building Services Piping.

B. American Society of Sanitary Engineering (ASSE):

1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1019 - Performance Requirements for Wall Hydrants, Freezeless, Automatic Draining, AntiBackflow Types.

C. American Society for Testing and Materials International (ASTM):

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
5. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Water Works Association (AWWA):

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C651 - Disinfecting Water Mains.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

F. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

5. Pumps: Submit pump type(s), capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on metallic and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 General

A. All materials in contact with water shall be NSF61-certified.

B. All bolts, nuts, and washers in chemical room shall be stainless steel 316, and shall be provided by the valve or fitting manufacturer specifically for use with their respective components.

2.2 CHLORINATION BUILDING WATER PIPING

A. Steel Pipe: Refer to Section 33 11 00 – Water Utility Distribution Piping.

B. Ductile Iron Pipe: Refer to Section 33 11 00 – Water Utility Distribution Piping.

C. Polyvinyl Chloride (PVC): Schedule 80, ASTM D1785, at locations indicated on Drawings.

1. Fittings: PVC Schedule 80 per ASTM D2467.

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Steel Piping: Class 150, malleable iron, threaded.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
3. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Steel Piping: Class 150, forged steel, slip-on flanges.
2. Ductile Iron: Class 125 flanges
3. Copper Piping: Class 150, slip-on bronze flanges.
4. PVC Piping: PVC flanges.
5. CPVC Piping: CPVC flanges.
6. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.4 BALL VALVES

A. Stainless steel ball valves

1. May be imported or domestic
2. Manufacturers:
   a. Milwaukee Valve.
   b. Apollo
   c. Red White Valve Corp.
   d. Stockham
3. Working Pressure: Not less than 350 psi
4. Inlet/Outlet: NPT, or as shown on Drawings
5. All stainless steel construction, including body, tailpiece, ball, ball retainer, stem, handle, handle nut, packing nut, and lock washer
6. Valve shall be actuated manually using lever-type handle, one-quarter turn to open and close. Handle length and range of motion shall allow handle to be located in most accessible location without interference with any other object.

B. 4-inch Ball Valve

1. Manufacturers:
   a. Val-Matic Valve and Manufacturing Corporation
      1) Series 4200

2) Substitutions: Approved equal.

b. Pressure Rating:

1) Rated to 150 psi full differential working pressure.

2) Shell test pressure 300 psi.

3) Leak test at 150 psi.

4) Ductile iron body with ductile iron ball

5) Stainless steel trim and external fasteners

c. Coating: Fusion bonded epoxy conforming to AWWA C550 and NSF 61; interior/exterior.

d. Valve Ends:

1) Flanged ends drilled in accordance with ANSI Class 125 bolt pattern.

2) Pressure rating not less than that of valve body.

e. Handle and Operator:

1) Plant service actuator with handwheel.

i. Manufacturer & model: AUMA GS100.3, OAE

ii. Size: 126:1 reduction ratio. Fully closes valve in 31 turns of handwheel.

2) Handwheel maximum rim pull shall not exceed 80 lbs.

3) Actuators shall be self-locking type able to hold valve in any intermediate position without fluttering or creeping. Actuators shall have external travel stops for open and closed position adjustment. Internal stops which require actuator cover and grease removal shall not be used.

4) Actuators shall have mechanical position stops able withstand 450 ft-lbs of input torque.

5) Open left, close right.

6) Limit switch

i. Westlock Limit Switch Model 2007.

ii. Switch shall change state when valve is 100% open.

7) Lock and chain are to be installed around handwheel to prevent opening while pipeline is flowing.

C. PVC Ball Valves

1. Shall be used where called for on the Drawings, or for any additional ball valves required to be added to PVC piping within the chemical room.

2. Manufacturers:
    a. NIBCO, Inc.
    b. Spears Manufacturing Co.
    c. Substitutions: Approved equal
3. True union valve ends
4. PVC Schedule 80
5. Working pressure: 150 psi

2.5 CHECK VALVES

A. Manufacturers:
    1. Val-Matic Valve and Manufacturing Corporation, Surgebuster, Series 7200
    2. Substitutions: Approved equal

B. Swing check valve, complying with AWWA C508

C. Shall provide 100% flow area with a maximum disc travel of 35 degrees.

D. Cv factor shall be not less than 440 for 4" valve, not less than 1,040 for 6" valve and not less than 1900 for 8" valve.

E. Working pressure rating: 250 psi.

F. The valve body and cover shall be fabricated of ductile or cast iron conforming to ASTM A126.

G. Valve ends shall be either flanged conforming to ANSI B16 (Class 125), or mechanical joint, as indicated on Design Drawings.

H. The valve disc shall be fabricated EDPM with alloy steel and nylon reinforcement.

I. Coating: Fusion bonded epoxy conforming to AWWA C550 and NSF 61; interior/exterior.

2.6 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
    1. Carpenter & Paterson Inc.
    2. Creative Systems Inc.
    3. Flex-Weld, Inc.
    4. Glope Pipe Hanger Products Inc.
    5. Michigan Hanger Co.
    6. Superior Valve Co.
    7. Substitutions: Approved equal.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

E. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

F. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamps.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

2.7 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

2.8 WATER PRESSURE GAUGES

A. Manufacturers:

1. WIKA
2. Substitutions: Approved equal.

B. Must conform to ANSI B40.1 and have the following characteristics:

1. Liquid filled, altitude/psi process gauge.
2. Stainless steel isolation ball valve.
3. Accuracy: 0.5% of full scale.
4. Wetted materials: 316 SS.
5. Case material: Polypropylene; safety glass window.
6. Connection: 1/4" NPT(M), bottom.
7. Dial Size: 4-1/2".
8. Mounting: Stem or surface.
9. Range: As indicated on Drawings.

2.9 COMBINATION AIR VALVE:

A. Manufacturer:

1. Val-Matic Valve and Manufacturing Corporation, Model # 201C.2SV, Single Body Type.

2. Substitutions: Not permitted

B. Working pressure: 300 psi

C. Test Pressure: 450 psi

D. Intlet: 1” NPT

E. Cast iron body, cover and baffle; stainless steel trim, float, and fasteners.

F. Seat: Resilient Buna N.

G. Valve to perform functions of air release, pipe fill air exhaust and vacuum relief.

2.10 PRESSURE RELIEF VALVES

A. Manufacturers:

1. Watts, Model BP30.

2. Substitutions: Approved equal.

B. Bronze body with NPT threaded male inlet and NPT threaded female (drain) outlet connections, stainless steel spring and test lever.

C. Pressure relief setting as indicated on Drawings or as directed by Engineer.

2.11 HOSE BIBS AND SAMPLE COCKS

A. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel lock shield and removable key, integral vacuum breaker in conformance with ASSE 1011.

B. Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with hand wheels, and vacuum breaker in conformance with ASSE 1011.

C. Booster Pump (chemical room):

1. Pump Manufacturers:

a. Franklin: ModelBT4 5FBT05S4

b. Substitutions: Not permitted.

2. Flow Range: Up to 8 gpm.

3. Operating Duty Point: 2gpm @220’ TDH.

4. Horsepower: ½ HP

5. Single Phase

6. Stainless Steel shell, shaft, discharge housing and suction bracket.

7. Thermoplastic impellers and diffuser, floating eye seal, ceramic shaft sleeve, rubber discharge bearing.

2.12 TAPPING SADDLES

A. Tapping Saddles:

1. Manufacturers:

a. Romac Industries, Inc

b. JCM Industries, Inc

c. Substitutions: Approved equal.

2. Saddles shall only be used on taps 2-inches or smaller.

3. Chlorinator Room Taps: Stainless steel tapping saddles, JSM 502, OAE, heavyweight treaded outlet, full band type, with full circumferential SS band, 8" width stainless steel band.

4. All saddles shall be specifically designed for use on the type of pipe that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Minimum Working pressure rating: 200 psi.

7. Tapped Outlet: FNPT or as indicated on Drawings

8. All pipe taps shall be made with an engineer approved "tapping machine".

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end steel pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Inserts:

1. Provide inserts for placement in concrete forms.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

B. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708 and MSS SP 89.
2. Support horizontal piping as schedule.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping sheet lead packing between hanger or support and piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1-inch above finished floor level. Caulk sleeves.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Install non-conducting dielectric connections wherever joining dissimilar metals.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

D. Group piping whenever practical at common elevations.

E. Slope piping and arrange systems to drain at low points.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not accessible.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Provide support for utility meters in accordance with requirements of utility companies.

K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

L. Paint all steel pipe and uncoated ferrous appurtenances blue:

1. Minimum surface preparation: SSPC-SP1
2. Primer: 1 coat Sherwin Williams Galvite HS, OAE
    a. 3.0-4.5 mils dry film thickness
3. Finish: Two coats Sherwin Williams Industrial Enamel (B54 Series), OAE
    a. 2.0-4.0 mils dry film thickness
4. Follow all other paint manufacturer recommendations for preparation and application.

M. Install domestic water piping in accordance with ASME B31.9.

N. Sleeve pipes passing through partitions, walls and floors.

O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

P. Install unions downstream of valves and at equipment or apparatus connections.

Q. Install valves with stems upright or horizontal, not inverted.

R. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

S. Install gate ball or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers, if applicable.

T. Install globe ball or butterfly valves for throttling, bypass, or manual flow control services, if applicable.

U. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

V. Provide spring loaded check valves on discharge of water pumps, if applicable.

W. Provide flow controls in water circulating systems as indicated on Drawings, if applicable.

X. Install potable water protection devices on plumbing lines where contamination of domestic water may occur.

Y. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

3.6 INSTALLATION – BOOSTER PUMPS

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Support piping adjacent to pump so no weight is carried on pump casings.

C. Install pumps on vibration isolators.

D. Install flexible connectors at or near pumps where piping configuration does not absorb vibration.

E. Provide line sized shut-off valve and strainer pump suction fitting on pump suction, and line sized soft seat check valve, balancing valve, and shut-off valve combination pump discharge valve on pump discharge.

F. Provide air cock and drain connection on horizontal pump casings.

G. Provide drains for bases and seals.

H. Check, align, and certify alignment of base mounted pumps prior to start-up.

I. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

J. Lubricate pumps before start-up.

3.7 CLEANING

A. Prior to starting work, verify system is complete, flushed and clean.

B. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

C. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

D. Maintain disinfectant in system for 24 hours.

E. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

F. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

G. Take samples no sooner than 24 hours after flushing and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 26 01 00

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

1.2 ELECTRICAL DIVISION INDEX

26 01 00	General Electrical Provisions
26 05 23	Control Voltage Electrical Wire & Cables
26 11 00	Raceways
26 12 00	Wires and Cables
26 12 16	Transformers
26 13 00	Outlet Boxes
26 13 30	Cabinets
26 14 00	Wiring Devices
26 16 00	Panelboards
26 18 10	Fuses
26 19 00	Relays and Contactors
26 27 33	Instrumentation and Controls Requirements
26 45 00	Grounding
26 56 00	Exterior Lighting
26 60 10	Lightning Protection
27 43 30	SCADA PLC System

1.3 REQUIREMENTS

A. Furnish all labor, materials, service, equipment and appliances required to complete the installation of the complete Electrical System in accordance with the Specifications and Contract Drawings.

1.4 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. Regulatory Agencies: Installation, materials, equipment and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC) and the terms and conditions of the Electrical Utility and other authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations and authorities shall be made by the Contractor without additional charge.

B. Underwriters Laboratories (UL) or Factory Mutual (FM): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriters Laboratories, Inc. or Factory Mutual, Inc. The label of, or listing by, UL or FM is required.

C. Standards: Where referenced in these Specifications or on the Drawings, the publications and standards of the following organizations shall apply: Joint Commission on Accreditation of Healthcare Organizations (JCAHO), American Society of Testing and Materials (ASTM), Insulated Power Cable Engineers Association (IPCEA), National Fire Protection Association (NFPA), American National Standards Institute (ANSI), and National Electrical Manufacturers Association (NEMA).

D. Conflicting code requirements shall be brought to the attention of the Engineer. Where two or more codes apply, the most stringent of the codes shall govern.

1.5 SUBMITTALS AND SUBSTITUTIONS

A. Material List: Within 30 days of Contract Award or Notice to Proceed and before material is ordered, the Contractor shall submit for approval a list of all proposed material and equipment, indicating manufacturer's name and general description.

B. Shop Drawings: Submit for approval to the Engineer a minimum of six copies of all shop drawings no later than 30 days after the material list has been approved and prior to ordering any material. Show complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation. Indicate in the transmittal that submittal has been reviewed and accepted and all Contract deviations identified. In addition to specific references or requests; submit shop drawings for the following applicable items: panelboards, lighting fixtures, transformers, primary cable and gear, alarm systems and all special equipment.

C. Substitutions may be requested in accordance with the specification.

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS: The Electrical requirements for equipment specified or indicated on the Drawings are based on information available at the time of design. If equipment furnished for installation has Electrical requirements other than indicated on the Electrical Drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection, grounding, and installation as required to accommodate the equipment supplied, without additional charge to the Owner. All adjustments to the Drawings reflecting the Electrical System shall be delineated in a submittal to the Engineer immediately upon knowledge of the required adjustments. The complete responsibility and costs for such adjustments shall be assigned to the respective section of these Specifications in which the equipment is furnished.

2.2 MATERIALS

A. All similar materials and equipment shall be the product of the same manufacturer.

B. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the Contract requirements and meets the approval of the Engineer.

C. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.

2.3 ALTITUDE: Equipment affected by altitude shall perform satisfactorily the function intended at the altitude of the project site.

2.4 WET AREA EQUIPMENT: All equipment within the buildings shall be installed in a NEMA 3R, NEMA 12 or weatherproof enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), unless otherwise noted on the drawings.

PART 3 EXECUTION

3.1 GENERAL: Fabrication, erection and installation of the complete Electrical System shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surface where Electrical equipment or material is to be installed, removed or relocated and report any unsatisfactory conditions to the Engineer before starting work. Commencement of work signifies this Contractor's acceptance of the prevailing conditions.

3.2 TEMPORARY POWER AND LIGHTING: Furnish and install all temporary Electrical facilities required for construction and safety operation. No part of the permanent Electrical Systems or the existing Electrical System may be used for temporary service unless approved by the Engineer.

3.3 UTILITIES

A. GENERAL: The Drawings reflect requirements of the serving utilities based on information derived from representatives of the utilities. During the project design phase, the fact that the Engineer may undertake to show the utility(s) requirements, does not necessarily indicate that the Engineer represents the utilities or their requirements; therefore, within 10 working days after Contract Award and/or Notice to Proceed has been issued, the Contractor shall be responsible for coordinating the requirements of the utilities for the Power System. The Contractor shall be responsible for coordinating the requirements for the Telephone, and Fiber Optic, if applicable.

B. Any deviations from the documents shall be brought to the attention of the Engineer no later than 10 working days after Award of Contract and/or Notice to Proceed. Failure to notify the Engineer within the 10-day time frame signifies the acceptance of documents and utility requirements by the Contractor and all associated costs therein.

3.4 EXCAVATION: Comply with Division 31 “Earthwork”.

3.5 PERFORMANCE TESTS

A. Thoroughly test all fixtures, services and all circuits for proper operating conditions and freedom from grounds, surges, and short circuits before acceptance is requested. All equipment appliances and devices shall be operated under load conditions.

B. After the interior-wiring system installation is complete and at such time as the Engineer may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices and equipment after installation to assure that all material continues to possess all the original characteristics as required by the governing codes and standards as listed in these Specifications.

C. After occupancy of the building has taken place and nominal building power loads have been established, make voltage readings at all panelboards. Based on these readings make final

adjustments of taps on all transformers in the building, as directed by the Engineer. Submit to Engineer correspondence and/or drawing delineating readings.

D. Perform such other tests as required by other sections of these Specifications or as requested by the Engineer to prove acceptability.

E. Furnish all instruments and labor for testing.

F. The contractor will provide personnel to configure and startup all VFD's, Radio Transmitter Units (RTU'S) (including video signal or microwave transmission, if required), PLC control panels, starters and any other control or monitoring equipment not listed that was provided and installed by the Electrical Contractor at no additional cost to the owner.

3.6 OPERATING INSTRUCTIONS AND MANUALS

A. Instructions: Without additional charge to the Owner, the Contractor shall provide an experienced and competent representative to instruct the Owner or his representative fully in the concept, theory, operations, adjustment and maintenance of all equipment furnished for the Electrical System. Contractor shall provide at least two (2) weeks notice to the Engineer in advance of this period. Contractor shall provide DVD of instructions to Owner not less than two (2) weeks prior to scheduled final acceptance of the Project.

B. Manuals: Upon completion of the work, prepare and deliver to the Owner three (3) sets of complete operating and maintenance manuals for the systems and major equipment installed. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data. Operating and maintenance manuals as required herein shall be submitted to the Engineer for review and distribution to the Owner not less than two (2) weeks prior to the scheduled final acceptance of the Project.

C. Other: The above requirements are in addition to specific instruction and manuals specified for individual systems or equipment.

3.7 DRAWINGS

A. General: The Electrical Drawings show the general arrangement of all conduit, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The Architectural and Structural Drawings shall be considered as a part of the work insofar as these Drawings furnish the Contractor with information relating to the design and construction of the building. Architectural Drawings shall take precedence over Electrical Drawings. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, elbows, pullboxes and accessories as may be required to meet such conditions.

B. Field Measurements: The Contractor shall verify the dimensions governing the Electrical work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions and those indicated on the Drawings.

3.8 LOCATION OF EQUIPMENT AND OUTLETS

A. The approximate locations of cabinets, panelboards, wiring gutters, switches, lights, light outlets, power outlets, etc., are indicated on the Drawings; however, the exact location shall be determined after thoroughly examining the general building plans and by actual measurements during construction to avoid conflicts with any Structural, Architectural, or other trades, with all locations subject to the approval of the Engineer.

B. Verify with the Engineer all locations of conduit, boxes, etc., stubbed in the floor prior to installation.

3.9 IDENTIFICATION AND SIGNS

A. Mark each individual motor controller, disconnect switch, transformer and remote control device to identify each item with its respective service using engraved nameplates.

B. Provide nameplates with engraved lettering not less than 3/8" high where specified or noted. In general, use white core laminated plastic, attached with screws. Embossed plastic adhesive tape is not acceptable. Flush mounted devices may have identification engraved in the device plate.

C. Identify panelboards, transformers and cabinets by engraved nameplates with descriptions indicated on the Drawings together with indication of the location of the feeder overcurrent protection. Install on inside of hinged doors or panelboards and cabinets.

Example: Panel 2P

120/208V, 3-phase, 4-wire

Fed from Panel MDP/cct. #4

D. Provide warning signs on all equipment or devices operating at 300 volts or more, reading "DANGER-480 VOLTS", etc. with white letters on red background of standard code size. Signs shall be decals.

E. All underground utilities indicated on the Drawings shall have a 6" wide plastic marker installed continuously in the trench at 12" below grade. The marker shall have continuous markings embossed in the tape identifying the system installed, i.e., communications, fiber optic, telephone, power.

F. Identify all exposed conduits, junction and pullboxes at maximum intervals of twenty feet and as indicated below. Identify exposed conduits according to the system carried by means of appropriate UL-recognized Brady wire marking sleeves, conduit and voltage markers, or approved equal by the Owner. Identify junction and pullboxes by painted on stencils or approved labels. Identification shall be placed at necessary intervals on straight conduit runs, close to all terminations, adjacent to all changes in directions and where conduits pass through walls or floors. Permanent identification markings on the sleeve or marker shall be to specification. Primary labels shall include voltage and shall have black lettering on an orange background. Secondary labels shall include information regarding power distribution such as “Fire Alarm” or “Grounding” and shall have a color scheme as indicated below. If the conduit is less than ¾” in diameter, color banding plus tags may be used. Color banding shall be ½” wide and resist UV rays, abrasion, corrosion, alkali, and acids.

1. Electrical Conduit Color Code (Common Ground Alliance Best Practices and APWA Uniform Color Code)

Secondary Label and Banding Color	Conduit Contents
Red	Fire Alarm Systems
White	Access/Security Systems
Dark Blue/White	Data Systems
Gray	Telecommunications
Black	120/208 Volt Power
Orange	277/480 Volt Power
Green	Grounding
Black/White	Computer/Data
Red (White on Red)	Electric Power Lines, Cables, Conduit, and Lighting
Orange (Black on Orange)	Communication, Alarm
White on Red	Fire Alarm System
White on Brown	Can be used for clarity on a Conduit not mentioned

F. Identify all receptacles and switch devices with the circuit and overcurrent protection device. Identification may be by waterproof, permanent marker on the rear of the device cover plate or as approved by the Engineer and Owner.

3.10 WARRANTY: Deliver originals of all guarantees and warranties on this portion of the work to the Engineer. Warrant all equipment, materials and workmanship for one year in accordance with the terms of the Contract.

3.11 PRODUCT HANDLING: Use all means necessary to protect Electrical materials and equipment before, during and after installation and to protect the installed work of other trades.

3.12 RECORD DRAWINGS: As part of this Contract, the Contractor shall provide a complete marked-up set of Contract Documents indicating all changes to the documents during the project construction phase to the Engineer. Changes to the Electrical System shall be documented on a set of "Record Drawings" on a daily basis.

END OF SECTION

SECTION 26 05 23

CONTROL-VOLTAGE ELECTRICAL WIRE AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. RS-232 cabling.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.
5. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

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.

PART 2 - PRODUCTS

2.1 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.

4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1581.

2.2 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.3 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Shielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Control Circuits: Stranded copper, Type THHN-THWN, in raceway.

2.5 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Cable will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Cables may not be spliced. Secure and support cables at intervals not exceeding 6 inches from terminals.

2. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.

3. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination points. Remove and discard cable if damaged during installation and replace it with new cable.

4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

5. Pulling Cable: Monitor cable pull tensions.

C. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

D. Separation from EMI Sources:

1. Separation between cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

2. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

3. Separation between cables in grounded metallic raceways and power lines and electrical

equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

4 Separation between Cables and Electrical Motors and Transformers, 5 kVA or 3HP and Larger: A minimum of 48 inches.

5 Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.2 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

- Class 1 remote-control and signal circuits, No 14 AWG.
- Class 2 low-energy, remote-control, and signal circuits, No. 18 AWG.

3.3 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding."

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 26 Section "General Electrical Provisions"

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance.
2. Visually inspect cable placement, cable termination, grounding and bonding, and labeling of all components.
3. Test cabling for resistance, shorts, opens, intermittent faults, and polarity between conductors.

C. Document data for each measurement and submit.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 11 00

RACEWAYS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 CONDUITS

A. Rigid Steel Conduit: Rigid, threaded, thick-wall with zinc-coated on the inside and either zinc-coated or coated with an approved corrosion-resistant coating on the outside. Conduit installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Rigid Aluminum Conduit: Rigid, threaded, thick-wall type, approved for the application.

C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated or coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.

D. Rigid Non-Metallic Conduit: Schedule 40, high impact PVC with 7,000 psi tensile strength at 73.4 degrees Fahrenheit, 11,000 psi flexural strength, 8,600 psi compression strength, approved 90 degree conductors. Carlon, Triangle or approved equal.

E. Electrical Metallic Tubing (EMT): Mild steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.

F. Flexible Conduit: Commercial Greenfield, galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.

G. Liquid-Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid-tight PVC outer jacket and a separate grounding conductor installed in the conduit.

H. Conduit Size: Minimum conduit size 1/2" except where specifically approved for equipment connections. Sizes not noted on the Drawings shall be as required by the NEC.

2.2 CONDUIT FITTINGS

A. Rigid Steel Conduit, IMC and EMT Fittings: Iron, steel, die-cast only. Conduit fitting and bodies installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Rigid Aluminum Conduit Fittings: Malleable iron, steel or aluminum alloy. Ferrous fittings zinc-coated or cadmium plated. Aluminum alloy fittings shall conform to the characteristics defined by UL for rigid aluminum metallic conduit and shall not contain more than 0.04 percent copper.

C. Rigid Non-metallic Conduit Fittings: Approved for the purpose and as recommended by the manufacturer.

D. Flexible Conduit Fittings (Commercial Greenfield): Either die-cast, steel, or malleable iron only with insulated throats and shall be of one of the following types:

1. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.

2. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

3. Wedge and screw type with angular in-edge fitting between the convolutions of the conduit.

E. Liquid-tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon, or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seal.

F. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. Set-screw type fittings for rigid aluminum conduit not permitted. EMT couplings and connectors either die-cast, steel, or malleable iron only, "Concrete-tight" or "Raintight", and either the gland and ring compression type or the stainless steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set-screws or indentations as a means of attachment are not permitted.

G. Bushings: Insulated type, designed to prevent abrasion of the wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC, and rigid aluminum conduit.

H. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each run of 100 feet of exposed conduit shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory-installed packing and a grounding ring.

I. Sealing Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.3 WIREWAYS: Square D Company square duct lay in type without knockouts with lengths and fittings hinged to provide an unobstructed wireway to "lay-in" conductors, use standard lengths. Field cuts permitted where absolutely necessary. Rust-inhibiting phosphatizing coating on sheet metal parts. Blue-gray baked enamel finish. Hardware plated to prevent cross fittings, transposition section, gussett brackets, nipples, pull boxes, reducer fittings, wall flanges, panels or cabinet flanges, elbows, ceiling and wall support brackets and supporting hardware, etc.

PART 3 EXECUTION

3.1 CONDUIT INSTALLATION

A. Conduit Systems: Rigid steel conduit, IMC, rigid non-metallic conduit or EMT unless otherwise specified. Rigid Steel conduit shall be installed in the Chlorination building control

room and Rigid Steel conduit that's PVC coated on the inside and outside shall be installed in the Chlorination building Chemical room. Refer to drawings for additional requirements.

B. Aluminum Conduit: Aluminum conduit may be used only in dry locations above ground in sizes two inch or larger for Power and Communications Systems.

C. Rigid Non-metallic Conduit: Install in accordance with manufacturer's recommendations. Joints shall be solvent welded. Field bends shall utilize approved bending equipment. Provide rigid steel elbows and rigid steel conduit risers on underground runs or runs in concrete. Provide a suitable bond wire in each run except low voltage communications runs. Underground runs under concrete slabs may be direct buried without concrete encasement if of approved type. Rigid non-metallic conduit may be used for the secondary service conduit between the transformer and main distribution panel outside the perimeter of the building only when encased in concrete. Concrete total encasement shall be a minimum of four inches around outside of conduit. Rigid non-metallic conduit is not permitted to be surface mounted in ducts, plenums or other air handling spaces. All 90 degree bends installed in underground runs shall be rigid steel conduit. For encased conduits carrying 600 volts or more, the concrete shall be colored red using a permanent dye

D. EMT: Not permitted underground or embedded in concrete.

E. Flexible Conduits: Use flexible conduit only for motor or equipment connections and then only to the extent of minimum lengths required for connections. Length shall not exceed 5 feet without approval from the Engineer and Owner. Install flexible conduit connections at all resilient-mounted equipment. Provide liquid-tight flexible conduit in exterior, wet or damp locations and for connections to wet pipe mechanical systems.

F. Conduit in Concrete: Rigid steel conduit or rigid non-metallic conduit may not be embedded in concrete that is in direct contact with the earth. When embedded, the outside diameter shall not exceed one-third the thickness of the concrete slab, wall or beam, shall be located entirely within the center third of the member, and the lateral spacing of conduits shall not be less than three diameter unless otherwise prohibited by Engineer.

G. Steel Conduit in Ground: Rigid steel conduit that is not completely encased in concrete but is in contact with ground or on a vapor barrier shall be wrapped with Scotchwrap 51 half-lapped, or shall have an additional outside factory coating of polyvinyl chloride with a minimum coat thickness of 20 mils. Other PVC or Phenolic-resin epoxy coating material which is equally flexible and chemically resistant may be used providing approval by the Engineer is obtained prior to the installation.

H. Exposed Conduits: Install exposed conduit systems parallel to or at right angles to the lines of the building. Right angle bends in exposed runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii not less than those of standard elbows.

I. Concealed Conduits: Install conduit systems concealed unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities, and where specifically approved by the Engineer. Install concealed conduit systems in as direct lines as possible.

J. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.

K. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.

L. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be sealed tight with rated fire and smokeproofing compounds.

M. Duct seal all conduit ends.

3.2 CONDUIT SUPPORTS

A. Supports: Provide supports for horizontal steel conduits and EMT not more than eight feet apart with one support near each elbow or bend and one support within one foot of each coupling, including runs above suspended ceilings.

B. Straps: Install one-hole pipe straps on conduits 1-1/2" or smaller. Install individual pipe hangers for conduits larger than 1-1/2". Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.

C. Trapezes: Install multiple (trapeze) pipe hangers, Uni-Strut or approved equal, where two or more horizontal conduits or EMT run parallel and at the same elevation. Secure each conduit or EMT to the horizontal hanger member by specifically designed and approved fasteners for the system used.

D. Hanger Rods: Install 1/4" diameter or larger steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.

E. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. Power-driven fasteners may be used to attach pipe straps and hanger rods to concrete where approved by the Engineer. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy Fasteners of ERICO Products, Inc., or approved equal. Wire wrapped around conduits and supporting members will not be accepted. Conduit fastened to the wall above the ceiling is not acceptable.

3.3 IDENTIFICATION: Identify per Section 26 01 00, Paragraph 3.09F

3.4 CLOSING OF OPENINGS: Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, including bus ducts, such openings, if unused, or the spaces left in such openings, shall be closed in a manner approved by the Engineer. All closure material along with installation methods shall retain the fire rating integrity of the surface being penetrated. All openings in walls or floors remaining after removal of existing conduits, raceways, or bus ducts shall be closed in a like, approved manner.

END OF SECTION

SECTION 26 12 00

WIRES AND CABLES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)

A. Type:

Conform to the applicable UL and IPCEA Standards for the use intended. Copper conductors with 600 volt insulation unless otherwise specified or noted on the Drawings. Stranded conductors for No. 6 and larger and where elsewhere specified or noted on the Drawings.

All conductors shall be copper. Aluminum conductors will be permitted only on 600 volt and above systems.

A. Insulations: Type THHN/THWN insulation unless otherwise specified or noted on the Drawings. Type THHN/THWN minimum or type XHHW filled cross-linked polyethylene 90 degree C. thermosetting insulation for conductors larger than No. 6 and elsewhere as required by NEC. 90 degrees C. minimum insulation within fixture wireways of fluorescent fixtures.

B. Size: No. 12 minimum unless otherwise specified or noted on the Drawings. Not less than NEC requirements for the system to be installed.

C. Color Coding: Phase, neutral and ground conductors color-coded in accordance with industry standard. Connect all conductors of the same color to the same phase conductors.

	Phase A	Phase B	Phase C	Neutral
120/240V/1 Phase	Black	Red	-----	White
208Y/120V/3 Phase	Black	Red	Blue	White
277/480V/3 Phase	Brown	Orange	Yellow	Gray

Ground shall be Green for all systems.

D. Conductors No. 12 and 10 shall be solid color compounded for the entire length and each like color shall be connected only to the particular phase throughout the project. Conductor sizes larger than No. 10 may be color-coded at each termination and in each box or enclosure with six inches of half-lapped 3/4" pressure sensitive, plastic tape of respective colors in lieu of solid color compound.

2.2 VERTICAL CABLE SUPPORTS: Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used without metallic sheath.

2.3 CONNECTORS AND LUGS

A. For copper conductors No. 6 and smaller: 3M Scotch-Lok or T&B Sta-Kon, or equal compression or indent type connectors with integral or separate insulating caps.

B. For copper conductors larger than No. 6: Solderless, indent, hex screw, or bolt-type pressure connectors, properly taped or insulated.

2.4 TAPE: Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-1000. Equal to 3-M Super 88 Tape.

2.5 FEEDER CIRCUITS: Single conductor feeder cables shall be of the size and type as indicated on the Drawings. Sizes shown are for copper conductors unless otherwise noted on Drawings.

2.6 BRANCH CIRCUITS

A. Branch circuits shall be No. 12 AWG copper minimum and shall be larger AWG size where indicated on Drawings. Where branch circuits exceed 100 ft. in length, the AWG size shall be increased to accommodate voltage drop.

B. Branch circuits to all equipment, fixtures and outlets shall include a white neutral and green wire equipment ground.

PART 3 EXECUTION

3.1 WIRE AND CABLE TESTS (600 VOLTS): Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Engineer, and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing, and conduct tests in the presence of the Engineer. Submit written reports of the tests and results when requested by the Engineer.

3.2 SPLICES (480 VOLTS AND UNDER): Permitted only at outlets or accessible enclosures. Conductor lengths shall be continuous from termination to termination without splices unless approved by the Engineer.

3.3 PULL WIRES: In each empty conduit, except underground conduits, install a plastic line having tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard-drawn copper pull wire or a plastic line having a tensile strength of not less than 200 pounds.

3.4 RACEWAYS: Install in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the Drawings.

3.5 CONDUIT BENDS: Radius or bends not less than ten times the outer diameter of the cable.

3.6 CONDUCTOR PULL: Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture collected have been swabbed out.

3.7 FEEDER IDENTIFICATION: Tag feeder circuits in each enclosure with wrap-around circuit designation labels.

3.8 CONNECTORS AND LUGS: Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

3.9 BUNDLING: Conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits, utilizing marlin twine, two-ply lacing or nylon straps.

END OF SECTION

SECTION 26 12 16

TRANSFORMERS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Wires and Cables: Section 26 12 00.

D. Wiring Devices: Section 26 14 00.

E. Cabinets: Section 26 13 30.

F. Motor and Circuit Disconnects: Section 26 17 00.

G. Fuses: Section 26 18 10.

H. Grounding: Section 26 45 00.

1.2 REQUIREMENTS: Furnish all labor, materials, service equipment and appliances required to complete the installation of the electrical distribution system in accordance with the following schedule of equipment and as described herein and shown on the Drawings.

1.3 SUBMITTALS: Submit complete shop drawings with outline dimensions, wiring diagrams, catalog cuts and descriptive literature, including no load loss, total loss, regulation at 100% and 80% power factor and net weight.

1.4 STANDARDS FOR DESIGN, MANUFACTURE AND TESTING: Standards as described in ANSI C57.12.26-2007 will be met unless otherwise specified herein.

PART 2 PRODUCTS

2.1 GENERAL: Conduit, fittings, supports, 600 volt and wiring and splices and wiring generally are covered under other sections of these Specifications.

2.2 DRY TYPE TRANSFORMERS

A. General: Size and Characteristics as shown on Drawings. Unless otherwise specified, the design, manufacture and testing of dry type transformers and methods of conducting tests and preparing reports shall be in accordance with NEMA Standard Publication for Specialty Transformers, No. ST1-4, (USASI-089). Provide separate primary and secondary windings for each phase with industry standard voltage taps. Provide with a suitable terminal compartment. The terminal compartment temperature shall not exceed 75 degrees C. when the transformer is operating continuously at rated load with ambient temperature of 40 degrees C.

B. Insulation: Class H insulation shall be rated for continuous operation of KVA with a temperature rise of not over 150 C. above a 40 C. ambient and with a maximum hot spot temperature of 220 C. Class F shall have a maximum hot spot temperature of 185

C. Enclosures: Ventilated for air cooling. Single phase transformers equal to and larger than 25 KVA and three phase transformers equal to and larger than 15 KVA shall be fully enclosed in steel enclosures. Transformers smaller than the above shall be fully enclosed, in steel enclosures, with or without compound fill, or shall have exposed cores, impregnated winding and steel enclosures enclosing all live parts.

D. Sound Rating: Noise levels, determined in accordance with NEMA standards for Specialty Transformers, shall not exceed the following: 50 dB, over 50 KVA, but less than 150 KVA.

E. Manufacturers: General Electric Hevi-Duty, Cutler-Hammer or Sorgel. If requested, the transformer manufacturer shall furnish written certification that all dry type transformers furnished by him are constructed and tested in accordance with standards referenced herein.

F. Mounting: Unless otherwise indicated on the Drawings dry type transformers having ratings not exceeding 45 KVA shall be suitable for wall mounting. Shop drawings of wall brackets and platforms for transformers having ratings exceeding 30 KVA shall be submitted for approval.

G. Noise Suppression: Mount on approved vibration and noise isolating and dampening supports. Conduit connections to transformers shall be made with flexible metal conduit, not less than 18" nor more than 36" in length.

H. Grounding: The materials, equipment, and devices related to the grounding system are specified under other sections of these Specifications.

PART 3 EXECUTION

3.1 DRY TYPE TRANSFORMER INSTALLATION

A. Separately Derived Systems: Transformers creating separately derived distribution systems such as dry type transformers shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment and secondary neutral ground. The size of grounding conductor from the transformer to the main equipment ground shall be determined by considering the transformer secondary as a service.

B. Testing: The Contractor shall test the complete grounding system with a ohm-meter at the service ground. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Engineer.

C. Grounding Connections: Clean surfaces thoroughly before applying ground lugs or clamps. If the surface is coated, the paint, enamel or lacquer must be removed. Where galvanizing is removed from metal, it shall be painted or touched up with "Galvanoz".

D. Identification: Provide engraved micarta label on front of case indicating which panel transformer is fed from and which panel it feeds.

END OF SECTION

SECTION 26 13 00

OUTLET BOXES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Construction: Zinc-coated or cadmium plated sheet steel boxes of a class to satisfy the conditions at each outlet except where unilet or condulet bodies are required. Knockout type with knockouts removed are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4" octagon concrete rings and 4" octagon hung ceiling boxes with bars may be folded type; one-piece deep-drawn for all other boxes. All exposed outlet boxes shall be Type FD casted boxes. Outlet boxes in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Size: To accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed six inches deep except where necessary to permit entrance of conduits into sides of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.

C. Fixture Studs: 3/8" malleable iron fixture stud in outlet boxes for ceiling lighting fixtures and interior bracket lighting fixtures, other than lamp receptacles and drop cords.

D. Exposed: Screw-joint type with gasketed weatherproof covers in locations exposed to the weather.

E. Wall-Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified not less 4" square by 1-1/2" deep for 2 devices and multi-gang boxes for more than 2 devices. Boxes for switches and receptacles on unfinished walls may be screw-joint type with covers to fit the devices. Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

F. Light Fixture Boxes: 4" diameter by 1-1/2" deep minimum for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures to have 3" diameter openings. Screw-joint boxes with canopy seat for ceiling and interior bracket fixtures with exposed conduits. Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001

Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

G. All Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

H. Grounding Terminal: Provide a grounding terminal in each box containing a green equipment ground conductor, or serving motors, lighting fixtures or receptacles. Grounding terminal shall be green colored washer-in-head machine screw or grounding bushing.

2.2 PULLBOXES: Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets or pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion-resistant screw or bolt attachment. Pullboxes installed in the chlorination chemical side of the building shall be rated for use in a corrosive and wet environment and shall be UL listed for that use.

2.3 WET AREA EQUIPMENT: All equipment within the buildings shall be installed in a NEMA 3R, NEMA 12 or weatherproof enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), unless otherwise noted on the drawings.

PART 3 EXECUTION

3.1 OUTLET BOXES

A. Installation: Unless otherwise specified or shown on the Drawings, outlet boxes shall be flush mounted and the front edges of the boxes or plaster covers shall be flush with the finished wall or ceiling line or if installed in walls and ceiling of incombustible construction, not more than 1/4" back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. Boxes in plastered walls and ceilings shall be provided with plaster covers. Box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hanger, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steel work. Boxes shall be secured to metal studs with sheet metal screws. Metal stud clips, such as Caddy “MSF”, are not acceptable. All boxes shall have far side box supports installed similar to Caddy #766.

B. Mounting Heights: The mounting height of a wall-mounted outlet box shall be construed to mean the height from the finished floor to the horizontal centerline of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. The height of all outlets shall be at the same height when there is a secondary type wall construction along with the masonry construction. The height in the masonry construction shall be the governing factor. Verify exact height of all boxes with Engineer.

C. Wall mounted switch, receptacle and signal outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to the trim. Install outlet boxes near the doors or the lock sides as shown on Architectural Drawings unless other locations are approved by the Engineer.

3.2 PULLBOXES: Provide additional pullboxes wherever necessary to meet requirements for maximum lengths of conduit runs and maximum numbers of bends per the NEC.

3.3 FIXTURE CONNECTIONS: Surface light fixtures in accessible ceilings shall be connected with minimum 1/2" flexible metallic conduits, 4 to 6 feet long with grounding provisions.

3.4 IDENTIFICATION: Identify all exposed junction and pullboxes according to the system carried by means in accordance with DIVISION – 26 01 00-3.9

END OF SECTION

SECTION 26 13 30

CABINETS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 GENERAL: Sheet steel except those exposed to wet or rain conditions that shall be raintight unless otherwise noted. Cabinets without through feeder wiring shall be arranged to provide a wiring gutter not less than 4" wide for branch circuit panelboards served by feeders up to 4/0. Panelboards served by feeders in excess of 4/0, up to and including 750 MCM, shall be provided with top, bottom and side gutters 8" wide. Panelboard cabinets in all cases shall meet or exceed the minimum requirements of Article 312 of the National Electrical Code. Cabinets shall be of standard make and shall be equal in all respects to those bearing the Underwriters Laboratories label. Cabinets, including boxes shall be made of galvanized steel. All outside surfaces of trim and doors shall be given a factory finish coat of No. 61 ANSI gray paint, or approved manufacturer's standard. Cabinet for telephone and communications systems shall have 5/8" exterior grade, one-face B-grade or equal plywood backboard inside with maximum height and width. All Cabinets within the building shall be NEMA 3R or NEMA 12 enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), and outdoor or as noted on the drawings.

2.2 FEED THROUGH GUTTERS: Where feeders go through panelboard cabinets to serve panelboards above or beyond, the wiring gutters in panelboard cabinets shall be a minimum of 8" on sides, top and bottom.

2.3 FRONTS: One piece sheet steel frame and a hinged door with catch and lock for flush cabinets. Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. One piece sheet steel with 3/4" flange with all edges shaped to cover edge of box. Fronts may be secured to box by means of flathead screws with captive nuts or clamps.

2.4 DOORS: Doors shall close against a rabbet placed all around the inside edge of the frame with a close fitting joint between door and frame. The doors shall be fitted with substantial flush hinges placed not over 24" apart, nor more than 6" from ends of doors, and fastened permanently to the door and frame with flat-headed rivets or spot welds, or with concealed flush piano hinges. Fastening screws of fronts shall be set not over 24" apart. Doors over 48" in height shall be equipped with a vault hinge and a three point catch.

2.5 DOOR-IN-DOOR: Both surface and flush cabinets shall be door-in-door. The door over the interior of the cabinet shall be provided with hinges and combined lock and latch. The outside door over the cabinet gutters shall have a hinge on one side, and machine screws into threaded holes in the cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type

cabinets shall have a 1/2" deep lip bent over all around, with the corners welded and grounded; or in the case of flush cabinets, a steel angle frame, equivalent in strength to the bent over lip, shall be welded to the inside of the door. The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter. All locks shall be keyed alike.

2.6 LOCKS: Furnish each cabinet with a combination catch and flat key lock. The telephone, electrical and signal cabinet locks shall be fitted to separate keying for each system. Furnish two keys for each cabinet.

2.7 GROUND BAR: Each cabinet for a panelboard shall be provided with a copper interior ground bar suitably braced or bolted to the cabinet wall. The equipment ground bar shall be equivalent in current carrying pressure connector terminations for the associated feeders, branch circuits, etc.

PART 3 EXECUTION

3.1 CABINETS: Cables installed in the wiring gutters of cabinets shall be neatly bundled, routed and supported. Minimum bending radii as recommended by the cable manufacturer shall not be reduced. Lighting and power cabinets shall be installed with tops 6'-6" above floor or less and bottoms not less than 12" above floor. The height above floor of the highest over current device handle shall not exceed 6'-6".

3.2 SPACE: If cabinet is not shown on the plans, placement shall be appropriate for an ergonomic work area. Cabinets shall have front working clear space in accordance with OSHA regulations.

END OF SECTION

SECTION 26 14 00

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 SNAP SWITCHES: Unless otherwise specified each snap switch (flush tumbler-toggle) shall be of the AC general use type for mounting in a single-gang spacing, fully rated 20 amperes, 120-277 volts, conforming to minimum requirements of the latest revision of the Underwriters Laboratories, Inc., UL 20, Fifth Edition, Standard Snap Switches and further requirements herein specified. Industrial Specification grade, heavy duty, single pole, three way or four way, of the maintained momentary or lock type as indicated on the Drawings. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts, AC 120/277 volt general use snap switches shall be capable of withstanding tests as outlined in NEMA Publication WDI-1965, and shall be as follows unless otherwise noted:

20A120-277V AC	Hubbell	Bryant	P & S
1P	1221-I-IV	4901-I-IV	20-AC-1-I-IV
2P	1222-I-IV	4902-I-IV	20-AC-2-I-IV
3 way	1223-I-IV	4903-I-IV	20-AC-2-I-IV
4 way	1224-I-IV	4904-I-IV	20-AC-3-I-IV

2.2 RECEPTACLE

A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publication WDI-1965, Part 3 and Part 10. Single or duplex as shown or noted on Drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.

B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.

C. Unless otherwise noted, receptacles shall be as follows:

Type	Hubbell	Bryant	P&S
Spec. Grade Duplex - 20 amp	5362-I	5362-I	5362-I
GFCI, Spec. Grade Duplex - 20 amp	GF-5362-I	GFR53FT-I	2091-FI
Isolated Gnd., Orange, Spec. Grade Duplex - 20 amp	IG-5361	5361-IG	IG5366-SS
Safety Receptacle, Duplex	SG-62HI	SG-62	SG-62

D. Special: Receptacles for special applications shall be as indicated on the Drawings.

2.3 PLUG CAPS: Except for duplex receptacles and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles.

2.4 DEVICE PLATES

A. General: Provide device plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi-gang outlet plates for multi-gang boxes. Plates shall be Stainless Steel unless otherwise noted. Chlorine Room plates shall be stainless steel grade 316L or better unless otherwise noted.

B. Exposed: Plates for exposed joint fittings shall match the fittings with edges of plates flush with edges of fittings. Heavy cadmium steel plates with gasket. Plates for cast type boxes at locations subject to wet or rain conditions shall be of cast, vapor tight type. Provide hinged lift covers for devices.

C. Communication: Plates for telephone and signal outlets shall each have a 3/8" bushed opening in the center. Wall plates for push-button and buzzer outlets shall have openings to suit the push buttons and buzzers.

D. Plates for special purpose outlets shall be of a design suitable for the particular applications.

E. All plates installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

2.5 REMOTELY CONTROLLED SWITCHES OR RELAYS: Electro-magnetically operated, mechanically held unless otherwise required. Rugged construction, substantially made, conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Lighting Control Equipment. Ratings as indicated on the drawings, suitable for the application. Contacts shall be double break, renewable, solid wiping type, silver to silver or silver Tungsten alloy, self aligning, quick make, quick break, with a minimum inductive load rating of 20 amps. Relays shall be as manufactured by Allen-Bradley, ASCO, Cutler-Hammer, General Electric, Square D, or Cutler-Hammer, equal to ASCO mounting and enclosure. Device shall be mounted in a NEMA 12 or NEMA 3R enclosure as indicated on the drawings.

2.6 MOMENTARY CONTACT SWITCHES: Tumbler type single pole double throw momentary contact for 3 wire connection, with OFF position when tumbler handle is in the center, similar in appearance to the conventional snap switch. Handle or key complete as indicated on the Drawings. 20 ampere at 120-277 volts for control of 30, 60, or 100 ampere remotely controlled switches or relays rated 101 amperes and above. Provide cover plates to match the finish of other conventional snap switch plates in the area. Provide nameplate to identify the circuit or equipment controlled. Device shall be mounted in a NEMA 12 or NEMA 3R enclosure as indicated on the drawings.

2.7 ENCLOSURE: All equipment enclosures within the buildings shall be rated for wet locations (NEMA 12 or NEMA 3R as indicated on the drawings). All equipment enclosure installed in the chlorination chemical rooms shall be rated for use in a corrosive and wet environment and shall be UL listed for that use and shall be NEMA 4X.

PART 3 EXECUTION

3.1 DEVICE PLATES: Install with alignment tolerance of 1/16" and all edges in continuous contact with wall surfaces.

END OF SECTION

SECTION 26 16 00

PANELBOARDS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Cabinets: Section 26 13 30.

D. Fuses: Section 26 18 10.

E. Grounding: Section 26 45 00.

1.2 SUBMITTALS: Submit complete shop drawings with outline dimensions, descriptive literature and complete description of the frame size, trip setting, class and interrupting rating of all overcurrent devices. Identify available space.

PART 2 PRODUCTS

2.1 GENERAL: Dead front, safety type with voltage ratings as scheduled. Panelboards shall be of the type required for the short circuit and duty ratings indicated on the drawings. Panelboards shall be as manufactured by General Electric, ITE, Square D, or Cutler-Hammer and shall be circuit breaker or fusible type as scheduled.

2.2 CABINETS: Each panelboard shall be enclosed in a single sheet metal cabinet with front doors, catches, locks, etc., as specified in Section 26 13 30, Cabinets.

2.3 DOOR-IN-DOOR: Both surface and flush panels shall be door-in-door NEMA 3R or NEMA 12, indicated on the drawings, enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings). The door over the interior of the panel shall be provided with hinge and combined lock and latch. The outside door over the panel gutters shall have a hinge on one side and machine screws into threaded holes in the panelboard cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type panels shall have a 1/2" deep lip bent over all around with the corners welded and ground; or, in the case of flush panels a steel angle frame, equivalent in strength to the bent over lip shall be welded to the inside of the door. The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter or as required by NEC All locks shall be keyed alike.

2.4 BREAKERS: Molded-case or combination molded-case and current limited fuses as scheduled or required. Provide quick make and quick break toggle mechanism, inverse time trip characteristics and trip free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide a trip element for each pole, a common trip bar for all poles and a single molded insulating material handle. Handle ties will not be accepted. Adjustable magnetic trip devices shall be set at the factory to the low trip setting.

Provide breaker frame sizes as required for the continuous rating or the interrupting capacity, whichever is larger.

2.5 BOLTED TYPE: Circuit breaker current-carrying connections to the bus shall be of the bolted type, factory assembled. Stab in type not permitted. Provide bus bars for three phase panelboards of the sequence phased type connection and arranged for three-phase, four wire mains, unless otherwise indicated on the Drawings.

2.6 FUSIBLE SWITCH UNITS: Quick make, quick break type with external operation handle suitable for padlocking in OFF position. Provide interlock to prevent opening cover when switch is in ON position unless interlock release is operated. Provide switch frame sizes as required for the continuous rating or the interrupting capacity, whichever is larger. Fusible panelboards shall be UL rated and listed for service entrance where applicable.

2.7 SPACE ONLY: Where "Space Only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device.

2.8 DIRECTORIES: Provide circuit directories on the inside face of the door of each panel.

2.9 LABELS: Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws or phenolic buttons or small window frame type. Adhesive stick on labels alone will not be acceptable unless specifically approved.

2.10 SKIRTS: Where noted on the Drawings panelboards shall be skirted with complete metal enclosures and barriers separating the panel interior.

PART 3 EXECUTION

3.1 DIRECTORIES: Provide typewritten circuit descriptions referencing permanent room numbering assigned in lieu of the room numbering shown on the Drawings inserted in plastic holder. Text shall be able to be read entirely without moving the card.

3.2 CIRCUIT NUMBERING: Circuit numbering shown on the Drawings is based on pole position in the panelboard and not consecutive numbering.

3.3 PHASE ROTATION: Phase A, left bus; phase B, center bus; phase C, right bus (front viewing).

END OF SECTION

SECTION 26 17 00
MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 - PRODUCTS

2.1 DISCONNECTING MEANS

A. Safety Switches: Fusible or non-fusible Type HD quick break safety switches of the sizes and capacities indicated or required. Raintight enclosures at locations exposed to the weather.

B. Separately Enclosed Motor Snap Switches: Motor snap switches may be used for motor disconnect means, controller and motor overcurrent protection when applicable. These devices shall be horsepower rated and may contain motor running overcurrent protection.

C. Safety Type Disconnecting Switches: Heavy duty, quick make, quick break type, 250 or 600 volt rating as required for the application. Number of poles and ampacity as noted or required by code. Fusible where noted with fuse clips suitable for Buss Fusetron Class R Fuses. Short circuit rating of 200,000 RMS Amperes with CV Class R rejection feature installed in fuseholders. NEMA 1 enclosures for dry locations. NEMA 3 R enclosures for wet locations or at exposed weather locations unless otherwise noted.

2.2 MANUFACTURERS

A. General Electric, ITE, Square D, or Cutler-Hammer.

PART 3 - EXECUTION

3.1 DISCONNECT MEANS: Install in each location indicated on the Drawings and elsewhere as required by NEC.

END OF SECTION 26 17 00

SECTION 26 18 10

FUSES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS:

2.1 FUSES

A. General: Dual element, time delay type, based on heavy service, Buss Fusetron, or equal, unless otherwise noted or required for installation.

B. Current Limiting Fuses: Provide where indicated on the Drawings. For individual motor circuit protection, provide fuse sized approximately 175 percent of full load current with 100,000 amperes interrupting capacity. For non-motor feeder protection in conjunction with fused switches, install NEMA Class L fuses sized 175 percent of load current or as required for coordination with air and molded case circuit breakers, shall be furnished by the circuit breaker manufacturer.

C. Above 600 amps; Class L, "Hi-Cap" as manufactured by Bussman or approved equivalent by Chase-Shawmut or Federal Pacific.

D. Below 600 amps, as required by short circuit duty, Class K-1, "Limitron" or class K-5, "Low Peak" or Class K-5, "Fusetron" as manufactured by Bussman or approved equivalent by Chase-Shawmut or Federal Pacific.

E. All switches having current limiting fuses installed shall have a Lamicoid nameplate with white lettering on red background reading:
WARNING, REPLACE ONLY WITH CURRENT
LIMITING FUSES AS ORIGINALLY INSTALLED

2.2 COORDINATION: Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

PART 3 EXECUTION

3.1 COORDINATION: Coordinate the low voltage fuses required for the project to provide basic selection protection and properly coordinate with the other associated protective equipment.

3.2 SPARE FUSES: Furnish one complete spare set of each size of fuses. Deliver to the Owner in the original boxes. It shall consist of 100% fuse replacement for all fuses required for panelboards and safety switches.

END OF SECTION

SECTION 26 19 00

RELAYS AND CONTACTORS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 GENERAL: Electromagnetically operated, electrically held unless otherwise required. Rugged construction substantially made conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Industrial Control Equipment. Relays and contactors shall be as manufactured by General Electric, ITE, Square D, or Cutler-Hammer.

2.2 RATINGS: As indicated on the Drawings or required, suitable for the application.

2.3 CONTACTS: Double break, renewable, solid wiping type, silver to silver or silver tungsten alloy, self aligning, quick make, quick break, with a minimum inductive load rating adequate for the load controlled, but not less than 25 amps.

2.4 ENCLOSURES: NEMA 3R or NEMA 12, as indicated on the drawings, for surface mounting in non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), Flush mounted with hinged door and flush latch where indicated. Sound-absorbing enclosures where located in or adjacent to occupied areas. Enclosures installed in the chlorination chemical side of the building shall be rated for use in a corrosive and wet environment and be UL listed for that use.

PART 3 EXECUTION

3.1 INSTALLATION: Install and connect in accordance with related work specified in other sections of these Specifications.

END OF SECTION

SECTION 26 27 33.1

CHLORINATOR AND WELL SITE INSTRUMENTATION AND CONTROLS REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Control Operations anticipated for equipment identified in this Section and Related Sections.
2. Testing, Startup, and Commissioning Requirements.
3. Instruments:
    a. Flowmeters.
    b. Thermostat.
    c. Intrusion Switch.
    d. Smoke Detectors.
    e. Transducer (tank level transducer and well transducers).
4. Miscellaneous electrical equipment:
    a. Variable Frequency Drives (for submersible well pump motors).
5. General Requirements applicable to Division 26.

B. Related Sections:

1. Section 01 00 00 – Basic Requirements.
2. Section 22 11 05 – Chlorination Facility Plumbing.
3. Division 26 Electrical Technical Specifications
4. Section 44 44 16 – Chlorination Equipment.
5. Section 27 43 30 – SCADA Radio Telemetry System.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Well Site / Tank Site electrical items:

1. Basis of Measurement: By Each or by Lump Sum
2. Basis of Payment: includes, meter pole, socket, and all electrical components and connections not separately listed (including flowmeters and VFDs). Excludes SCADA equipment and primary pole, primary conductor, transformer and meter provided by utility.
   a. The make and model numbers of the Flowmeters and Variable Frequency Drives (VFD)s are subject to change. In the event of a change in the make, model, and or size, the following provisions for payment and in Section 2.9 shall be followed:
   b. Contractor shall be eligible for an equitable adjustment in payment for material costs for these items from the Contingency Allowance on the bid form.
   c. If an equipment cost adjustment is requested by the Contractor, the Contractor must provide dated quotes identifying differential in price from the supplier.
   d. A maximum of 15% mark-up to the net increase in the supplier price for this equipment may be charged by the Contractor. No other additional amounts will be paid to the Contractor for coordination or completion of the work.

B. All other instruments identified paragraph 1.1 of this Section.

1. Basis of Measurement: By Each or by Lump Sum, incidental to site, building, vault, or tank electrical item, unless identified separately on the bid form.
2. Basis of Payment: These items are incidental to Well Site or Chlorination building electrical items identified on the bid form.

1.3 SUBMITTALS

A. General: Submit in accordance with Division 01 00 00.

B. Catalog Data, Design Data and Details: Submit manufacturer’s latest published literature and data sheets for equipment specified in Part 2. Circle or complete manufacturer's part and model numbers; do not use highlighter.

1. Submit data sheets per ISA S20 for each instrument.

2. Material List/Schedule/Equipment List:

   a. Submit list of tools required to calibrate each instrument provided under this section.

3. Installation Instructions/Methods: Submit manufacturer's installation, calibration, and test procedures for equipment provided under this section.

C. Shop Drawings: Submit shop drawings with arrangement and construction drawings for control panels for field installation. Include location of equipment and physical routing of wiring. Include dimensions and identification of all components. Include I/O point terminations. Show grounding layout for enclosures.

D. Wiring Diagrams/Elementary Diagrams:

1. Show wiring schematics together with circuit terminations, terminal numbers, and IDs associated with the control equipment, including field devices, termination locations, surge suppressors, and relays as required.

2. Show grounding diagram for each instrument or device as applicable.

1.4 OPERATION, MAINTENANCE AND CLOSEOUT SUBMITTALS

A. Maintenance and operating instructions/data: Submit Operations and Maintenance manuals for the following equipment specified in Part 2 of this Section.

B. Field test results/logs/surveys/records: Submit certification that equipment supplied under this section is calibrated over specified range per manufacturer's specifications and site conditions.

C. Spare parts list: Submit list of parts with manufacturer and model number.

D. Warranties and Software Licenses: Submit manufacturer's warranty certificates for items supplied under this Division.

E. Project Record Documents: Submit as-built drawings for control panels, control devices, and field wiring. Include physical layout of equipment in cabinets, wiring diagrams, and physical routing of field wiring. Contractor shall supply DVD of start-up instructions.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with Navajo Tribal Utility Authority (NTUA) standards.

B. Conform to reference standard by date of issue current on date for receiving bids.

C. Specified reference standards are a minimum for the installation. Where the contract documents exceed the requirements of the reference standards, then the contract documents govern.

D. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Occupational Safety & Health Administration
200 Constitution Avenue
Washington, D.C. 20210

ANSI American National Standards Institute
11 West 42nd Street
New York, NY 10036

EIA Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201

FCC Federal Communications Commission
1270 Fairfield Road
Gettysburg, PA 17325

IEEE Institute of Electrical and Electronics Engineers
445 Hoes Lane
PO Box 1331
Piscataway, NJ 08855

ISA Instrument Society of America
67 Alexander Drive

PO Box 12277
Research Triangle Park, NC 27709

MIL Military Specification
Naval Publications and Forms Center
Tabor Avenue
Philadelphia, PA 19120

NEC National Electric Code
1 Batterymarch Park
Quincy, MA 02269

NEMA National Electrical Manufacturers' Association
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209

NFPA National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

UBC Uniform Building Code
International Conference of Building Officials
South Workman Mill Road
Whittier, CA 90601

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

1.6 ABBREVIATION LIST

AC	Alternating Current
AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
ASCII	American Standard Code for Information Interchange
bps	Bits per Second
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel Referenced to Milliwatt
DC	Direct Current
DI	Digital Input
DO	Digital Output
EMT	Electrical Metallic Tubing
GPM	Gallons per minute
HOA	Hand-Off-Auto switch
IC	Instrument Cabinet
ID	Identification
I/O	Input/Output
mA	milliamperes

MAS	Multiple Address System
MB	Megabyte
MHz	Megahertz
mS	Millisecond
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
RTU	Remote Terminal Unit.
RGS	Rigid Galvanized Steel
SCADA	Supervisory Control and Data Acquisition
VAC	Volts Alternating Current
VDC	Volts Direct Current
VFD	Variable Frequency Drive

1.7 CONTROL OPERATIONS

A. General

1. There are five (5) well distinct well sites, each with their own Well Site (WS) SCADA PLC. Well Site #1's PLC monitors and controls two wells, whereas all other WS PLC's monitor and control only one well each.

   a. Each WS PLC enables or disables the well pump motor VFD to start or stop flow from the well.

   b. The WS PLC monitors flowrate and depth to water as measured by the local flowmeter and well transducer.

   c. Each Well Site communicates only with the central Chlorination Building PLC (at the Tank Site) via SCADA radio connection. Individual well sites do not communicate directly with each other or with NTUA's existing SCADA network.

2. The control system configuration for the Chlorination Building provides chlorinated water to the Distribution Storage Tank. The local controls automatically chlorinate any water provided to the tank. When the tank level falls below a low-level set point, as measured by a vault-installed Pressure Transducer on the storage tank site, the Chlorination Building (CB) SCADA PLC calls for one or more groundwater wells to begin pumping. The resulting water flow is measured by the flow meter in the centralized Chlorination Building, which sends a flow rate signal independently to the chlorination control panel and to the CB PLC. When the chlorination control panel detects flow above a user-adjustable minimum flow rate, the chlorination control panel sends an enable signal to the chlorine booster pump. The chlorine control panel, chlorination booster pump, and related chlorination equipment shall provide flow-proportioned chlorination appropriate for the supply flowrate, which will vary significantly depending on which wells are pumping. When the tank level reaches a high level set point, the CB PLC calls for well pumps to shut off. The consequent cessation of flow is measured by the flow meter and the chlorination control panel deactivates the chlorine booster pump and ceases chlorination.

   a. In anticipation of Reach 14.8A supply pipeline's future construction, the CB PLC, SCADA equipment and local controls shall be equipped in

anticipation for inputs/outputs from the Reach 14.8A facilities and manage chlorination of 14.8A-provided water.

3. The CB PLC shall post flowrate, tank level, chlorination system status, repeated pertinent individual well data including flowrates, alarms, and other status information to the existing NTUA SCADA Network via licensed radio connection.

4. The control system can be enabled manually at the Chlorination Building PLC Human Machine Interface (HMI).

B. Vanderwagen Tank Site Chlorinator Building (CB) Programmable Logic Controller (PLC)

1. The CB PLC will have the capability to start and stop flow from one or more wells based on operating parameters programmed into the controller.

2. When the tank level falls to 80% or below, the CB PLC will signal via SCADA connection for one or more wells to start pumping.

   a. The CB PLC shall be programmable at NTUA's discretion to be capable of initiating well operation in lead/lag sequences, and/or alternating pumping of multiple wells at a time. The PLC shall allow for NTUA to re-configure the sequencing of well pumping in the future considering well performance and system demand.

3. The CB PLC receives cumulative chlorinator building flowrate (both analog and totalized flow) from the chlorination building flow meter and posts the flowrate to SCADA.

4. When the tank level rises above the Tank High Level set point, the chlorinator building PLC will start down sequence for all wells online to stop pumping and flow to the tank will cease. The CB PLC can also be controlled locally via the HMI to send commands to cease pumping at desired wells.

5. The operator can remotely stop all well pumping via SCADA. A 0-bit ("enable") signal from SCADA allows the chlorination building PLC to start or stop well pumping according to programmed lead/lag and sequencing of well pumping based on tank level. A 1-bit ("disable") signal from SCADA results in the chlorination building PLC signaling all wells to stop pumping, regardless of tank level or flow rate.

6. The chlorinator building PLC and associated SCADA equipment shall also receive data from the individual well sites via SCADA, make that data available at the local HMI, and retransmit data to NTUA SCADA Network via SCADA as identified in the SCADA inputs and outputs (I/O) section below.

C. Programmable Logic Controller (PLC) at each Well Site

1. Each Well Site (WS) PLC will have the ability to initiate startup and shutdown to the well pump given signals received from the Chlorinator Building (CB) PLC via radio connection.

2. The well pump may also be started or stopped manually at the WS PLC HMI.

3. The WS PLC receives well flowrate and transducer data for the well and repeats this data to CB PLC via radio connection.

4. The WS PLC receives pump status (on/off) and frequency from the well pump's Variable Frequency Drive (VFD) and repeats this data to the CB PLC via radio

connection.

5. Considering water level measured by the downhole transducer, the WS PLC shall be programmable at NTUA's discretion to stop well pumping by signaling to the well pump motor's VFD.

    a. If the WS PLC shuts off the well pump to allow for water level recovery, the pump will be prevented from re-starting for a minimum duration. The minimum programmed time before resuming pumping will be adjustable and determined by NTUA.

    b. The WS PLC shall be capable of sending a signal to the well pump's VFD to adjust or modulate frequency to allow maintain adequate water level.

D. Well Transducer

1. Each well water transducer measures the water level above the transducer set depth and sends a 4-20mA analog pressure signal to the Well Site PLC, for use locally for pumping and well water level management. The water level is also sent to the Chlorinator Building PLC via radio connection.

E. Pressure Transmitter (at Tank Site)

1. The tank level pressure transmitter measures the tank water pressure at the base of the Chichiltah Vanderwagen tank, and sends a 4-20mA analog pressure signal to the CB PLC and level shall be shown on HMI.

2. The pressure transmitter is located on a pressure tap in a vault, as indicated on the drawings.

F. Flowmeters

1. The water flow through the centralized chlorinator building is measured by a magnetic flowmeter.

    a. The flowmeter sends a 4-20mA analog flow rate to the Chlorination Control panel.

    b. The flowmeter sends a 4-20mA analog flowrate and a totalizer pulse signal to the CB PLC.

    c. The flowmeter is configured for unidirectional flow to the Water Tank.

    d. The flowmeter is configured with a Low Flow Cutoff, to prevent flow indication for very low flow rates.

2. The water flow from each well is measured by a flowmeter, which sends a 4-20mA analog flow rate and a totalizer pulse signal to the well site PLC. The Flowmeter is configured for unidirectional flow from the well.

    a. Well site flowmeters shall each be capable and configured for measuring and reporting flows across a minimum range of 1 gpm and 40 gpm.

G. Gas Chlorination System.

1. The gas chlorination system injects chlorine into the tank water supply pipe, at the chlorine building. The system is configured so that the chlorine gas feed rate is proportional to the actual water flow rate. The proportional feed rate is manually adjustable from the gas chlorination system control panel.

2. The gas chlorination system control panel receives a 4-20mA signal from the flow

meter (transmitted via the flowmeter assembly's loop splitter) that is proportional to the actual water flow into the tank. This analog input is used to start and stop the chlorine booster pump and pace the rate of chlorine gas injection.

3. A 4mA flow signal equals zero flow.

4. The gas chlorination system control panel provides up to four user configurable alarm signals to the PLC.

5. A high/low vacuum switch provides two separate alarms when the chlorine vacuum level either rises or falls below an adjustable/acceptable range.

H. Gas Chlorination Booster Pump.

1. The Booster Pump is activated by the chlorination control panel when water flow exceeds a user-adjustable minimum flow rate.

2. A contact in the booster pump starter provides a pump running signal to the local PLC.

I. Chlorine Gas Cylinder Scale.

1. The two chlorine gas cylinders are mounted to a scale that measures the weight of each tank. The scale sends a 4-20mA signal (or digital) for each cylinder to PLC for monitoring the cylinder weight.

2. Local digital display

J. Chlorine Gas Detection System.

1. Monitors for chlorine gas leaks in the chlorine room.

2. Battery back-up.

3. Auto test module.

4. Audible and visual alarms.

5. Chlorine gas detector/receiver shall be mounted on the wall in the Chlorine room, near the chlorine gas cylinder scale, at 6'-0" above the finished floor.

6. Separate chlorine gas sensor/transmitter shall be mounted on the wall behind the chlorine gas cylinder scale at 6" above the finished floor.

7. Red strobe light, for chlorine gas leak alarm indication. Strobe light shall be installed in the Chlorine room and shall be activated by the Chlorine Gas detector/receiver when chlorine gas is detected.

8. Generates a visual alarm that is visible through the glass view window in the door. Control panel positioned so that it is hard to hit by shooting through the view window, but alarm strobe is still visible.

9. Provide warning and alarm signals to SCADA when chlorine gas is detected above user-adjustable thresholds.

10. Provides trouble signal to SCADA (via PLC) if sensor fails.

K. Chlorinator Building (CB) PLC Inputs and Outputs (I/O):

1. Display all inputs and outputs on HMI and post to NTUA SCADA network.

2. Analog Inputs to CB PLC:

a. Cumulative chlorinator building flow rate (in gpm).

b. Flow rate (in gpm) at each well.

c. Water level (in ft. below ground surface) at each well.

d. VFD frequency at each well.

e. Distribution tank level (in feet) as measured by transducer.

f. Gas cylinder weight - Cylinder #1 (in pounds)

g. Gas cylinder weight - Cylinder #2 (in pounds)

3. Digital Inputs to CB PLC:

   a. Totalized (pulse) volumetric throughput of chlorinator building (gallons)
      i. Calculated by CB PLC using flow totalizer pulses generated by flow meter. Meter will generate pulses on two channels. PLC will keep running tally of cumulative throughput in a register, which will be posted to SCADA.

   b. Totalized volumetric throughput of each well (gallons)

   c. Pump status of each well (on / off)

   d. Chlorine booster pump running signal

   e. Chlorine gas proportional feed rate

   f. Chlorine gas warning

   g. Chlorine gas alarm

   h. Chlorine gas detector auto-test fault

   i. High vacuum alarm

   j. Low vacuum alarm

   k. Intrusion alarm for Chlorination Building control room door.

   l. Intrusion alarm for Chlorination Building chlorination room door.

   m. Smoke Detection

   n. Low temperature alarm

4. Analog Outputs from CB PLC:

   a. Display all analog inputs listed above on HMI and post to NTUA SCADA Network.

5. Digital Outputs from CB PLC:

   a. Display all digital inputs listed above on HMI and post to NTUA SCADA network.

   b. Remote stop of well pumping

      i. 1 causes all well pumps to stop.

      ii. 0 allows well pumping to start or stop based on tank level.

      iii. Start/stop pumping signals above are sent via radio to individual WS PLCs, considering lead/lag and other well operations sequencing programmed at the CB PLC.

L. SCADA Inputs and Outputs (I/O) for each Well Site (WS):

1. Display all inputs and outputs on HMI locally and post to NTUA SCADA Network where identified.
2. Analog Inputs to WS PLC:
    a. Well flow rate (in gpm)
    b. Water level (in ft. below ground surface (b.g.s.)) at each well
    c. VFD frequency
3. Digital Inputs to WS PLC:
    a. Remote stop of well pumping (from CB PLC via radio)
        i. 1 causes well pump to start
        ii. 0 causes well pump to stop
    b. Totalized volumetric throughput of well (gallons)
        i. Calculated by WS PLC using flow totalizer pulses generated by the well's flow meter. Meter will generate pulses on two channels. WS PLC will keep running tally of cumulative throughput in a register, which will be posted to SCADA.
4. Digital Outputs from WS PLC (sent to CB PLC via radio):
    a. Totalized volumetric throughput of well (gallons)
    b. Pump status of well (on / off)
    c. VFD alarm signals
5. Analog Outputs from WS PLC (sent to CB PLC via radio):
    a. Well flow rate (in gpm)
    b. Water level (in ft. below ground surface (b.g.s.)) within well
    c. VFD frequency

1.8 Communications

A. Refer to Section 27 43 30 – SCADA Radio Telemetry System, for further details and requirements pertaining to SCADA system equipment and connections.

PART 2 PRODUCTS

2.1 Chlorination Equipment, SCADA and Radio Telemetry Systems, other electrical equipment, and plumbing:

A. See Related Sections.

2.2 CORROSION RESISTANCE:

All electrical components in the chemical room, including all equipment, enclosures, conduits, switches and any other gear, shall be rated for use in corrosive environment due to chlorine gas. Conduit, cover plates, j-boxes and fitting installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001

Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

2.3 FLOWMETERS

A. Manufacturer:

1. Honeywell evoQ_4
2. Substitutions: None

B. Supplier:

1. Meter with necessary analog and pulse transmitters shall be programmed by NTUA.
2. Contractor shall coordinate submittals on flow meter, pulse transmitter and appurtenant equipment with Engineer and NTUA, and receive Engineer's approval prior to ordering materials.
3. Contractor shall coordinate installation with NTUA.
4. Contractor shall reimburse NTUA for materials and labor.

C. Provide flanged, electromagnetic flowmeter meeting the following requirements:

1. Sizes: As shown on Drawings
2. Battery powered
   a. Replaceable battery
   b. 5 year minimum battery life
3. Flange: ANSI B16.1 Class 125, epoxy coated cast iron.
4. Liner: Polyethylene epoxy
5. Electrodes: AISI 316 Stainless Steel
6. Grounding Rings: AISI 316 Stainless Steel, per manufacturer's recommendations.
7. Pressure Rating: 230 psi maximum operating pressure.
8. Sampling rate: 0.5 seconds
9. Accuracy:
   a. +/- 1.5% of true flow value through normal flow range.
   b. > 95% accuracy at Low Flow. (Low flow is defined by the manufacturer of specified equipment as 0.25 GPM for 2" meters, and 1.7 GPM for 4" meters.)
10. NSF-61 Approved
11. Provided with LCD display mounted on top of meter, incorporating totalized volume, reference flow-rate, and alarm functions.

D. Provide pulse transmitter module meeting the following requirements:

1. Battery powered (10 year battery life)
2. Maximum load current: 20mA
3. Maximum load voltage: 30V DC
4. Pulse output: NPN signal

5. Pulse weight: Provide transmitter with Pulse Output Option G
    a. Channel 1: 1gallon
    b. Channel 2: 10 gallon
6. Channel 3: Alarm output channel will transmit signals indicating: meter low battery, pulser low battery, measurement stopped/no water, and tamper.
7. Enclosure: IP 68 / NEMA 6P
8. Operating temperature: 15°F to 120°F

E. For Chlorination Building water meter only:

1. The chlorination building flowmeter shall be equipped and configured with a loop splitter for the 4-20mA analog flow rate signal, including flowmeter assembly accessories as needed, such that this signal can be provided directly to both the Chlorination Control Panel and the CB PLC. This analog signal shall NOT be repeated through the CB PLC nor through the Chlorination Control Panel.
2. Replacement Steel Spool
    a. Contractor to provide flanged steel spool the same dimensions as flowmeter as a spare part.
    b. Spool to be used to replace flowmeter, during repair.
    c. Contractor to test spool prior to installing flowmeter to ensure fit.

2.4 PRESSURE TRANSMITTER

A. Provide pressure transmitter meeting the following requirements:

1. Type 316 stainless steel wetted process parts.
2. 316 Stainless steel head.
3. NEMA 4/IP 67 watertight electronics housing.
4. Process connector: 1/4-inch NPT.
5. Stainless steel instrument tag, with process ID.
6. Input Power: 2-wire current loop driven by 24 VDC power supply.
7. Output Signal: 4 - 20 mA proportional to pressure over specified range.
8. Output Load: 1400 Ohms, maximum.
9. Instrument range: 0-30 psi.
10. Accuracy: ±0.5% of calibrated span.
11. Stability: ±0.2% of upper range limit per year.
12. Conduit connector: 1/2-14 NPT.
13. Electrical Connections: Screw terminals for Instrument Cable.
14. Manufacturers Reference: Wika Type C-10, No substitutions.

2.5 WELL PRESSURE TRANSDUCER

A. Well pressure transducers and accessories listed below shall be furnished by the Well Driller (Stewart Brothers Drilling Company), not by the Contractor.

B. Manufacturer: Druck Model PTX 1835 Series, OAE Type 316 stainless steel wetted process parts.

C. Manufacturer: Druck Model PTX 1835 Series, OAE

D. Polyurethane cable, with adequate length to reach from installation inside the transducer pipe at pump setting depth, to termination inside panel onsite.

E. Lightning Surge Arrestor

F. Accessories

1. STE Moistureproof sensor termination enclosure
2. Slimline sink weight

2.6 THERMOSTAT

A. Provide thermostat meeting the following physical requirements:

1. Surface mount.
2. Remote capillary, 5 foot.
3. Setpoint dial:
   a. High limit: 55-175 °F.

B. Provide thermostat meeting the following electrical requirements:

1. Contact Arrangement: SPDT.
2. Contact Rating: 8A, 120 VAC.
3. Electrical Connections: Screw terminals for Instrument Cable.
4. Grounding: Ground housing per manufacturer's instructions.
5. Manufacturer’s Reference: Honeywell T675A.

C. Provide two (2) redundant thermostats: one for heater/ ventilation control, and one to provide low-temperature alarm signal to PLC to be posted to SCADA.

2.7 INTRUSION SWITCH:

A. Type: Magnetic Contact.

B. Construction: Aluminum housing, with anodized aluminum finish.

C. Mounting: Integral mounting holes.

D. Maximum Voltage: 30 VDC.

E. Contact Arrangement: SPDT, Form C.

F. Gap Distance: Up to 3”.

G. Lead Type: 3’ flexible metal clad jacketed, #22 AWG.

H. Manufacturer’s Reference: Sentrol 2507-A.

2.8 LIMIT SWITCH (for chlorination room door)

A. As identified on Electrical Drawings.

2.9 VARIABLE FREQUENCY DRIVES (VFD)

A. VFDs for submersible well pump motors shall be furnished and installed by the Contractor.

B. The manufacturer and model numbers below may be relied upon by the Contractor for basis of bid. However, the Manufacturer's Reference and sizing details must be verified during or prior to the submittals process before Contractor orders the equipment.

1. The Owner or Engineer may require a change in this equipment to ensure compatibility with well pump motors which are being purchased and installed by the Well Driller as part of a separate project, to ensure compatibility with NTUA standards, or for other reason's at the Owner's discretion.

2. Coordinate with Well Driller's pump supplier (TP Pump / OTC of Albuquerque, NM) to ensure VFD submitted is appropriate for operation of the submersible pump and motor actually supplied and installed in the well. Verify equipment and programming requirements with pump supplier to ensure acceptable ramp up speed for the submersible pump.

C. Manufacturer's Reference:

1. VFD for Well 1B pump motor: Danfoss VLT Aqua Drive #FC-202P7K5
   a. Rated for use with 7.5 HP submersible pump at 7,500' elevation.

2. VFD for all other well pump motors: Danfoss VLT Aqua Drive #FC-202P5K5
   a. Rated for use with 5 HP submersible pump at 7,500' elevation.

PART 3 EXECUTION

3.1 GENERAL

A. Perform work in accordance with ANSI/NFPA 70 and 79 unless otherwise specified.

B. Install equipment and products in accordance with manufacturer's instructions.

3.2 FLOWMETER INSTALLATION

A. Contractor shall coordinate furnishing and installation of meters and all required appurtenances and converters in Chlorination Building and at Well Sites with NTUA.

1. Contractor shall submit metering equipment for Engineer and NTUA review.

2. Following submittal review, Contractor shall purchase Meters and accessories.

3. Meters shall be provided to NTUA by Contractor programmed by NTUA.

   a. Contractor shall reimburse NTUA for programming costs from an allowance identified on the bid form, if directed by Owner.

4. NTUA shall provide fully programmed meters to Contractor.

5. Contractor shall install meters.

B. Wire magnetic flowmeter transmitter control and power wiring. Provide instantaneous flow and flow totalizer signals to the local PLC at each site.

C. Ground flowmeter and transmitter per manufacturer's recommendations. Connect transmitter ground wire to panelboard ground. Provide grounding rings.

D. Ensure wiring to meter and accessories in Well Site meter vaults does not interfere with

workspace in the vault.

E. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.3 PRESSURE TRANSMITTER INSTALLATION

A. Connect pressure transmitter to associated tank site piping.

B. Wire pressure transmitter to PLC.

C. Ground housing per manufacturer's instructions. Ground cable shield at PLC enclosure terminal block only.

D. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.4 WELL PRESSURE TRANSDUCER INSTALLATION

A. Owner’s Well Driller shall be responsible for installation of a transducer downhole within each well.

B. Contractor shall:

1. Coordinate with Well Driller, Engineer, and NTUA, as needed, for scheduling, calibration and startup of well transducers.

2. Reimburse Well Driller from an allowance on Bid Form for Well Driller’s costs to purchase and/or install transducers, if directed by Owner.

3. Be responsible for installation and connection of each transducer and accessories from the wellhead pitless to the Well Site PLC.

4. Confirm and record appropriate installation depth in well with Well Driller, Engineer and NTUA.

5. Wire pressure transmitter to PLC.

6. Ground housing per manufacturer's instructions. Ground cable shield at PLC enclosure terminal block only.

7. Install accessories (excluding those installed downhole in well) per manufacturer's instructions.

8. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.5 THERMOSTAT INSTALLATION

A. Mount thermostat 5’-0” above finish floor to centerline of switch.

B. Direct sensing tip toward center of room away from cold exterior walls. Insulate capillary tube if required to prevent cold spots.

C. Wire thermostat switch to exhaust fan control circuit.

D. Wire low temperature alarm to PLC. Calibrate and set low temperature alarm set-point.

E. Calibrate and test per manufacturer’s recommendations. Record calibration and test data.

3.6 INTRUSION SWITCH INSTALLATION

A. Locate switch in location where it is least likely to be damaged due to normal daily operations.

B. Install within specified adjusting points and per manufacturer's recommendations.

3.7 LIMIT SWITCH INSTALLATION (for chlorination room door)

A. Locate switch per Drawings and in location where it is least likely to be damaged due to normal daily operations.

B. Install within specified limits of travel and per manufacturer's recommendations.

C. Wire limit switch to exhaust fan control circuit.

3.8 VARIABLE FREQUENCY DRIVE INSTALLATION

A. Install and program as per VFD manufacturer and well pump motor manufacturer's recommendations. Coordinate programming of VFD with NTUA.

3.9 OTHER ELECTRICAL EQUIPMENT FABRICATION AND INSTALLATION

A. Connect analog input devices as 4-20 mA current loop in the field and in the enclosure. Coordinate analog device loop power requirements with device manufacturer.

B. See Related Sections and Drawings for additional details and requirements.

3.10 INSTALLATION AND START UP

A. Provide on-site supervision for installation, calibration, equipment testing, start up, and functional testing efforts.

B. Contractor shall provide all set-up, programming, and calibration of the PLC, using a programmer selected by the Owner, at Contractor's expense. A bid allowance is provided on the Bid Form for this sole purpose.

C. Coordinate schedule with Well Driller and Engineer to ensure Well Driller is present at start up and testing of VFDs and well transducers.

D. Prepare process and instrument lines as follows:

1. Verify all lines which are opened during the installation are cleaned per the recommendation of the Owner.

2. Leak test all lines which are opened during the installation.

E. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.

2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

F. Test field wiring for continuity before applying power to equipment.

G. Verify voltage upstream of each overcurrent device before applying power to equipment.

H. Ensure all manual valves are OPEN and switches/breakers are ON as required for normal site operation.

I. Calibrate instruments.

J. Test radio or other connections between each Well Site and Chlorinator Site. Confirm respective I/Os are received, sent and processed as required in this specification at each site.

3.11 SITE ACCEPTANCE TESTING

A. Prepare commissioning binder and include the following items:

1. Red-lined wiring diagrams.
2. Completed instrument data sheets.
3. Instrument Operations and Maintenance manuals.
4. Checksheets and test records.

B. Ensure sufficient spare parts and consumables are available to complete the site acceptance test.

C. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.
2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

3.12 TEST RECORDS

A. Record test results on appropriate checklists or other records that can be traced to the item and individual responsible for performing the test.

B. Identify the following on the test records:

1. Specific item tested.
2. Procedure number and revision to which the test was performed.
3. Model and serial number of any test equipment used.
4. Calibration expiration date for any test equipment used.
5. Range of Calibration.
6. Data recorder by signature or stamp.
7. Type of observation.
8. Results and acceptability.
9. Action taken in connection with any deficiencies noted.

C. When modifications, repairs or replacements are made after completion of tests, retest to the extent necessary to verify acceptability in accordance with the original plans and specifications, and to ensure compatibility with system interfaces.

3.13 TRAINING

A. Provide the following training for the Maintenance Technicians.

1. Number of Attendees: 10.
2. Duration:
    a. 1/2 day formal training on-site.
3. Location: Owner's facility.
4. Topics:
    a. Hands-on troubleshooting of instruments and hardware.

b. Use of test equipment.

c. Use of technical manuals for preventive and corrective maintenance.

5. Video recording of training and three (3) DVD copies produced.

6. Operate the complete system in Auto with operator(s) for at least 15 minutes.

7. Check complete system for alarm conditions.

B. Provide follow-up training 30 days after system acceptance.

1. Number of Attendees: 6.

2. Duration: 1 day.

3. Location: Owner's facility.

4. Topics: Additional Maintenance topics as required.

5. Video recording of training and three (3) DVD copies produced.

C. Text material: Use O&M Manuals and supplemental materials as required.

END OF SECTION

SECTION 26 42 10

IMPRESSED CURRENT CATHODIC PROTECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Design, furnish, install, energize, adjust, and test an automatically controlled, impressed current, cathodic protection system, for the interior of a steel reservoir complete as described herein.

B. Coordinate related work included in other Sections.

C. Cathodic protection system shall include wire, conduit and related appurtenances to complete the connection of the cathodic protection system to the power source and all other related structures and connections.

1.2 QUALITY ASSURANCE

A. Obtain complete impressed current cathodic protection system from one system supplier.

B. Conform to the recommendations of the National Association of Corrosion Engineers (NACE).

C. Conform to ANSI/AWWA D104-11.

D. Conform to National Electric Code.

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

B. Design work by parties certified by a NACE Cathodic Protection Specialist, certified and licensed at location of project.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit for review detailed calculations, drawings and data documenting the sizing of the cathodic protection system components including, but not limited to: anode, rectifier, batteries, potential control devices, electrical cable, conduits, reference cells, cable connectors, connection insulation, anode suspension ropes, installation arrangement and details.

C. Contractor may submit minor variations to the proposed system for Engineer and Owner approval, prior to installation.

D. Submit Final Certified Operations Report.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Basic Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of all system components.

C. Operation and Maintenance Data: Include periodic test procedures.

PART 2 PRODUCTS

2.1 GENERAL

A. A complete impressed current cathodic protection system consisting of a platinized niobium wire anode loop within the reservoir, an electrical system capable of meeting the requirements of the cathodic protection system and providing power to a device for level measurement, control equipment and devices necessary to maintain constant tank-to-water potential, and facilities as required to monitor system performance.

B. An automatic control system to provide completely unattended operation under all normal operating conditions. Design the system with the capability of automatically maintaining a selected constant potential at the locations monitored by its reference device or devices under all normal operation conditions.

C. Provide an impressed current cathodic protection system that is fully protected against abnormal conditions such as those that result from lightning strikes, internal system short circuits, or overloads.

D. All materials potentially in contact with water or in the condensation area shall conform to ANSI/NSF 61.

2.2 TANK-TO-WATER POTENTIAL CONTROL DEVICES

A. Include control devices of solid-state design capable of maintaining a constant tank-to-water potential within the tank of minus 900 millivolts, with a maximum potential variation less than 20 millivolts, or as determined by the Contractor's NACE-certified CP system designer. Provide control devices free of errors produced by IR drop.

B. Provide control devices that do not require manual tap adjustment to maintain output of impressed current through the full rated output current range of the device.

C. Circuit the potential control device so that its measuring circuit is sensitive only to the potential of the metal surface being protected and is unaffected by voltage drops occasioned by the flow of protective current through the various components between the power source and the metal surface being protected.

D. Furnish potential control devices with demonstrated satisfactory performance in a similar installation for at least two years.

E. Mount the potential control devices with rectifier in a NEMA 3R enclosure.

2.3 MONITORING REFERENCE CELLS

A. Furnish two removable monitoring reference cells.

B. Installed location of both reference cells shall be determined by the Contractor's NACE-certified CP system designer.

C. Locate cells near tank roof hatch to provide access to cells.

D. Clearly and permanently identify the terminals to which the connecting cables from these cells are terminated.

2.4 POTENTIAL MEASUREMENT OPENINGS

A. Provide potential measurement openings with gasketed covers in each quadrant where highest and lowest structure-to-water potentials are expected to be found.

2.5 ELAPSED TIME METER

A. Provide elapsed time meter(s) that operate when the potential control device is operating and supplying protective current to the tank.

2.6 IMPRESSED CURRENT ANODE SEGMENTS

A. Provide anodes with connection wire of platinized niobium wire sized for 20-year service life.

B. The anode system will be designed for the specified service life, based on an assumption that 25% of interior surface area of tank below high water level is bare and free of protective coatings.

2.7 ELECTRICAL CABLE

A. Stranded copper with 600-volt insulation.

B. Type THWN insulation for cable that will never be submerged.

C. Anaconda type CP, cathodic protection cable with low density, high molecular weight polyethylene insulation for any cable that might be submerged.

2.8 CONDUIT

A. Flexible conduit shall be used.

2.9 REFERENCE CELLS

A. Copper saturated copper sulfate solution type guaranteed for twenty-year service life.

2.10 CABLE CONNECTORS

A. Use copper compression connectors for splices in cable runs and at anode connection.

2.11 ANODE SUSPENSION ROPES

A. Nylon or Engineer approved substitute.

2.12 ANODE CABLE ROUTING

A. Route anode cables through the reservoir sidewall by means of a pressure entrance fitting nominally two feet above ring-wall.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the cathodic protection system in accordance with reviewed and approved submittals.

B. Furnish technically competent superintendent and experienced employees, each with at least five years of documented experience on similar installations, as required to accomplish the cathodic protection system installation in a prompt and effective manner.

C. Install all equipment level and plumb and located for easy maintenance access. Install conduit parallel to dominant structure surfaces and supported at intervals of not more than five feet.

D. Provide a separate positive DC output cable to each anode wire loop.

E. Clearly and permanently identify each terminal as to the anode ring or section of the ring supplied by the feeder cable connected to that terminal.

F. Install the anode ring at a height of 8 to 10 feet above the floor of the tank. Exact height to be determined by the Contractor's NACE-certified CP system designer.

G. Install all interconnecting conductors and cables external to the reservoir in conduit.

H. Route conductors and cables between devices located external to the reservoir and components located internal to the reservoir to minimize conductors and cables within the reservoir.

I. Complete all welding and cutting for installation of cathodic protection equipment, devices, and raceways prior to coating tank. In the event that welding or cutting is required after tank coating, internal coating shall be repaired in accordance with Section 09 97 14 – Water Storage Tank Painting.

3.2 ENERGIZING, ADJUSTING, AND TESTING

A. The system shall be fully energized, adjusted, and tested within one month after the completion of the project's 11-month inspection.

B. Fill reservoir to normal capacity and maintain level throughout the cathodic protection adjustment period.

C. Energize the cathodic protection system and adjust the system for optimum performance based on tank-to-water potential readings at various locations within the reservoir.

D. Set controls for minimum output and increase manually until protective levels approach those required for protection.

E. When the tank-to-water potential measured with each monitoring reference cell is at least 0.85 volts, make tank-to-water potential measurements at four-foot intervals from the tank bottom to the high water line at each potential measurement opening. Record each measurement. Adjust output until no tank-to-water potential is greater than 1.00 volts nor less than 0.85 volts, or as determined by Contractor's NACE-certified CP system designer.

F. After the initial tank-to-water potential adjustments are complete, switch to automatic potential control.

G. Between 24 hours and 72 hours after completion of initial adjustment, make final adjustments using the same procedure as during the initial adjustment.

H. Provide the Engineer with a Final Certified Operations Report documenting all control device settings and potential measurements.

3.3 Cathodic Protection System Service Agreement: Provide an agreement for five \(5) years of service for the tank cathodic protection system, starting upon the date of energizing the cathodic protection system. The agreement would require completion of the following service and testing on an annual basis, meeting or exceeding the minimum requirements of AWWA D104-11.

A. The service agreement shall be directly between the NACE-certified CP system provider and NTUA.

B. Owner reserves right to reject service provider for any reason and require Contractor to provide another service provider acceptable to the Owner at no additional cost to the Owner.

C. Annual service:

1. Wiring, anodes, rectifier, fuses, and accessories shall be observed and electrical measurements shall be taken to test anodes and reference cells.

2. Any damage or deficiencies with the cathodic protection system should be noted for correction.

3. Any handhole covers, gaskets, and bolts shall be positioned to fully cover any handhole and bolt hole openings in the roof.

4. The Contractor shall forward certified results of the evaluation and recalibration of the cathodic protection system to the Owner.

D. Annual testing:

1. The Contractor shall perform tank-to-water potential profile measurements to verify the effectiveness of the cathodic protection system.

2. The testing shall show changes in metal potential for all wetted surfaces of the tank interiors measured against a calibrated portable reference cell.

3. Measurements shall be made at a minimum of five separate locations per tank.

4. The Contractor shall submit copies of the tabulated results of the test to the Owner.

END OF SECTION

SECTION 26 45 00

GROUNDING

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Raceways: Section 26 11 00.

D. Outlet Boxes: Section 26 13 00.

E. Wires and Cables: Section 26 12 00.

F. Wiring Devices: Section 26 14 00.

G. Cabinets: Section 26 13 30.

H. Motor and Circuit Disconnects: Section 26 17 00.

I. Panelboards: Section 26 16 00.

PART 2 PRODUCTS

2.1 Materials, equipment and devices related to the grounding system are specified under other sections of these Specifications.

PART 3 EXECUTION

3.1 GENERAL: Install two separate grounding systems, a service grounding system and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the Drawings or as specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 SERVICE GROUNDING SYSTEM

A. General: The service grounding system is provided for the AC service neutral ground. Current return conductors, such as neutrals of the service entrance, feeder circuits and branch circuits, shall not be used for equipment grounding. Care must be exercised to ensure that neutral bars are not bonded to the enclosures of panelboards, etc., which are not part of the main service equipment. Except for separately derived systems, the neutral conductors shall be grounded only in the main service equipment.

B. Common Ground Point: Establish one common ground point in the main service equipment by interconnecting the insulated neutral bus (or bar), the uninsulated equipment ground bus (or bar), and service grounding electrode conductor.

C. Neutral Disconnecting Means: Install a neutral disconnecting means in the main service equipment for disconnecting and isolating the neutral bus from the common ground. The disconnecting means may be disconnecting links in the interconnection between the insulated neutral and uninsulated equipment ground.

D. Neutral Bars: Provide an insulated neutral bar, separate from the uninsulated equipment ground bar, in all panelboards, transformers, starters, disconnect switches, cabinets, etc., which have neutral connections.

3.3 EQUIPMENT GROUNDING SYSTEM

A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the Drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current-carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current-carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.

B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.

C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground box (or bar) with a conductor or bar sized for 50% of the largest service overcurrent device.

D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all panelboards, starters, disconnect switches, cabinets, etc. for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in panelboards or a separately mounted bar adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.

E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.

F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three phase feeder and each branch circuit with a three phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits where indicated on the Drawings. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel feeders

installed in more than one raceway each raceway shall have a green insulated equipment ground conductor installed.

G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings and other fixed equipment.

H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center or separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.4 SEPARATELY DERIVED SYSTEMS: Transformers creating separately derived distribution systems, such as dry type transformers, shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

3.5 GROUNDING ELECTRODES: Two service ground electrodes shall be utilized. One shall be the main cold water metallic water piping system and the other shall be a made electrode consisting of not less than twenty feet of bare copper conductor encased along the bottom of a concrete foundation footing which is in direct contact with the earth (NEC 250-50). Make the connections to the cold water pipe inside the building at the point of entrance. The grounding electrode for separately derived systems shall be approved for the application.

3.6 GROUNDING CONDUCTORS: The grounding conductors for both service ground electrodes shall be insulated or bare copper, sized in accordance with NEC 250-66, including the conductor for the made electrode. The conductors shall be continuous without joint or splice and shall be installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and the most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor, but not less than Type TW. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards of transformers the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal sheathed holes. All connections shall be available for inspection and maintenance.

3.7 GROUND CONNECTIONS: Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanoz", or equal.

3.8 TESTS

A. Remove all jumpers between the equipment ground busses and the service (neutral) ground busses in the main service panel and all separately derived systems. See Section 3.02.C.

B. For each grounding system, using an ohm-meter, measure the resistance between the two ground busses at the panel where the jumper was installed. The resistance shall be greater than 10 megohms.

C. Re-connect the equipment and service bus jumpers on all systems. See Section 3.02.C.

D. For each grounding system, using an ohm-meter, measure the resistance between the two ground busses at the panel farthest away (electrically) from the panel where the jumper was installed. The resistance shall be less than 5 ohms.

E. Submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Engineer.

F. Test resistance from grounding electrode system to ground using ohm-meter.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.

2. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

A. HID: High-intensity discharge.

B. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

5. Photoelectric relays.

6. Ballasts, including energy-efficiency data.

7. Lamps, including life, output, and energy-efficiency data.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

D. Warranty.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One complete replacement set.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
3. Ballasts: Furnish at least two of each type.

PART 2 PRODUCTS

2.1 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Exterior fixtures shall comply with the New Mexico Night Sky Ordinance.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather-and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel, SS 316 or better.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat-and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and tested luminaire before shipping.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Adjustable window slide for adjusting on-off set points.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F (minus 18 deg C) and higher.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.

2. Sound Rating: A.

3. Electronic.

4. Total Harmonic Distortion Rating: Less than 10 percent.

5. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F (minus 18 deg C) and higher.

D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:

— Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.

— Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).

— Normal Ambient Operating Temperature: 104 deg F (40 deg C).

— Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

— Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

— 5 HID LAMPS

C. High-Pressure Sodium Lamps: ANSI C78.42, average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

PART 3 -EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to structural supports.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards

END OF SECTION

SECTION 26 60 10

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

1.2 REQUIREMENTS: Comply with Underwriters Laboratories. Inc. UL 96A, and NFPA Standard #78.

PART 2 PRODUCTS

2.1 GENERAL: All materials for the lightning protection system shall be suitable for a copper-bronze system.

2.2 AIR TERMINAL RODS: Air terminal rods shall be 24 inches in height and shall have a tapered point. The rod shall be 1/2 inch minimum diameter below the point and shall be solid copper.

2.3 CONNECTORS: All clamps used in connecting conductors to each other and to air terminals shall be made of high conductivity copper or bronze alloy suitable for copper-copper or copper-bronze joints as the cast may be, and drawn tight with bolts or capscrews of similar metal clamps. Bolts or capscrews shall be of sufficient cross section that there shall be no distortion or breaking under any stress to which they might be subjected under ordinary usage.

2.4 CONDUCTORS: Counterpoise conductor below grade shall be bare stranded copper lightning protection and grounding conductor weighing not less than 420 pounds per thousand feet. The size of any wire in the cable shall be not less than .0689". Roof conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge. Down lead conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge.

2.5 GROUND RODS: Shall be one inch round and ten feet long, copper weld with top of the rod three feet minimum below grade. If copper can be seen from offsite it must be masked, capped, or disguised.

PART 3 EXECUTION

3.1 INSTALLATION: The installation shall be accomplished by the manufacturers installing contractor of the LPI, working under the direct supervision of the manufacturer. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splicers, and bonds with cable downleads routed concealed either directly in the building construction or in 1" PVC conduit to ground. Downlead cables shall not be brought directly through the roof. Through-roof connectors with solid rods or conduit through approved flashings shall be utilized for this purpose. Copper equipment shall not be connected to aluminum surfaces except by means of an approved bimetal transition fittings.

3.2 DRAWINGS: Shop drawings and plans for the system installation shall be approved by the Engineer before the cutting, fabricating, assembling, finishing, delivering or installation of any materials specified herein.

3.3 COORDINATION: The installer will work with other trades to insure a correct, neat, and unobtrusive installation. The lightning protection installer shall assure a sound bond to the main water service and interconnection with other building ground systems, including both telephone and electrical. All final flashing and sealing of lightning protection system roof penetrations shall be furnished and installed by the roofing contractor in compliance with the roofing system in use. A copy of the lightning protection system shop drawings shall be forwarded by the architect to the roof contractor for coordination purposes.

3.4 WORKMANSHIP: The installation shall comply with the applicable codes. All materials shall be new. Defective equipment and equipment damaged in the course of installation or tests shall be replaced or repaired in a manner meeting the approval of the Architect.

3.5 UNDERWRITERS LABORATORIES, INC. CERTIFICATION: The lightning protection system extension shall receive the Underwriters Laboratories Master Label. The master label shall be evidence that the installation of the lightning protection system has been made by an installer accredited by a manufacturer of listed lightning protection materials, that materials used are subject to factory inspection and are labeled and that the installation will require a field inspection program by UL with a report of inspection to the Owner, covering proper installation of the labeled materials according to UL requirements. Coordinate all facets of the extension to maintain master label for existing system and to provide a complete master labeled system for the entire complex. The contractor shall also submit copies of as-built shop drawings with LPI Form LPI-1-R91 to finalize the LPI Certified System Application with a copy of the test results.

3.6 AIR TERMINAL RODS: Shall be securely connected to and made electrically continuous with the roof conductors. Air terminals shall extend above the roof to which they are attached. Where practicable all air terminals shall be provided with at least two paths to ground.

3.7 ROOF CONDUCTORS: Shall be connected to all metal parts of the roof. Sharp turns in conductors shall be avoided. Bends shall have a radius of eight inches or more and shall not turn more than 90 degrees. Roof conductors shall be connected to form a closed loop and connect all air terminals together. Connections to air terminals shall be made with screwed or bolted clamps.

3.8 DOWN CONDUCTORS: Shall be electrically continuous from all terminals or roof conductors to the grounding system. Down conductors shall be concealed and shall be as widely separated as possible. All connections to down conductors shall be made with screwed or bolted clamps.

3.9 TESTS: After the installation of the lightning protection and static grounding system is completed and at such time as the Architect may direct, the Contractor shall provide a UL field inspector to conduct an operating test, as specified by the manufacturer, for approval. The Contractor shall furnish all instruments and personnel required for the test and it shall be performed in the presence of the Architect and Owner. Loose connections, inadequate ground or improper workmanship found by such tests shall be replaced or corrected at the Contractor's expense and the system retested until conditions are satisfactory. A report on the test shall be provided to the Owner.

3.10 Connections shall be made in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors hardware, conductors and connections methods so metal in direct contact will be galvanic ally compatible.

END OF SECTION

SECTION 27 43 30

SCADA RADIO TELEMETRY SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0, or latest version.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Section, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. SCADA PLC System and components.

1.3 DEFINITIONS

FCC:	Federal Communications Commission.
HMI:	Human Machine Interface.
MHz:	Megahertz.
NECA:	National Electrical Contractors Association.
NEMA:	National Electrical Manufacturers Association.
NFPA:	National Fire Protection Association.
NTUA:	Navajo Tribal Utility Authority, end-user for microwave radio system.
PLC:	Programmable Logic Controller.
RTU:	Remote Terminal Unit.
SCADA:	Supervisory Control and Data Acquisition.

1.4 SYSTEM DESCRIPTION

A. There are five (5) well distinct well sites, each with their own Well Site (WS) SCADA PLC.

B. This is one (1) tank site with a chlorination building with a SCADA PLC.

C. The contractor shall purchase, construct, energize, and program six (6) new radio SCADA systems and connect them to the NTUA SCADA network, including control panels, PLCs, radios, outdoor/indoor enclosures, antennas, and AC electrical equipment.

   a. Well Sites #1 - #5:

      i. Unlicensed Radios per NTUA IHS Version 4.

      ii. Individual well sites do not communicate directly with each other or with NTUA Headquarters. Each well site has a separate unlicensed radio connection with the Chlorination Building.

iii. Each well site PLC shall be able to receive controls, and send pertinent well information including well transducer readings, flowrates, well operational status, and alarms to the Chlorination Building PLC via radio signals.

b. Chlorination Building (CB) PLC at the Chichiltah Vanderwagen Tank Site shall have both an NTUA IHS Version 4 unlicensed and licensed radio.

i. Unlicensed Radio per NTUA IHS Version 4

1. Communicates with each of the five (5) well sites.

2. CB PLC shall be able to both send and receive inputs/outputs (I/O), including controls, and pertinent well information including well transducer readings, flowrates, well operational status, and alarms.

ii. Licensed Radio per NTUA IHS Version 4

1. To communicate to an existing NTUA SCADA RTU site already connected to the NTUA SCADA network, to be identified by NTUA at a later time, which in turn will have the capability to relay data to NTUA headquarters.

2. PLC be able to both send and receive I/O's, to and from the existing NTUA SCADA network including controls, and pertinent chlorinator information including pressure transmitter readings, flowrates, chlorinator data, SCADA health, power supply status, tank level, and alarms.

3. PLC will have the ability to relay SCADA I/O's from each well site to the existing NTUA SCADA network.

D. The drawings show the remote radios and hardware components and how they shall be configured.

E. All SCADA equipment and programming shall comply with the Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0, or latest version. No substitutions will be allowed.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for radio telemetry equipment.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add testing record of each piece of adjustable equipment, listing name of person testing and date of test.

D. Source quality-control test reports on coaxial cable sweep tests.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For radios, include operation and maintenance manuals. In addition to items specified in Section 01 00 00 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.
2. Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.

B. Environmental Conditions: Capable of withstanding the wind, relative humidity and temperature conditions for specific equipment specified in Part 2.

1.8 COORDINATION

A. Coordinate size and location of raceway system, and provisions for electrical power to equipment of this Section.

B. Coordinate Work of this Section with requirements of NTUA.

C. Coordinate installation of equipment supports and wall penetrations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. All products and materials required to provide SCADA communications shall comply with Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0.

PART 3 EXECUTION

3.1 GENERAL WIRING

A. Wiring Method: Install cables in raceways and as otherwise indicated.

B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

C. Grounding: According to recommendations in IEEE 142 and IEEE 1100.

3.2 COAXIAL CABLE INSTALLATION

A. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps may not be used for heating.

B. Cable shall not be installed in same raceway with power cable.

C. Coaxial cable shall not be spliced.

D. Outdoor connections shall be installed in enclosures meeting NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.

E. Do not exceed manufacturer's recommended minimum bending radiuses

F. Attach antenna lead-in cable to support structure at intervals not exceeding 3 feet.

G. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

H. Exposed Cable: Install parallel to building lines, follow surface contours, and support cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

I. Cable Support: Install supports at intervals recommended in writing by cable manufacturer. Install supports within 6 inches of connector so no weight of cable is carried by connector. Use no staples or wire ties, pull tie-wrap snug, and do not over tighten.

3.3 ANTENNA INSTALLATION

A. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space. Parts that require periodic service or maintenance shall be readily accessible.

B. Align antenna elements to achieve maximum signal level and quality.

C. Grounding: As a minimum, comply with NFPA 780, "Installation of Lightning Protection Systems."

D. Antenna Cable Entrance: Use entrance fittings, seal, and waterproof penetrations of the building envelope.

3.4 FIELD QUALITY CONTROL

A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

B. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Replace malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved:

C. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

E. Operational Tests: Perform operational system tests to verify that system complies with Specifications.

F. A field radio pathway survey was not completed for the project.

1. Unlicensed Radio communication between Well sites and Chlorinator - based upon preliminary mapping, desktop line of sight evaluations, and near proximity, there may be some obstacles, including but not limited to tree cover height along the pathways that may interfere with radio communications between some sites. The Engineer will provide radio field survey results to the Contractor prior to construction. For the purpose of basis of bid, the Contractor may assume that there will be adequate radio signal strength between the individual well sites and the chlorinator.
2. Licensed Radio communication between Chlorinator and existing NTUA SCADA Network. It is anticipated that the chlorinator building's radio connection will be with a proposed NTUA radio tower site in development by Others, located at Gibson Peak, east of Gamerco, NM. Based upon preliminary mapping, it appears there are no known obstacles that would prevent radio communications and it is assumed that there would be adequate radio signal strength between Gibson Peak and the chlorinator.
3. Contractor shall verify that there is adequate signal strength for all radio pathways.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing surface debris.
2. Removing designated paving, curbs, and other obstructions.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 31 22 13 - Rough Grading.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of the New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Conform to applicable State of New Mexico code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area and/or salvage area for placing removed materials.

3.2 PREPARATION

A. Call New Mexico “One Call” at 811 and/or local utility companies at least three (3) working days before performing Work.

1. Request that underground utilities be located and marked within and surrounding construction areas.

B. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

C. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within indicated areas. Remove stumps and surface rock.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site, as directed in field by Engineer.

B. Tree removal:
   1. Trees larger than 3" in diameter shall be cut, de-limbed, and left in stacks on edge of ROW for public firewood gatherers. Place firewood such that the public may gather it without creating safety hazards or additional disturbance to the public, work site or the environment.
   2. Trees smaller than 3" in diameter, slash, and brush shall either be chipped and spread on the ROW or hauled to appropriate disposal site. Chipped material shall be distributed so as not to interfere with successful re-vegetation efforts.
   3. Tree stumps and other material that cannot be chipped or used by the public shall be hauled to an appropriate disposal facility.

C. Partially remove paving, curbs, and other obstructions as indicated on Drawings. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities as directed by Owner and/or Engineer. Indicate removal termination point for underground utilities on Record Documents.

E. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

F. The Engineer will indicate to the Contractor which obstructions are to be removed, disposed of, or salvaged, and will require special documentation.

G. All existing fences crossed by the Work, or are within the construction area, are to be removed and rebuilt to original condition or better. Fence materials resulting from such removal are to be stored or disposed of as directed by the Engineer. Fence materials

suitable for reuse or salvage that are damaged, lost or destroyed due to the Contractor's negligence or carelessness are to be replaced at the Contractor's expense.

H. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

A. Excavate top 6 inches of topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials or vegetable matter for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.

D. Remove excess topsoil not intended for reuse, from site.

E. All equipment shall be properly maintained and with proper safety devices.

F. Contractor must maintain control of dust and minimize blowing debris.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating subsoil.

2. Cutting, grading, filling, rough contouring, and compacting site for site structures and building pads.

B. Related Sections:

1. Section 02 21 32 - Surveying

2. Section 31 10 00 - Site Clearing: Excavating topsoil.

3. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.

4. Section 31 23 23 - Backfill: General building area backfilling.

5. Section 33 11 00 - Water Utility Distribution Piping

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The following payment concepts only apply when a corresponding item is included in the Bid Schedule. If no specific item is provided, then this work shall be considered incidental to any items which require grading.

B. Topsoil Fill:

1. Basis of Payment: Includes excavating existing soil, supplying soil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

C. Subsoil Fill:

1. Basis of Payment: Includes excavating existing subsoil, supplying subsoil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Structural Fill:

1. Basis of Payment: Includes excavating existing subsoil, supplying structural fill materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.3 REFERENCES

A. Subsurface data:

1. See 01 00 00 Basic Requirement for any geotechnical reports and subsurface data and/or reports available.

2. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports and the Technical Specifications, the more stringent requirement shall apply.

3. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
10. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
12. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
13. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
14. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
15. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
16. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
17. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
18. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
19. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
20. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.

21. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
22. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
23. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
24. ASTM D5080 - Rapid Determination of Percent Compaction.
25. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Samples: Submit, in airtight containers, 20 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

B. Perform Work in accordance with New Mexico Standard Specifications for Public Works Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. As specified in Section 31 23 23 - Backfill.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Call New Mexico “One Call” at 811 and/or local utility companies at least three (3) days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area, or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 and the Drawings for site-specific requirements.

C. Identify required lines, levels, contours, and datum.

D. Notify utility company to remove and relocate utilities.

E. Protect remaining utilities from damage.

F. Protect plant life, lawns, and other features remaining as portion of final landscaping.

G. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Do not excavate in rain or snow.

C. Do not excavate frozen materials.

D. Blasting is not allowed.

E. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

F. Remove excess subsoil not intended for reuse and dispose of in accordance with these Technical Specifications.

G. Benching Slopes: Horizontally bench existing slopes greater than 4:1 (H:V) to key placed fill material to slope to provide firm bearing.

1. Do not exceed maximum slope of 4:1 (H:V) unless otherwise noted on the Drawings or directed by the Engineer.

H. Stability: Replace damaged or displaced subsoil as specified for fill.

I. Notify Owner of any utility damage at once so emergency measures can be taken. The Contractor will pay for any required repairs.

J. Remove and exclude water, including storm water, groundwater, irrigation water, and/or other waters, from all excavations. Dewatering wells, well-points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level below the bottom of excavations. Water shall be removed and excluded until backfilling is complete and all field soils testing have been completed.

K. Excavation Below Fills and Embankments: The subgrade areas beneath embankments shall be excavated to remove not less than the top 1 foot of native material and, where such sub-grade is sloped, the native material shall be benched. After the required excavation or over-excavation has been completed, the top 12 inches of material shall be scarified and moisture added or material dried to optimum moisture and the exposed surface shall be proof rolled.

L. Excavation under areas to be paved shall extend to the bottom of the sub-base. After the required excavation has been completed, the area shall be scarified a minimum of 12 inches below the subgrade surface and recompacted prior to the placement of the sub-base

aggregate and/or base course aggregate. The finished sub-grade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

M. Damage to existing or new facilities or work caused by the Contractor's operations shall be repaired at no additional cost to the Owner.

N. Material beyond prescribed lines which is loosened by the Contractor's operations shall be removed, replaced and/or compacted, as directed by the Engineer, at no additional cost to the Owner.

3.4 FILLING

A. See Technical Specification 31 23 23 – Backfill.

3.5 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:

1. The finished grade substantially conforms with the drawings, or any deviation therefrom is approved by the Engineer

a. Blend with natural terrain

b. Minimum slope: 2%

c. Maximum slope: 4:1 (H:V)

2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set for in Technical Specification 31 23 23 - Backfill and the Drawings.

3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.6 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Field moisture content measured as specified in Section 31 23 23 - Backfill.

E. Unit weight of in-place compacted material shall be measured as specified in Section 31 23 23 - Backfill.

F. Perform in place compaction tests as specified in Section 31 23 23 - Backfill.

3.8 CORRECTION OF SUB-STANDARD WORK

A. Section 31 23 23 – Backfill: Correction of Sub-Standard Work.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities.
2. Sheeting and shoring.
3. Disposal of excavated material.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 03 05 00 - Basic Concrete Materials and Methods.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
4. Section 31 23 18 - Rock Removal.
5. Section 31 23 23 - Backfill: General backfilling.
6. Section 33 11 00 - Water Utility Distribution Piping

1.2 REFERENCES

A. Sub-surface Data:

1. See 01 00 00 Basic Requirement for any geotechnical and subsurface data and/or reports available.
2. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports and the Technical Specifications, the more stringent requirement shall apply.
3. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. NMSSPWC

1. NMSSPWC Sections 701, 801 & 802 "Trenching, Excavation and Backfill".

C. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

D. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
10. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
12. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
13. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
14. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
15. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
16. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
17. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
18. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
19. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
20. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
21. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
22. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
23. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.

24. ASTM D5080 - Rapid Determination of Percent Compaction.

25. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported fill materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico, Navajo Nation and U.S. Bureau of Reclamation standards.

B. Perform Work in accordance with applicable OSHA trench safety standards.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Pipe Bedding and Embedment: As specified in Section 31 23 23 - Backfill.

B. Pipe Backfill: As specified in Section 31 23 23 - Backfill.

C. Structural Fill: As specified in Section 31 23 23 - Backfill.

D. Concrete: Structural concrete, as specified in Section 03 30 00, with minimum compressive strength of 4,000 psi at 28 days. Concrete for thrust blocking with minimum compressive strength of 3,000 psi at 28 days.

PART 3 EXECUTION

3.1 PREPARATION

A. Call New Mexico “One Call” at 811 and local utilities not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

C. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

D. Identify required lines, levels, contours, and datum locations.

E. Protect plant life, lawns and other features remaining as portion of final landscaping.

F. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

G. Maintain and protect above and below grade utilities indicated to remain.

H. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES, GRADES AND DIMENSIONS

A. Excavate trench to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required based on field conditions.

2. Deviations from horizontal and vertical pipeline and grade by Contractor: Refer to

3. Section 33 11 00 - Water Utility Distribution Piping.

4. When bottom of trench is rocky, over-excavate and fill as specified in Section 31 23 23 – Backfill.

B. Excavate trench to minimum width as indicated on Drawings.

1. Increase trench width as required to meet required clearances between pipe and trench wall, to avoid voids in the haunch areas of the pipe and to meet embedment compaction requirements or minimum soil cement slurry layer thickness. Increased trench width, if needed to meet these requirements, shall be provided at no additional cost to the Owner.

3.3 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove to 6 inches of topsoil and stockpile separately. The stockpiled soil shall be free of organic material. This topsoil shall be spread on top of the reclaimed area after backfilling, prior to re-seeding.

C. Remove lumped subsoil, boulders, and rock to bottom of trench.

D. Rock removal requiring specialized equipment or procedures as defined in Section 31 23 18 - Rock Removal, will be identified, quantified and paid for in accordance with Section 31 23 18.

E. Allowable open trench: Trenches may be opened in advance of pipe placement and backfill operations under the following conditions:

1. Do not open more than ½ mile of trench at one time. Do not leave any section of trench open for more than 24 hours.
2. Do not leave any trench open at the end of the workday within 100 feet of any road, driveway parking lot or other trafficked area, whether said road or driveway is shown on the Drawings or not.
3. Do not block vehicular traffic or impede access to homes or businesses.
4. Temporary fences shall be required for all trenches left open when the Contractor is not working on-site. All required temporary fencing shall be provided at no additional cost to the Owner.
5. Provide security at open trenches to protect the public, livestock, wildlife and the environment.
    a. Comply with all stipulations set forth by County, BIA Department of Transportation, the Navajo Nation, and other land-controlling agencies and owners of existing utility lines. These stipulations are provided in the Appendices.
    b. Provide animal escape ramps and cross-overs in accordance with the ROW stipulations provided in the Appendices.
6. Contractor is solely responsible for safety of all open trenches and bears sole liability for any incidents or accidents arising from open trenches.
7. The Owner may further restrict the amount of open trench as needed due to safety, land use or environmental considerations.

F. Remove water or materials that interfere with Work. Remove groundwater by pumping to keep excavations dry.

G. Provide uniform and continuous bearing and support for bedding material and pipe.

H. Do not interfere with 45 degree bearing splay of foundations. Any excavation in this area shall be backfilled and compacted using the same materials and methods as structural fill for new buildings. Refer to Section 31 23 23.

I. Slope or shore trench as needed to meet safety requirements. When sidewalls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Backfill and compact to reach specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

M. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

N. Remove excess subsoil not intended for reuse from site.

O. Do not excavate in the rain or snow without approval from the Engineer.

P. Do not excavate in frozen materials without approval from the Engineer.

Q. Blasting is not allowed.

3.4 ADDITIONAL EXCAVATION

A. Perform additional excavation in trench bottom for pipe foundations as show on drawings and other additional excavations beyond specified lines as directed by the Engineer.

3.5 OVEREXCAVATION

A. When foundation material is over-excavated beyond specified or directed lines, fill the over-excavation with embedment or bedding material and compact in accordance with Section 31 23 23 - Backfill.

B. If foundation material is over-excavated by being disturbed or loosened during excavation, compact material in place or remove and replace with embedment or bedding material as determined by the Engineer and compact in accordance with Section 31 23 23 - Backfill.

3.6 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work. If the Engineer orders the sheeting to be left in place for the protection of the work, a payment will be allowed only for the actual cost of the timber left in place.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 BACKFILLING OF TRENCHES

A. See Section 31 23 23 – Backfill for general backfill requirements, as well as trench backfill, bedding and embedment requirements around pipelines.

3.8 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:

1. The finished grade substantially conforms with the drawings, or any deviation therefrom is approved by the Engineer

a. Blend with natural terrain

b. Minimum slope: 2%

c. Maximum slope: 4:1, unless otherwise noted on Drawings

2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set forth in Section 31 23 23 - Backfill and the Drawings, and

3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.9 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.10 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Field moisture content measured as specified in Section 31 23 23 - Backfill.

E. Unit weight of in-place compacted material shall be measured as specified in Section 31 23 23 - Backfill.

F. Perform in place compaction tests as specified in Section 31 23 23 - Backfill.

G. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the Owner.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting installed construction.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 18

ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing identified and discovered rock during excavation.

B. Related Sections:

1. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.
2. Section 31 23 23 - Backfill: Backfill materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Trench Rock Removal:

1. Basis of Measurement:

a. By vertical linear foot (VLF) of trench excavation. Each VLF is measured as horizontal linear foot of trench multiplied by the depth of excavated rock. The depth of the excavated rock may be less than the total trench depth. The width of trench is not a factor in the VLF calculation.

2. Basis of Payment:

a. Includes preparation of rock for removal, mechanical disintegration of rock, removal from position, loading and removing from trench.

b. Payment will not be made for over-excavated work beyond the required bedding depth below invert elevation of pipe as shown on Drawings, nor for replacement materials.

c. If native trench rock is processed and used as pipe bedding or backfill material, the cost of such processing will be considered incidental to the cost of trench rock removal.

d. If trench rock is hauled away from site and replaced with imported material, the costs of rock hauling and disposal, as well as the costs of obtaining and hauling imported fill material will be considered incidental to the cost of trench rock removal.

e. The cost of placing and compacting embedment and backfill material, regardless of whether it is native or imported, will be considered incidental to pipeline installation.

3. Contractor shall notify Engineer prior to commencement of rock removal work when rock is encountered and specialized equipment will be required, and await approval from Engineer before proceeding.

4. Contractor and Engineer must agree on rock quantity at the end of each day that such work was completed, and both parties must sign off on the quantity on the corresponding Engineer’s daily field report.

B. See 01 00 00 for any potholing data that the owner has obtained. Pot holing data is included in the Exhibits to the Contract Documents package. This data is provided for informational purposes only and will not be used as a basis for payment. Final quantities will be determined in the field during the construction process, in coordination with the Engineer.

1.3 DEFINITIONS

A. Rock: Solid mineral material of size that cannot be removed with conventional equipment such as a track excavator or chain-driven trencher (excluding rock saw).

B. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 30 bank cubic yards per hour.

C. If material cannot be excavated by conventional equipment, the Engineer must be immediately notified. The Contractor shall provide performance tests of the specified conventional or equivalent equipment. If the Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

1.4 SUBMITTALS

A. Submit type of equipment to be used for rock removal and/or processing.

B. If processed native rock is to be used for embedment and backfill, submit sieve analyses and other geotechnical data on the processed material, as required in field by Engineer.

1. Laboratory costs associated with such testing shall be reimbursable under project testing allowance. Other costs, such as sample collection and transport, are not covered under the allowance.

1.5 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Coordination.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination.

B. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical methods.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings.

D. For utility trenches, excavate to below invert elevation of pipe as shown on Drawings to ensure adequate bedding below pipe, and provide trench width as shown on Drawings to allow for proper embedment compaction or soil cement placement on sides of pipe. Exceptions to minimum trench width will be considered by Engineer if Contractor can demonstrate proper bedding and compaction are provided.

E. Disposal of excavated materials: Removed materials may be disposed of on-site, provided all criteria under Section 31 23 17 – Trenching, Article 3.8, are met.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. Not allowed.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Request visual inspection of foundation bearing surfaces by Engineer before installing subsequent work.

END OF SECTION

SECTION 31 23 23

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Pipe bedding material.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 22 13 - Rough Grading: Site filling.
3. Section 31 23 17 - Trenching: Backfilling of utility trenches.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 42 14 - HDPE Corrugated Drain Pipe.

1.2 REFERENCES

A. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

B. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T99 - Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 3050mm (12-in.) Drop.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society for Testing and Materials International (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3, 2,700 kN-m/m3).
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Percentage Compaction: Ratio, expressed as percentage, of actual density of material compared with maximum dry density based on Modified Proctor (ASTM D1557).

B. Optimum Moisture Content: Based on Modified Proctor (ASTM D1557).

C. Unified Soil Classification System: Based on ASTM D2487.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit samples and certified test documentation of all materials to be used.

C. Materials Source: Submit name of imported fill materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Submit field soil test on material in place as backfill and pipe bedding material.

F. Submit construction drawings with compaction test locations marked and labeled with station, date, test number, depth of test below ground surface, and test result.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Suitable materials may be processed on-site, or may be imported. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner, unless a unit price item is included for imported materials on the Bid Form. The following types of materials are defined as suitable where scheduled:

1. Type A (three-quarter inch minus aggregate backfill): Crushed rock or gravel, and sand with the gradation requirements below.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No.200	0 – 12

2. Type B (Class I crushed stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

3. Type C (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value not less than 30.
   a. This material to be used only when approved by Engineer.

4. Type D: (pipe bedding material): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 5 percent passing a No. 10 sieve and 1 to 2 percent passing a No. 200 sieve.

5. Type E (pea gravel backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

6. Type F (coarse drain rock): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2-inch	90- 100
1-inch	20 – 55
3/4-inch	0 – 15
No. 200	0 – 3

7. Type G (aggregate base, base course) as follows:

Sieve Size	Percentage Passing
1-inch	100
3/4 inch	80-100
No.4	30-60
No.10	20-45
No. 200	3-10

8. Type H (graded drain rock): Drain rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

9. Type I Not Used

10. Type J (cement-treated backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.

11. Type K (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type L (controlled low strength material): Controlled low strength material, also referred to as ‘soil cement slurry’ or ‘flowable fill’ shall meet the following requirements:
    a. Slurry shall have a 7-day compressive strength of not less than 50 psi and not more than 150 psi. The compressive strength shall be determined in accordance with ASTM D4832.
    b. Typical cement content: 3 to 10 percent by dry weight of soil to obtain specified compressive strength.
    c. The water-cement ratio of the mix shall not exceed 3.5:1. The water content shall not exceed that required to provide a mix that will flow and can be pumped.

d. The consistency of the slurry shall be such that the slurry flows easily into all openings between the pipe and the lower portion of the trench.

13. Type M (aggregate sub-base, structural fill). Well-graded crushed rock or natural gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
4-inch	100
3-inch	95 100
No. 200	3 - 15

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, the Engineer shall be immediately notified. In case of conflict between types of pipe embedment backfills, the Contractor is to use the agency-specified backfill material if that material provides a greater degree of structural support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, the Contractor shall use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types, including use of native soil, shall be used in accordance with the following provisions. Native soil used for fill and backfill must meet the requirements of the type of material specified below and as shown for the corresponding type of material shown in 2.1.A above.

1. Embankment fills shall be constructed of Type M material, as defined herein, or other material approved by the Project Engineer. Drainage structures embankments shall be backfilled with materials used in original construction.
2. Pipe zone backfill shall consist of the following materials for each pipe material listed below. All pipe bedding material shall receive prior approval by the Engineer before use.
   a. Concrete pipe, shall be provided Type A or B pipe bedding and embedment backfill material, or native material that meets the criteria described below, and is acceptable to the Engineer.
   b. Plastic pipe shall be provided Type D bedding and embedment zone material, or native material that meets the criteria described below, and is acceptable to the Engineer.
      1) In trenches where dewatering is required, the pipe bedding material and embankment backfill shall be Type A or B as directed by the Engineer.
   c. Excavated native material will be allowed, provided that it is free draining and contains no organic materials, no rocks larger than 1/2-inch, clods or frozen lumps. A proctor of this material shall be submitted to the Engineer for review and approval before use. If native backfill material is approved, on-site screening may be required by Engineer to remove any rock material larger than 1/2-inch at no additional expense to the Owner. The location of such sites must be coordinated with the Owner.
3. Trench zone backfill for pipelines shall be any of Types A through H backfill materials or any mixture thereof.

4. Final backfill material for pipelines under paved areas shall be Type G backfill material.
5. Final backfill under areas not paved shall be the same material as that used for trench backfill, unless otherwise indicated.
6. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
7. Aggregate base materials under pavements, curb and gutter, and sidewalk shall be Type G material constructed to the thickness indicated.
8. Aggregate sub-base shall be Type M material.
9. Backfill around structures shall be Types A through Type H materials, or any mixture thereof.
10. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter fabric shall be placed over the exposed foundation. Filter fabric shall be Mirafi 140 N, Mirafi 700X, or equal.
11. Under all other structures, Type G or H material shall be used.
12. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 6 inches, unless otherwise approved by Engineer.

D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING FOR STRUCTURES, SITE WORK AND APPURTENANCES

A. Backfill areas to contours and elevations with unfrozen materials as indicated on the Drawings or as directed by the Engineer.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer.

D. Place material in continuous layers as follows (unless otherwise approved by Engineer):
1. Subsoil Fill: Maximum 6 inches compacted depth.
2. Structural Fill: Maximum 6 inches compacted depth.
3. Granular Fill: Maximum 6 inches compacted depth.

E. Employ placement method that does not disturb or damage other work.

F. Maintain optimum moisture content of backfill materials to attain required compaction density.

G. Slope grade away from building minimum 6 inches in 10 ft, unless noted otherwise.

H. Make gradual grade changes. Blend slope into level areas.

I. Shape and drain embankments and excavations, maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work, and reestablish grade where settlement or erosion occurs.

J. Bench hillside slopes or fills to key the embankment. Remove and re-compact a minimum of 12 inches normal to the slope of the hillside or fill as the embankment or fill is brought up in layers.

K. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

L. Remove surplus backfill materials from site.

M. Leave fill material stockpile areas free of excess fill materials.

N. Repair or replace remaining items damaged by excavation or filling.

3.4 BACKFILLING OF TRENCHES

A. Place a minimum of 4 inches of bedding material in pipe trenches to lines and grades indicated on Drawings or as directed by Engineer and compact before pipe is laid. Grade bedding material parallel to bottom of pipe.

B. Do not place material when either the material or the surface upon which it is to be placed is frozen.

C. Pipe zone backfill materials shall be manually spread around the pipe so that, when compacted, the pipe zone backfill will provide uniform bearing and side support.
   1. Exercise care not to damage pipe or appurtenances when placing embedment material.
   2. Maintain optimum moisture content of fill materials to attain required compaction density.
   3. Ensure material is placed to equal height on both sides of pipe to avoid unequal loading and possible lateral displacement of the pipe. Elevation difference of embedment between each side of pipe shall not exceed 6 inches.
   4. Place material in uniform layers.
   5. Work material into pipe haunches to prevent voids and achieve specified compaction under the haunches.
   6. No backfilling by machine methods permitted until a minimum of one foot of material has been placed by hand over the top of the pipe.
   7. Place material to a compacted depth of 12 inches over the top of the pipe, 15 inches of compacted depth over the top of the pipe in paved or traffic areas, and compacted by hand held compacting tools before other backfilling is done.

D. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

E. When the bottom of the trench is unstable, an additional 4 inches shall be over-excavated and filled with bedding material before pipe is laid.

F. Where rock is present and where there is concern that settling rocks in the surrounding material may rupture the pipeline, the amount of bedding material below and above the pipe shall be increased. In these cases there will be 8 inches of bedding material below the pipe and 15 inches above, as directed by the Engineer.

G. When using free-draining crushed rock or gravel for embedment on stretches longer than 300 feet, install trench plugs composed of silty, non-plastic material at 300 foot intervals to impede flow of trench water through the embedment.

H. Where trenches are outside of roads and sites, mound backfill per typical trench detail in the plans.

I. Under surfaced or paved roads, driveways or parking areas, apply base course at uppermost layer of backfill to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

3.5 COMPACTION

A. Do not place and compact soil under the following conditions:
   1. Ambient air temperature below freezing.
   2. Rain that creates puddles in clayey or silty materials.

3. Ice or snow pockets visible in material being placed.

B. Surface Preparation:
   1. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified percent compaction, if necessary.
   2. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing first layer of material to be compacted.
   3. Do not place material to be compacted on frozen surface.

C. Compact material in trenches in layers having approximately the same top elevation on both sides of the pipeline to avoid unequal loading and displacement of the pipe.

D. Placement:
   1. Place soil to be compacted in horizontal layers.
   2. Blend materials as needed to ensure compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations and other imperfections.

E. Compaction Procedures:
   1. Silty or Clayey Material:
      a. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers or other suitable compaction equipment.
      b. Uniformly distribute equipment passes.
      c. Compact in horizontal layers to compacted thickness of 6 inches or less.
   2. Cohesionless Free-Draining Material: Compact in horizontal layers to maximum compacted thickness of:
      a. Tampers and rollers: 6 inches
      b. Crawler-type tractors, vibrating drum rollers, surface vibrators or similar equipment: 12 inches
      c. Saturation and internal vibration: Penetrating depth of vibrator.
   3. When compacting pipe embedment material, exercise care not to damage the pipe or appurtenances with compaction equipment. Do not apply compaction equipment directly above the pipe.
   4. Demonstration: Lift thicknesses may vary depending on equipment and methods. Field adjustments to the specified lift thicknesses may be allowed or required. Contractor shall demonstrate that proposed equipment and methods will meet required compaction for the proposed lift thickness.
   5. Flooding and jetting is not allowed unless specifically approved by the Engineer.

F. Moisture Content:
   1. Optimum moisture content for each soil type, whether native soil or imported material, shall be determined by the Modified Proctor method, ASTM D1557.
   2. Moisture content during compaction shall be no more than 2 percentage points wet or dry of optimum moisture content.
   3. Moisten or aerate material, as necessary, to provide specified moisture content. Add water to soil in increments that will permit moisture content to be uniform and homogenous through each layer after mixing.
   4. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.

a. If clayey soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in clods.
b. Use of disks, harrows or rakes may be required to blend moisture prior to placement and compaction.

5. For cohesionless soils, add water as necessary during compaction, as these soils are free-draining.

G. Minimum Percent Compaction:

1. Over-excavation: Backfill of over-excavation to specified or directed lines shall be compacted to same percent compaction as embedment material or undisturbed foundation material, whichever is greater. If the in-place compaction of the undisturbed foundation material is greater than 95%, the over-excavation backfill may be compacted to 95%.
2. Pipe Bedding Material: Place and compact pipe bedding material as indicated on Drawings for given soil classification, pipe wall thickness, and depth of cover. If native material meets grading requirements and is used, compact to 95%.
3. Initial and Final Backfill:
   a. For trenches under any existing or proposed roads, pavement, curb gutter, sidewalk, shoulder, alley, slab, footing, wash crossings, canal embankment or within two (2) feet of above, compact to 95%.
   b. For trenches within any gas, electric or telephone utility easement, or within any road ROW outside the limits defined above in Part 3.5.G.3.a, compact to 90%.
   c. For trenches outside of roads and all other locations not defined above in Parts Part 3.5.G.3.a and Part 3.5.G.3.b, compact to 80% (or 100% of adjacent natural ground).
4. Embankments: Compact to same requirements as Final Backfill.
5. Under buildings, tanks, slabs and other structures: Compact in accordance with Geotechnical reports provided in Exhibit A.
6. Note that all Percent Compaction values in these Technical Specifications and Drawings are based on Modified Proctor, ASTM D1557, unless otherwise noted.

H. Soil Cement Slurry may be used in trenches, at Contractor's option and expense, to replace bedding, embedment or backfill materials where it is not practical to reach minimum compaction requirements using select material.

1. If soil cement slurry is to be used in lieu of embedment material, soil cement slurry shall also replace the bedding material. Do not use soil cement slurry for embedment on top of select material bedding.

3.6 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

D. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

E. Percent Compaction: Shall meet minimum required compaction as set forth in these specifications

F. Moisture Content: As set forth in these specifications.

3.7 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, Adjusting, and Balancing.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:
1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
2. Moisture Tests: ASTM D6938.

D. When tests indicate Work does not meet specified requirements, remove material, replace, compact, and retest.

E. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the soils testing operations, at the locations and depths required. The cost of all work associated with accessing, preparing, or time delays for testing to be included in the unit price of the applicable pay item being tested.

F. Compaction testing shall be done to the extent such that the Owner and Engineer can be reasonably assured that the backfill has been placed in accordance with the requirements of the Contract Documents, or as required by the utility for which the trenching is being provided, whichever is the more stringent. When a testing allowance is established on the Bid Form, the Owner and Engineer will determine the testing frequency to be used throughout the project. If no allowance is included, the frequency of testing shall be at least once every 400 linear feet of trenching, or at least once every 200 square feet below structural slabs.

G. Correction of Substandard Work: All fill and backfill represented by tests that fail to meet compaction, moisture content, soil classification or other specifications shall be uncovered as needed, replaced as needed, re-compacted and re-tested until all specifications are met, at no additional expense to the Owner.
1. Elevations, lines and grades of replaced material, as well as of pipe and other structures resting against such material, shall be re-surveyed at the direction of the Engineer. Contractor shall correct elevations, lines and grades as needed, at no additional expense to the Owner.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting Installed Construction.

B. Reshape and re-compact fills subjected to vehicular traffic.

3.9 SCHEDULE

A. Interior Slab-On-Grade:
   1. Per Geotech Report.

B. Exterior Side of Foundation Walls, Retaining Walls and Over Granular Filter Material and Foundation Perimeter Drainage:
   1. Fill Type A – H or any mixture thereof, to subgrade elevation. 6 inches thick, each lift, compact uniformly to 90 percent of maximum density.

C. Fill Under Asphalt and Concrete Paving:
   1. Compact subsoil to 95 percent of its maximum dry density.
   2. Fill Type G, to 2 inches below finish paving elevation, or to match existing conditions, whichever is greater, compact uniformly to 95 percent of maximum density.

D. Fill Over Drainage Piping Gravel Cover:
   1. Fill Type H, to 6 inches below finish grade, compact uniformly to 90 percent of maximum density.

END OF SECTION

SECTION 31 37 00

RIPRAP AND ROCK LINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Riprap placed loose.
2. Wire Caged Riprap.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 23 - Backfill.
3. Section 31 23 17 - Trenching.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Check dams and riprap placed loose:

1. Basis of Measurement: By cubic yard of riprap volume, riprap only.
2. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.

B. Wire caged rip rap:

1. Riprap:
   a. Basis of Measurement: By cubic yard of riprap volume, riprap only.
   b. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.
2. Wire mesh, geotextile, tie wire, angle iron, and other appurtenances:
   a. Basis of Measurement: By square yard of riprap area encaged in completed installation. Wastage will not be paid for.
      1) Measurement is based on actual coverage area. Where the Drawings require wire mesh both above and below the riprap blanket, both layers are included the pay item, but the coverage area is not doubled for purposes of measurement.
   b. Basis of Payment: Includes cutting and placement of wire mesh material both above and below the riprap, geotextile fabric, tie wires, and angle irons.

C. Bid items for riprap, rock check dams or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Gradation of rock.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with State of New Mexico Department of Transportation standard, if related to roadway construction or drainage.

C. Samples of riprap material shall be provided to the Engineer for inspection and approval for every 500 cubic yards of riprap delivered to the site.

D. Submit representative samples of riprap for testing using the Los Angeles Abrasion Test using ASTM-C131 and for Soundness Testing using ASTM C-88.

1. Loss of aggregate from abrasion test shall not exceed 40 percent. Sample results shall be provided to the Engineer for every 500 cubic yards of riprap delivered to the site.

2. Loss of aggregate for soundness test shall not exceed 15 percent. Sample results shall be provided to the Engineer for every 500 yards of riprap delivered to the site.

3. Riprap testing shall be covered under the testing allowance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish materials in accordance with State of New Mexico Department of Transportation standards, Section 602.

B. Riprap:

1. Shall comply with New Mexico Department of Transportation standards, Section 602.2

2. Angular shaped rock:

a. Minimum size (as measured in the smallest dimension):

1) Class A Wire enclosed riprap:

a) At least 50% of the rock shall be a minimum of 4 inches measured in the smallest dimension. Remaining smaller rock shall not be smaller in any dimension than the smallest mesh openings.

2) Uncaged riprap and rock check dams:

a) 8” minimum rock dimension, measured in the smallest dimension.

b. Solid and nonfriable.

C. Wire mesh:

1. Non-raveling, uniform, hexagonal double-twisted galvanized wire mesh, with a diameter of at least 0.087", with 2½" x 3¼" mesh openings.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2

D. Selvedges:

1. Selvedge wire with a diameter of at least 0.150-inch.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2.3

E. Stakes:

1. 4"x4"x3/8" angle iron, per New Mexico Department of Transportation standard, Section 602.

2. Lengths per Drawings.

F. Tie Wire:

1. Soft tempered Class 3 zinc coated 0.120-inch diameter tie wire.

G. Geotextile Fabric:

1. Provide non-woven geotextile (filter fabric) Class 1, as per New Mexico Department of Transportation standards, Section 604.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Do not place riprap over frozen or spongy subgrade surfaces.

3.2 PLACEMENT

A. Riprap locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of riprap to be determined in field by Engineer after installation of pipeline and related facilities.

B. Filter fabric:

1. Place Class 1 non-woven geotextile (filter fabric) between the riprap and the supporting soil.

C. Installed Thickness: As shown on Drawings, or as directed in field by Engineer.

D. Wire enclosure: Where wire enclosure is to be used, enclose rock in wire mesh and anchor in place as indicated on Drawings.

E. Class A Riprap Placement

1. Shall comply with New Mexico Department of Transportation standards, Section 602

2. Enclose Class A riprap with wire mesh drawn tightly on all sides. The Contractor may connect wire mesh using approved fasteners or lacing wire. Weave adjacent edges at least once with double loops of lacing wire that is as strong and flexible as the mesh.

3. Provide continuous lacing as far as possible that passes through each mesh opening. Where splicing is necessary, overlap the lacing at least 12 inches.

4. Space galvanized wire ties connecting top and bottom mesh layers approximately 24 inches on centers. Anchor the ties to the bottom wire-fabric layer. Extend the ties through the rock layer and secure to the top wire-fabric layer. Anchor wire-enclosed riprap to slopes with steel stakes driven into the Embankment. Space stakes in accordance with the Contract.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE AND GRAVEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate base course.
2. Clean gravel.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Preparation of site for base course.
2. Section 31 23 17 - Trenching: Compacted fill under base course.
3. Section 31 23 23 - Backfill: Compacted fill under base course.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing aggregate to the depths and at the locations indicated on the Drawings, and compacting.

B. Clean Gravel

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, placing gravel to the depths and at the locations indicated on the Drawings, and compacting.

1.3 REFERENCES

A. New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with NMDOT standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course:

1. Base course gradation shall have a percent passing sieve sizes as shown in TABLE 304, SECTION 304-BASE COURSE, New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction, latest edition.

B. Clean Gravel (Class I crushed stone):

1. Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

C. Subgrade surface shall be kept at all times in such manner that it will drain readily and effectively.

D. Mix aggregate material to provide a homogenous mixture of uniformly dispersed materials as placed in position for compacting.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate in layers that will permit the required density be obtained. Density requirements will be determined by AASHTO T-180.

B. Compact each layer of material full width with: (1) two passes of a 50 ton compression type roller, or (2) two passes of a vibratory roller having a minimum dynamic force of 40,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute, or (3) eight passes of a 10 ton compression-type roller, or (4) eight passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute.

C. No displacement (pumping) of subgrade soils shall be visually observed when loaded by heavy equipment traffic.

D. Level and contour surfaces to elevations and gradients indicated.

E. Incorporate only suitable roadway excavation material into embankments. Compact material placed in all embankment layers and the material scarified in cut sections to a uniform density of not less than 95% Standard Proctor density.

F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 3/8 inch measured with 10-foot straight edge in any direction.

C. Maximum Variation from Thickness: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Field testing of density and moisture content of in-place material will be performed in accordance with Nuclear Method, ASTM D6938.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: One test every 2,500 square feet or portion thereof, at locations directed by Engineer.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts.
4. Manual gates and related hardware.
5. Removal, relocation, salvage, and/or reconstruction of existing fence.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Fencing:

1. Basis of Measurement:
   a. Fencing: By linear foot to fence height specified, based on specified post spacing.
   b. Gates doors: By Each, as described on bid form.
2. Basis of Payment: Includes posts, rails, tension wire, fabric, gates, hardware, accessories, and attachments.

1.3 REFERENCES

A. ASTM International:

1. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
6. ASTM A585 - Standard Specification for Aluminum-Coated Steel Barbed Wire.
7. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

8. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
9. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
12. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
13. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
14. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
15. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
16. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
17. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Fence Height: 6 or 8 feet nominal, as shown on Drawings.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Personnel Gates: 3 ft opening width.

D. Vehicle Gates: Double-swing, each consisting of two (2) swinging sections, with total opening width of vehicle gates as shown on Drawings.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

C. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer's name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing Steel: ASTM F1083 Schedule 40 galvanized steel pipe, welded construction; coating conforming to ASTM F1043 Type A on pipe exterior and interior.

B. Fabric Wire Steel: ASTM A392 zinc coated wire fabric.

C. Barbed Wire: ASTM A121 galvanized steel or ASTM A585 aluminum coated steel; 12 gage thick wire, 3 strands, and 4-point 14 gage barbs at approximately 5 inches on-center.

D. Concrete: 3,000 psi concrete.

2.2 COMPONENTS

A. Line Posts: 2.38-inch diameter.

B. Corner and Terminal Posts: 2.88 inch.

C. Gate Posts: 4.0-inch diameter.

D. Horizontal Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66-inch diameter for fittings and truss rod fabrication.

F. Fabric: 2-inch diamond-mesh interwoven wire, 9-gauge thick, top selvage twisted tight, bottom selvage knuckle end closed.

G. Tension Wire: 7 gauge thick steel, single strand, galvanized.

H. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel, pressed steel, or malleable iron; galvanized, sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Galvanized cast steel or pressed steel, to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.

D. Gate Hardware: Center gate stop and drop rod; two 180-degree gate hinges for each leaf.

2.4 GATES

A. General:

1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings or by Engineer in the field.

2. Factory-assembled gates.

3. Design gates for operation by one person.

B. Swing Gates:

1. Fabricate gates to permit 180-degree swing.

2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

3. Gate center stop: Mushroom type, galvanized cast iron, 1 3/8” slot, 4” long anchor

2.5 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M; ASTM A153/A153M for components; ASTM A392 for fabric; 2.0 oz/sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq ft coating.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate, terminal, and gateposts plumb, in concrete footings with top of footing 1 inch above finish grade of base course and 1 inch below top of gravel. Slope top of concrete for water runoff.

C. Line Post Footing Depth below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gateposts.

F. Install top rail through line post tops and splice with 6-inch long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 1 inch above finished base course grade.

L. Ensure final grade of gravel is 1 inch above bottom of fence material, leaving the fence fabric embedded 1 inch into the 2-inch thick gravel layer.

M. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

N. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.

O. Install bottom tension wire stretched taut between terminal posts.

P. Install support arms sloped outward and attach barbed wire; tension and secure, with barbed wire installed with lowest strand not less than the required 6 or 8 feet (nominal fence height, per Drawings) from ground level.

Q. Support gates from gateposts. Do not attach hinged side of gate from building wall.

R. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf.

S. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings, if double gates are called for on the Drawings.

1. Use mushroom-type gate center stop, set in concrete.

T. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.

U. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

V. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

W. Extend concrete footings 2 inches above grade, and trowel, forming crown to shed water.

X. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 REMOVING EXISTING FENCE

A. All existing fences to be removed shall be recorded photographically or by video prior to removal or modification, to document pre-existing condition.

B. Existing fences requiring removal and reconstruction shall be rebuilt to the same condition as the original fence or better.

C. The materials in existing fences to be removed and rebuilt shall be salvaged and incorporated in the rebuilt fences. Fence materials damaged beyond reuse during removal or handling must be replaced at no additional expense to the Owner.

D. The costs associated with the removal and rebuilding of existing fences at the original location is considered incidental to the construction of the utility. If the fence is relocated as instructed by the Engineer, a separate bid item will be included in the Bid Schedule.

E. Existing fence materials to be removed that will not be reused within the project shall be provided to the Owner at a location within the project area specified by the Owner. Contractor shall take reasonable care to avoid damage to removed materials, so that the Owner may reuse such materials at another location. Costs to transport and reinstall removed materials outside the project area shall be borne by the Owner.

F. Posts shall be firmly reset to the line shown on the Drawings, or as directed by the Engineer. The spacing of the posts and the material to be strung and secured to the posts is to be the same as the original fence.

G. New tie material or staples must be used to fasten the fence material to the posts.

3.3 ERECTION TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Plumb: 1/4 inch.

C. Maximum Offset from Indicated Position: 1 inch.

D. Minimum distance from property line: 6 inches.

END OF SECTION

SECTION 32 33 10

FARM STYLE FENCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fence materials.
2. Excavation for post bases.
3. Concrete foundation for posts.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Fencing:
1. Basis of Measurement: By linear foot to fence height specified, based on specified post spacing.
2. Basis of Payment: Includes posts, barbed wire, tension wire, accessories, and attachments.

1.3 REFERENCES

A. American Wood-Preservers' Association (AWPA):
1. AWPA C1 - (2003) All Timber Products - Preservative Treatment by Pressure Processes.
2. AWPA C4 - (2003) Poles - Preservative Treatment by Pressure Processes.

B. ASTM International (ASTM):
1. ASTM A153/A153M - (2005) Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A702 - (1989; R 2006) Steel Fence Posts and Assemblies, Hot Wrought.
3. ASTM A780 - (2001; R 2006) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings.
4. ASTM C94/C94M - (2006) Ready-Mixed Concrete.
5. ASTM F1083 - (2004) Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

PART 2 PRODUCTS

2.1 POSTS

A. Metal Posts for Farm Style Fence:
1. Metal posts shall conform to ASTM A702 zinc-coated, length as indicated. Accessories shall conform to ASTM A702.

B. Wood Posts:
1. Wood posts shall be cut from sound and solid trees free from short or reverse bends in more than one plane. Tops shall be convex rounded or inclined. Posts shall be

free of ring shake, season cracks more than 1/4 inch wide, splits in the end, and unsound knots. Size and shape of posts shall be as indicated. Posts shall be treated in accordance with AWPA C1 or AWPA C4, as applicable.

2.2 WIRE

A. Tension Wire:
1. Tension wire shall be Type I or Type II, Class 4 coating, in accordance with ASTM A824.

B. Barbed Wire for Farm Style Fence:
1. Barbed wire shall conform to ASTM A121 zinc-coated, Type Z, Class 3, or aluminum-coated, Type A, with 12.5 gauge wire with 14 gauge, round, 4-point barbs spaced no more than 5 inches apart.

2.3 CONCRETE

A. ASTM C94/C94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 INSTALLATION

A. For farm style fence, the layout will be as indicated on the Drawings or as indicated in the field. Fences will not be located adjacent to natural or man-made terrain features that could provide easy access across the fence. The graded fence line will be indicated on the Drawings where required.

B. Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780.

3.2 EXCAVATION

A. Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a consistent clearance between the lowest wire strand and finish grade.

3.3 POST INSTALLATION

A. Posts for Farm Style Fence:

1. For wood posts, the Contractor shall excavate to depth indicated and brace post until backfill is completed. Backfill shall be placed in layers of 9 inches or less, moistened to optimum condition, and compacted with hand tampers or other approved method. Posts shall be set plumb and in proper alignment. Metal posts shall be driven or set in concrete as indicated.

B. Barbed Wire for Farm Style Fence:

1. Wire shall be installed on the side of the post indicated. Wire shall be pulled taut to provide a smooth uniform appearance, free from sag. Wire shall be fastened to line posts at approximately 15 inch intervals unless indicated otherwise.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil.
2. Placing topsoil.
3. Seeding, Hydroseeding, Seed Drilling.
4. Seed Protection, Mulching
5. Maintenance.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Rough grading of site.
2. Section 31 23 17 - Trenching: Rough grading over cut.
3. Section 31 23 23 - Backfill

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassed Areas:

1. Basis of Measurement: By linear foot of centerline within the disturbed area of pipeline right of way and temporary use area. Lump sum for each site.
2. Basis of Payment: Includes preparation of subsoil, topsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.3 REFERENCES

A. Federal Specifications:

1. OF-241 - Fertilizers, Mixed, Commercial.

B. ASTM International:

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. NNDA: Navajo Nation Department of Agriculture

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, and other accessories.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Perform Work in accordance with Navajo Nation Department of Agriculture standards.

C. Seed mixtures must be certified. There shall be no primary or secondary noxious weeds in the seed mixtures.

D. Temporary Best Management Practices (BMPs) must be installed along areas where sediment is being transported out of the construction area. Fiber rolls (mulch socks) rip rap blankets, rip rap check dams, soil cement, soil berms, surface roughening, or other appropriate BMPs shall be used in these areas. Such BMPs shall be included in the Storm Water Pollution Prevention Plan (SWPPP) provided and implemented by the Contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be as specified in applicable sections of these Specifications and in accordance with recommendations of the supplier.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Do not commence seeding until all work that could require ground disturbance has been completed, tested, and approved.

C. Contractor is advised that there are three (3) Navajo Nation Department of Agriculture (NNDA) seed mixtures included in the appendices, Selection of specific mixture will depend on existing vegetation and soil type at each location. Contractor shall coordinate with Engineer prior to purchasing seed to determine exactly where to use each seed mixture.

D. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNDA re-vegetation requirements and stipulations.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule, and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.9 MAINTENANCE SERVICE

A. Section 01 00 00 - Execution Requirements: Requirements for maintenance service.

B. The cover will be maintained by occasional mowing, spot spraying, reseeding weak areas, or by controlled burns. Maintain seeded areas for three months from Date of Substantial Completion. Maintenance shall include weekly watering.

C. After the first full season of growth (not the first year) the cover should be mowed or grazed to control annual weeds to encourage good growth. Timing of mowing should avoid nesting times of birds (indicated in Environmental Requirements).

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Furnish materials in accordance with Navajo Nation Department of Agriculture standards. Refer to seed mixtures provided in the Appendices.

B. Engineer, in consultation with NNDA, shall determine which seed mixture applies at each location within the project. Contractor is responsible to coordinate with Engineer to determine proper seed mix prior to purchasing seed.

C. In developing seed mixtures, the percentage of each included species should first be determined. This percentage, which should total 100, is then multiplied by the recommended seeding rate for the concerned species. This will give the required pounds PLS for that species in the mix.

2.2 SOIL MATERIALS

A. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

B. Erosion Fabric: Jute matting, open weave.

C. Herbicide: If required, Owner and Engineer’s approval must be obtained prior to use.

D. Stakes: Softwood lumber, chisel pointed.

E. String: Inorganic fiber.

F. Mulch:

1. Mulch of any kind shall not be used on Tribal lands.

PART 3 EXECUTION

3.1 GENERAL

A. Prepare and restore site per applicable NNDA Revegetation Plan, included in the Appendices to the Contract Documents.

B. Seed and reclaim all disturbed areas, including temporary construction easements and any areas disturbed by construction traffic.

C. Temporary fence gates along the pipeline alignment must be kept closed to manage the livestock in the pipeline area.

3.2 EXAMINATION

A. Verify prepared soil base is ready to receive the Work of this section.

3.3 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas. The heel of a boot should not sink in more than ½ to 1 inch.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

C. Topsoil removed from the right-of-way must not be mixed with sagebrush debris which may impede seed germination during the revegetation process.

D. In areas needing reseeding, the top layer of soil shall be softened by ripping and disking prior to seeding to create the soil structure necessary to allow for seed germination.

E. Scarify subsoil to depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.4 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

3.5 SEEDING

A. Use seed mixture indicated by Engineer, based on land ownership and native vegetation.

B. Apply seed at rates specified by NNDA for their respective seed mixtures. Use seed drill followed by drag packer over area to incorporate seed approximately ½ inch deep.

C. Planting Season: See Article 1.8. of this Section.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Seed placement rows on steep slopes should not be placed parallel to the down slope, but at angles to the down slope to prevent the formation of gullies and rills.

F. A seed drill followed by a drag packer shall be required unless specific exceptions are authorized in writing by the Engineer.

G. Some hand seeding may be needed along steep slopes where equipment is difficult to use.

H. Apply water with a fine spray immediately after each area has been seeded. Saturate to 4 inches of soil.

3.6 HYDROSEEDING

A. Hydroseeding shall only be allowed where it is physically unfeasible to seed drill.

B. Hydroseeding shall not be performed without prior written authorization by the Engineer.

C. Apply fertilizer and seeded slurry with hydraulic seeder at an approved rate evenly in one pass.

D. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

E. If hydroseeding is used, the specified rates of seed application shall be doubled.

3.7 SEED PROTECTION

A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

1. All slopes around the perimeter of applicable sites shall be covered with erosion fabric, regardless of grade.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36 inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. Protection of seeded areas from traffic: Contractor shall take measures as required by the Owner, Engineer, and/or land controlling agencies to prevent traffic on re-seeded areas. Such measures may include warning signs, fence post barricades, earthen berms, and/or other measures at intersections of seeded ROW and existing roadways and driveways, and at other locations as directed by Engineer. Earthen berms shall extend the full width of the disturbed area, with dimensions as directed in field by Engineer.

G. All seed protection measures, including traffic prevention, shall be subject to approval of land-controlling agencies.

3.8 MULCHING

A. Do not apply mulch on Tribal lands.

3.9 MAINTENANCE

A. Immediately reseed areas showing bare spots.

B. Repair washouts or gullies.

C. Protect seeded areas with warning signs during maintenance period.

3.10 SCHEDULE

A. All utility routes, disturbed areas, vault areas, and non-traveled areas in road rights-of-way to be reseeded when Work is completed in affected areas.

END OF SECTION

SECTION 33 05 23.16

TRENCHLESS UTILITY INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavation for approach trenches and pits.
2. Casing pipe.
3. Carrier pipe.

B. Related Sections:
1. Section 03 05 00 - Basic Concrete Materials and Methods.
2. Section 31 23 17 - Trenching.
3. Section 31 23 23 - Backfill.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Jacked Pipe:
1. Basis of Measurement: By linear foot measured on invert of jacked pipe from face to face of jacked pipe.
2. Basis of Payment: Includes excavation, jacked pipe, grout, spacers, accessories, tests, and backfill.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M133 - Standard Specification for Preservatives and Pressure Treatment Processes for Timber.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Railway Engineering and Maintenance-of-Way Association:
1. AREMA - Manual for Railway Engineering.

C. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
4. ASTM A449 - Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated 120/105/90 ksi minimum tensile strength General Use.
5. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

6. ASTM C33 - Standard Specification for Concrete Aggregates.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. American Wood-Preservers' Association:
1. AWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
2. AWPA C3 - Piles - Preservative Treatment by Pressure Process.

E. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

F. National Utility Contractors Association:
1. NUCA - Pipe Jacking & Microtunneling Design Guide.
2. NUCA - Trenchless Excavation Construction Equipment & Methods Manual.

1.4 DESIGN REQUIREMENTS

A. Design casing pipe and tunnel liner joints of leak proof construction. Design for earth and/or other pressures present plus highway H20 loading or railway E80 loading with associated recommended impact loading.
1. Highway Crossings: Design tunnel for earth and/or other pressure loads present, plus AASHTO H20 live loading.
2. Railroad Crossings: Design tunnel for earth and/or other pressure loads present, plus railroad E80 live loading with 50 percent added for impact.

B. Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe sections and as conditions permit, to minimize tendency of ground material to "freeze" around casing pipe.

C. Design steel tunnel lining in accordance with AREMA Manual for Railway Engineering, Section 4.15.5.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Installation Plan: Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignment.

C. Submit New Mexico Department of Transportation (NMDOT), McKinley County, Navajo Nation Division of Transportation (NDOT), and Bureau of Indian Affairs (BIA) Roads occupancy permit for installations along or under public throughways and lands, if not already obtained by the Engineer.

D. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes integrity of installation or safety.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico state, NDOT, County, and BIA standards, NUCA Trenchless Excavation Construction Equipment & Methods Manual, NUCA Pipe Jacking & Microtunneling Design Guide, AREMA guidelines.

B. When boring, jacking or tunneling under State, Tribal, BIA, or County highways and railroads, make application for and obtain occupancy permit.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.
   1. Work Experience: Include projects of similar magnitude and conditions.
   2. Furnish list of references upon request.

1.9 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-Construction Conference.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for delivering, handling, storing, and protecting products.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping system pieces from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

D. Accept system components on site in manufacturer’s original containers or configuration. Inspect for damage.

E. Use wooden shipping braces between layers of stacked pipe. Stack piping lengths no more than 3 layers high.

F. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

G. Support casing and carrier pipes with nylon slings during handling.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.12 FIELD MEASUREMENTS

A. Verify invert elevations prior to excavation and installation of casing.

1.13 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with NMDOT, NDOT, County, and BIA (if applicable), and utilities within construction area.

PART 2 PRODUCTS

2.1 CASING AND JACKING PIPE MATERIALS

A. Furnish materials in accordance with New Mexico state, NDOT, County, and BIA standards.

B. Steel Casing Pipe: ASTM A53/A53M, 35,000-psi minimum yield strength, casing diameter and minimum wall thickness as indicated on Drawings. Full circumference welded joints in accordance with AWS D1.1 to withstand excavation forces.

2.2 CARRIER PIPE MATERIALS

A. Water Utility Distribution System Piping: As specified in Section 33 11 00.

2.3 COVER MATERIALS

A. Soil Backfill for Trench Approaches and Pits to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.4 ACCESSORIES

A. Pipe Casing End Seals: Seamless, vulcanized edge, pull-on casing end seals composed of a minimum 1/8” thick 60 durometer synthetic neoprene rubber. Includes ½” wide T304 stainless steel bandings with 100% non-magnetic worm gear mechanism.

B. Pipe Casing Spacers: Constructed of heavy duty, two piece, 8" wide 14-gauge stainless steel bands, or hot rolled 14-gauge circular carbon steel with thermoplastic powder coating for extra corrosion protection, as identified on the Drawings or on the Bid Form. Bands bolt together to form a shell around the carrier pipe, with 10-gauge stainless steel or carbon steel risers (material to match bands) and glass filled polymer runners to support the carrier pipe within the casing pipe maintaining a minimum clearance of 1" between the casing ID and the spacer OD.

C. Pressure Grout Mix: One part portland cement, and 6 parts mortar sand mixed with water to consistency applicable for pressure grouting.

D. Mortar Sand: ASTM C404.

E. Portland Cement: ASTM C150, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

3.3 DEWATERING

A. Intercept and divert surface drainage precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop substantially dry subgrade for prosecution of subsequent operations.

C. Comply with New Mexico state, and Navajo Nation standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 EXISTING WORK

A. Maintain access to existing community facilities and homes as well as other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.5 PITS OR APPROACH TRENCHES

A. Excavate approach trenches or pits in accordance with installation plan and as site conditions require.

B. Ensure casing entrance face as near perpendicular to alignment as conditions permit.

C. Establish vertical entrance face at least 1 foot above top of casing.

D. Install dewatering measures and excavation supports as specified in Section 31 23 17.

3.6 CASING PIPE INSTALLATION

A. Boring:
1. Push pipe into ground with boring auger rotating within pipe to remove spoil. Do not advance cutting head ahead of casing pipe except for distance necessary to permit cutting teeth to cut clearance for pipe. Arrange machine bore and cutting head to be removable from within pipe. Arrange face of cutting head to provide barrier to free flow of soft material.
2. When unstable soil is encountered during boring retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
3. When voids develop greater than outside diameter of pipe by approximately one inch, grout to fill voids.
4. When boring is obstructed, relocate, jack, or tunnel as directed by Engineer.

B. Jacking
1. Construct adequate thrust wall normal to proposed line of thrust.
2. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.

3.7 PRESSURE GROUTING

A. Pressure grout annular space between casing pipe and surrounding earth.

3.8 CARRIER PIPE INSTALLATION

A. Clean, inspect, and handle pipe in accordance with Section 33 11 00.

B. Place carrier pipe in accordance with Section 33 11 00. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.

C. Support pipeline within casing on spacers at intervals identified on Drawings or according to manufacturer’s instructions if interval is not identified on Drawings, so no external loads are transmitted to carrier pipe. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.

D. Install bell restraint harnesses on any joints inside of the casing.

E. Install pipe casing end seals at ends of casing.

3.9 TOLERANCES

A. Do not over cut excavation by more than 1 inch greater than outside diameter of casing pipe.

B. Install casing pipe to vertical and horizontal alignment on Drawings within plus or minus 3 inches prior to installation of carrier pipe.

C. Install pipe bells with minimum ½-inch clearance to casing.

3.10 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Compaction Testing: As specified in Section 31 23 23.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.11 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish field technical assistance during following periods of casing installation:
   1. Unloading of casing materials and components.
   2. Prior to commencing excavation and during excavation as requested.

3.12 REMOVAL OF FACILITIES AND CONTROLS

A. Remove temporary facilities for casing installation and jacking operations in accordance with Section 01 00 00.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe and fittings for public line including potable water line.
2. Tapping Sleeves and Tees.
3. Underground and Aboveground Pipe Markers.
4. Bedding and Cover Materials.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 23 17 - Trenching: Execution requirements for trenching.
3. Section 31 23 23 - Backfill: Requirements for backfill to be placed.
4. Section 33 12 16 - Water Utility Distribution Valves.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: By the linear foot.

2. Basis of Payment: Includes hand trimming, excavation, trenching, piping and fittings, all valves and appurtenances not listed separately on the Bid Form, bedding, backfill, compaction, tracer wire, detectable warning tape, above ground pipe marker posts, concrete thrust restraints (where applicable), mechanical joint restraints, connection to public utility water source (if not separately listed on Bid Form). Special excavation methods for trenching in rock or hard soils, rock removal and disposal, and/or imported bedding material, if required to meet the project specifications, shall be considered incidental to the cost of the pipe installation. Soil cement, if used, shall be considered incidental to the cost of the pipe installation.

3. The cost of work associated with hydrostatic pressure testing for main pipeline shall be paid via a separate bid item. The cost of work associated with hydrostatic pressure testing for all other facilities for which a separate bid item is not provided shall be considered incidental to their respective bid items.

4. The cost of work associated with disinfection and bacteriological testing for main pipeline shall be paid via a separate bid item. The cost of Contractor's work associated with disinfection and bacteriological testing for all other facilities for which a separate bid item is not provided shall be considered incidental to their respective bid items.

a. Laboratory costs associated with bacteriological testing shall be considered incidental, and are not eligible for reimbursement under the testing allowance.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers (ASME):
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

C. American Society for Testing and Materials International (ASTM):
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
6. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
7. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
8. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
10. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
11. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
12. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
13. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
14. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
15. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
16. ASTM F2634 - Standard Test Method for Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method.

D. American Water Works Association (AWWA):
1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm), for Water.
4. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C116 - ANSI Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
7. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
8. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
9. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
10. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.
11. AWWA C206 - Field Welding of Steel Water Pipe.
12. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
13. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
14. AWWA C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
15. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
16. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.
17. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
18. AWWA C606 - Grooved and Shouldered Joints.
19. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution.
20. AWWA C901 - Polyethylene Pressure Pipe and Tubing, 1/2 In. through 3 In. (13 mm through 76 mm), for Water Service.
21. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In. (350 mm through 1,200 mm), for Water Transmission and Distribution.
22. AWWA C906 - Polyethylene Pressure Pipe and Fittings, 4 In. through 63 In. (100 mm through 1,575 mm), for Water Distribution and Transmission).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry:
1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

F. National Fire Protection Agency
1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

G. National Sanitation Foundation (NSF):

1. NSF-14 - Plastics Piping System Components and Related Materials
2. NSF-61 - Drinking Water System Components-Health Effects

H. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
1. NMSSPWC Sections 701, 801 & 802 “Trenching, Excavation and Backfill”.

I. Plastic Pipe Institute (PPI):
1. TR-33 - Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.

J. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings and accessories, and testing equipment.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Testing Plan: Contractor must submit proposed testing procedure specific to the project, including identifying filling locations, and equipment to be employed for hydrostatic testing of lines, as well as continuity testing for tracer wire, for approval by Engineer.

E. Contractor shall submit a joint restraint table for all types of restrained joints to be used for the project based on the manufacturer’s specifications and calculations.

F. Submittal for all coatings which demonstrate compliance with relevant AWWA and NACE standards.

G. As-built drawings and any Contractor-provided survey data. Refer to Sections 01 00 00 – Basic Requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of piping mains, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with Navajo Tribal Utility Authority (NTUA) standards.

B. All piping, fittings, valves, hydrants and any other potable water system appurtenances shall comply with the "Reduction of Lead in Drinking Water Act", in effect as of 2014, or any subsequent revision thereof.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property without prior authorization, or in areas obstructing pedestrian or vehicular traffic.

D. Store PVC materials out of sunlight. Contractor shall, at Contractor's expense, provide and maintain tarps, temporary shelters, or other such measures as necessary to protect PVC materials from sunlight. Such tarps or shelters must be adequately vented to prevent excess heat accumulation

1. Any PVC materials judged by the Engineer to be sun-damaged, including tan to brown discoloration, blistering, roughening or cracking of surface, or embrittlement, prior to installation shall be rejected.

E. Coated pipe shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

F. Coated pipe and other components shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or pipe shall not be used.

G. PVC pipe shall be bundled or stacked throughout the shipping, storage and handling process in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Excessive bundling or stacking that results in bends, kinks, gashes or uncorrectable ovality shall be rejected. Transport and handle pipe in accordance with AWWAM23 and pipe supplier's recommendations, whichever is most stringent. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

1. Any pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no fracture can be seen, shall be rejected.

2. Any pipe with a scratch or gouge greater than 10% of the wall thickness will be rejected.

H. Prior to shipment and again prior to installation, all materials shall be visually inspected for damage, including coatings and surfaces. Any damaged materials shall be repaired to original standards or replaced.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Polyvinyl Chloride (PVC):

1. AWWA C900 (whether jointed or fusible), with Dimension Ratio (DR) of DR18 for pipe 4” in diameter up to 36”, and DR21 for pipe greater than 36”, unless otherwise identified on the Drawings or on the Bid Form.
2. ASTM D2241, IPS Gasketed Pipe, NSF approved, SDR21 with Pressure Rating of 200 psi, or as scheduled, for all PVC pipe with a diameter of 2” and greater but less than 4" diameter.
3. Testing shall be in accordance with the referenced AWWA standard for all pipe types.
4. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
5. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
6. Pipe shall be blue in color for potable water use.
7. Nominal laying length:
    a. Jointed PVC pipe: 20 feet.
8. Gasketed Joints:
    a. Joints per ASTM D3139.
    b. Use rubber gaskets manufactured and tested in accordance with ASTM F477.
    c. For all PVC at petroleum line crossings or where otherwise indicated on Drawings, use petroleum-resistant gaskets in accordance with ASTM F477 or fusible PVC pipe joints.
9. Fittings:
    a. Ductile iron on all PVC pipe 4” diameter and greater.
        1) Refer to specifications for ductile iron fittings in this section, below.
    b. All PVC pipe and fittings less than 4” diameter shall be solvent welded Schedule 80.
    c. Solvent-weld joints are not permitted on pipe 4” diameter and greater.
10. Mechanical Joint Restraints:
    a. Refer to specifications for ductile iron joint restraints in this section, below.
11. Mechanical bell harnesses:

a. Refer to specifications for ductile iron bell restraint harnesses in this section, below.

B. Ductile Iron Pipe, Joints, and Fittings:

1. Manufacturers:

a. US Pipe

b. American Pipe

c. Substitutions: Approved Equal

2. Ductile iron pipe:

a. Pipe Class: AWWA C151, for nominal thickness, rated water working pressure and maximum depth of cover.

b. 350 psi working pressure.

c. Cement Mortar Lining: AWWA C104, standard thickness.

d. Exterior coating:

1) Buried service (site piping only, excluding chlorination building): Bituminous coating, per AWWA C151.

2) Inside and underneath chlorination building: TNEMEC N140 Pota-Pox Plus, rated for use in corrosive environments.

3. Fittings: Ductile iron.

a. Compact MJ fittings conforming to AWWA C153 or AWWA C110, unless otherwise noted on Drawings.

b. Flanged fittings shall conform to AWWA C110. Do not use flanged fittings for buried installations unless otherwise noted on Drawings.

1) Contractor responsible to ensure that all mating flanges have compatible diameters, bolt sizes and drill patterns. Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

c. Pressure rating of joints, fittings and gaskets shall be at least 350 psi, unless otherwise noted on the Drawings.

d. Pressure rating of flanged fittings and gaskets shall at least match that of the attached pipe, unless otherwise noted on the Drawings.

e. Marked with pressure rating, nominal diameter of opening, manufacturers' identification, country where cast, and degree of bend.

f. Coatings:
1) Bituminous Coating: AWWA C110.
2) Cement Mortar Lining: AWWA C104, standard thickness.

4. Joints:

a. Mechanical and Push-On Joints: AWWA C111.

b. Flanged Joints: AWWA C115; ASME B16.1.

5. Mechanical Joint Restraints:

   a. Mechanical joint restraints for all fittings and appurtenances, unless otherwise noted on Drawings.

   b. Mechanical joint restraints shall be Star, "EBAA Iron, Megalug®" Series 2000PV, 2200, Smith-Blair Cam-Lock, or approved equal, for all pipe 4" diameter and greater.

   c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior

   d. Provide sacrificial anode cathodic protection where indicated in this Section.

   e. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.

6. Mechanical Bell Restraint Harnesses:

   a. Mechanical bell restraint harnesses shall be used to obtain required restraint lengths noted on Drawings.

   b. Mechanical joint restraints shall be Star, "EBAA Iron, Megalug®" Series 1700 for Ductile Iron or 1900 or 2800 for PVC, or approved equal, for all pipe 4" diameter and greater.

   c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior

   d. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.

7. Flanges:

   a. Ductile or Cast Iron: ANSI/AWWA C110/A21.10 / ANSI B16.1, Class 125, unless otherwise noted on Drawings.

   b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

   c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

   d. Do not apply coatings to mating surfaces of flanges.

   e. Gaskets shall be rubber annular ring flange gasket in accordance with AWWA C115. Installation according to manufacturer's recommendations.

f. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of bolts.

g. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

h. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

i. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

8. Jackets:

a. AWWA C105 polyethylene jacket, Installation Method "A".

b. Double-wrap all ductile iron components.
1) Inner PE jacket shall be V-Bio enhanced, minimum thickness: 8 mil
2) Outer PE jacket shall be standard polyethylene, minimum thickness: 8 mil

c. Secure PE jackets with ultra-high molecular weight (UHMW) polyethylene film tape, 10 mil thickness.

1) Do not use duct tape to tape the PE jackets.

C. Polyethylene Pipe: AWWA C901 and ASTM D3035 for sizes up to 3" diameter; AWWA C906 and ASTM F714 for sizes 4" diameter and above.

1. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and ring tensile strength.

2. Polyethylene pipe and fittings shall be PE4710 high-density polyethylene meeting ASTM D3350 cell classification 44547C. The material shall be listed and approved for potable water in accordance with NSF Standard 61.

3. Four permanent co-extruded, equally spaced, blue color stripes in outside surface of pipe.

4. Molded fittings in accordance with ASTM D3261, and tested in accordance with AWWA C906.

5. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings; rated for internal pressure service at least equal to the full service pressure rating of the mating pipe; and tested in accordance with AWWA C906.

6. Polyethylene flange adapters made with sufficient through-bore to be clamped in a butt fusion-joining machine without use of a stub-end holder, as per pipe manufacturer's instructions.
7. All HDPE fabricated MJ adapters shall have steel stiffeners.
8. HDPE pipe and fittings shall have the same working pressure (as set forth in ASTM F714) as shown on the Drawing.
9. Nominal sizes indicated on Drawings for both pipe and fittings denote iron pipe size (IPS) unless otherwise noted.
10. All HDPE pipe and fittings shall be manufactured of PPI listed materials.
11. Pre-fabricated HDPE mitered bends and other fittings shall have internal weld bead completely removed prior to installation, using approved method for weld bead removal.

D. Steel Pipe and Fittings:

1. Pipe fabrication:
   a. Pipe 26" diameter or less, fabricate pipe per ASTM A-53 B.
   b. Fabricated in accordance with AWWA C200, except:
      1) Steel plate: ASTM A283, Grade C or D, or ASTM A36.
      2) Steel sheet: ASTM A1011, Designation SS, Grade 40, 45 or 50; or ASTM A1018, Designation SS, Grade 40.
      3) Standard wall thickness, unless otherwise indicated on Drawings.
2. Fittings and Special Sections:
   a. Steel for fittings: ASTM A283, Grade C or D, or ASTM A36 for carbon steel.
   b. Welding: Per AWS D1.1. All welding must be completed prior to application of lining and coatings, unless otherwise permitted by the Engineer. In no case shall any welding damage lining or coatings.
   c. Dimensions in accordance with AWWA C208.
   d. Custom fabricated fittings shall be designed and fabricated in accordance with AWWA M11, with outlet reinforcements per AWWA M11. All other standards and specifications for steel, welds, coatings, flanges and dimensions of component fittings provided herein shall apply equally to custom fabricated fittings.
   e. No custom-made fittings shall be used without prior written approval by the Engineer.
3. Coatings: Interior and exterior surfaces of all non-stainless steel pipe and fittings shall be coated as follows:
   a. Galvanized
   b. All coatings shall be NSF 61-approved.

c. All surfaces shall be ground smooth. All weld splatter and other defects shall be removed prior to blasting.

d. Surface preparation shall conform to SSPC-SP5 White Blast Clean with surface profile of 2.0 to 3.0 mils.

e. Coating thickness for both interior and exterior per manufacturer's recommended maximum thickness.

f. All wetted surfaces of pipe interior shall be coated. All exposed surfaces of pipe exterior shall be coated.

g. Do not apply coating to mating surfaces of flanges.

h. Typical water temperature: Less than 140 degrees Fahrenheit.

i. Road crossing casings:
   1) Open cut casings shall be coated in bituminous paint.

4. Additional Coatings:

   a. Exterior surfaces of all buried non-stainless steel pipe and welded fittings shall include cold-applied tape coating, manufactured and installed in accordance with AWWA C209, applied with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils. Such tape coating shall be applied in addition to fusion-bonded epoxy coatings specified above.

5. Flanges:

   a. Steel: ANSI Class 150 / AWWA C207 Class E / ASME B16.5 Class 150, unless otherwise noted on Drawings.

   b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

   c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

   d. Do not apply coatings to mating surfaces of flanges.

   e. Gaskets shall be ring-type, per AWWA C207, unless the flanged connection is between PVC and steel, in which case full face type gaskets with outer diameter equal to that of the flange shall be used.

   f. Retainers shall be fabricated of phenolic or other suitable material as recommended by manufacturer and conforming to NSF 61, with minimum thickness of 1/8 inch and minimum dielectric strength of 500 volts/mil.

   g. Nitrile sealing rings.

   h. Steel washers shall be 1/8-inch thick.

   i. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

j. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

k. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

l. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

6. Field Welding Materials:

a. Pipe: AWWA C206.

7. Stainless Steel Pipe and Fittings

a. Use where called-out on Drawings as Stainless Steel

b. Stainless Steel 304

c. Pressure rating: Not less than 350 psi Cold Working Pressure

2.2 TAPPING SLEEVES, TEES AND VALVES

A. Tapping Sleeves and Saddles:

1. Manufacturers:

a. Mueller Co.

b. Kennedy Valve Co.

c. Romac Industries, Inc

d. JCM Industries

e. Ford Meter Box Company, Inc

f. Smith-Blair, Inc

g. Substitutions: Approved equal.

2. For taps 2-inches or smaller, use nylon coated ductile iron tapping saddles with stainless steel dual compression straps.

3. For taps larger than 2-inches, use fusion-bonded epoxy-coated steel.

4. All saddles shall be specifically designed for use on the type of piping that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Saddle Working pressure rating: 350 psi.

7. Sleeve Working pressure rating: 250 psi

8. Tapped Outlet: FNPT as indicated on Drawings
9. All pipe taps shall be made with an engineer approved “tapping machine”.

2.3 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Tracer Wire: 12 AWG, Solid Copper, Single Conductor, 600V, UF-XHHW wire or equal, for underground installation.

C. Metal-backed detectable water marker tape: Bright colored, metallized for detection by above-ground metal detector, continuously printed, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service, imprinted with "BURIED WATER SERVICE" in large letters.

2.4 ABOVE-GROUND PIPE MARKERS

A. Carsonite marker posts, blue, with NTUA decals. Decals to be specified by NTUA and provided by the Contractor. Place markers as specified on the Drawings.

2.5 PIPE SUPPORTS AND ANCHORING

A. Metal for pipe support brackets: ASTM A123/A123M, galvanized structural steel thoroughly coated with bituminous paint.

B. Metal tie rods and clamps or lugs: Galvanized steel sized in accordance with NFPA 24 thoroughly coated with bituminous paint.

2.6 BEDDING AND BACKFILL MATERIALS

A. Bedding: Fill Type as specified in Section 31 23 23.

B. Soil Backfill from Above Pipe to Finish Grade: Soil Type as specified in Section 31 23 23. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.7 CASING SPACERS

A. Polyethylene Casing Spacer

B. Two part or multi segmented

C. Stainless steel 304 bolts, nuts and washers. All bolts shall be provided by the fitting manufacturer especially for use with their respective components.

2.8 BOLTS AND NUTS

A. Zinc-plated or fluoropolymer coated bolts and nuts shall be used for the installation of pipelines up to 500 mm (20") diameter and shall be carbon steel conforming to ASTM A307, Grade A, unless otherwise indicated on the approved drawings. Bolts and nuts shall have standard ANSI B1.1, Class 2A coarse threads.

B. Stainless steel bolts and nuts shall be used for the installation of pipelines 600 mm (24") diameter and larger and for submerged flanges. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and Grade 8M for nuts.

C. All bolt heads and nuts shall be hexagonal, except where special shapes are required. Bolts shall be of such length that not less than 6.4 mm (¼") or more than 12.7 mm (½") shall project past the nut in tightened position.

2.9 ACCESSORIES

A. Concrete for Thrust Restraints: Conform to Section 03 30 00, with minimum compressive strength of 3,000 psi.

B. Steel rods, bolt, lugs and brackets
1. For applications not in contact with soil: ASTM A36/A36M or ASTM A307 carbon steel.
2. For buried applications: Stainless steel 304.

C. Field-applied Roskote coal tar epoxy coating on all buried steel bolts on all fittings and valves.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing utility water main size, location, and invert, are as indicated on Drawings.

3.2 PREPARATION

A. Pre-Construction Site Photos:
1. If required in the Contract Documents, take photographs or videotape along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing site features that may potentially be impacted by the construction work.
3. Include project description, date taken and sequential number on back of each photograph.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

E. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

F. Restricted Areas and Culturally Sensitive Areas:

1. Contractor shall notify Engineer prior to work within 100 feet of any restricted area as designated on the Drawings; refer to Section 01 00 00.

2. The Owner's Archaeologist will flag culturally sensitive sites as designated on the Drawings.

3. Contractor shall maintain all flags, stakes and barricades in place until the end of construction. Contractor shall notify Engineer in the event of damage or removal of said markers. Re-marking due to negligence by Contractor shall be subject to charge-backs to the Contractor.

4. No work shall be performed within 100 feet of any restricted area unless barricades and/or flags are up.

5. No work shall be performed within 100 feet of any restricted area designated on the Drawings as requiring archaeological monitoring unless the Owner's archaeologist is physically present at the site.

3.3 TRENCHING AND BACKFILL

A. Excavate trenches in accordance with Section 31 23 17, including dewatering of excavations as required, to maintain dry conditions and preserve final grades at bottom of excavation.

B. Place bedding and trench backfill material in accordance with Section 31 23 23.

3.4 INSTALLATION - PIPE

A. Install bell-and-spigot PVC pipe in accordance with AWWA C605, AWWA M23 and pipe manufacturer's instructions, whichever is most stringent.

1. Use only lubricants supplied by the pipe manufacturer and apply to both bell and spigot ends of the joint, in accordance with manufacturer's recommendations.

2. Clean the gasket, bell, groove and spigot immediately prior to connecting pipe joints.

3. Do not over-insert pipe joints. Any over-inserted pipe joints shall be removed and the pipe bell and gasket inspected for damage. Any damaged bells or gaskets shall be discarded and replaced.

4. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

B. Install ductile iron piping and fittings according to AWWA C600.

1. Encase all ductile iron pipe and fittings that are not cathodically protected in polyethylene, per AWWA C105, Method "A".

a. Use two (2) separate polyethylene jackets.

1) Inner jacket: V-bio enhanced polyethylene

2) Outer jacket: standard polyethylene

b. No tears, cuts, rips or other breaks in the polyethylene encasement shall be acceptable. No dirt, water or debris inside the encasement shall be acceptable.

c. When installing ductile iron pipe floor penetrations under buildings and concrete slabs, bring both layers of polyethylene into the slab inside the roof felt isolation joint. Trim and tape the PE at the mid-point of the slab thickness (e.g. 6" below the floor for a 12" slab). Wrap the felt outside both layers of polyethylene. Trim the felt to 2" above the floor and seal with silicone.

d. When installing ductile iron floor drain lines, bring both layers of polyethylene into the slab, trim, and tape to pipe just below the inset floor drain.

e. Use only 10-mil UHMW polyethylene film to tape the PE jackets. Do not use duct tape.

2. Any damaged shop-applied coatings shall be repaired in accordance with manufacturers specification or this section for FBE coated pipes. In the event that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

C. Install steel pipe in accordance with AWWA M11. Field weld and test steel pipe, as needed, in accordance with AWWA C206, except as follows:

1. Test field welds by ultrasonic or radiographic method, in accordance with AWS D1.1.

2. Do not field weld pipe without permission from the Engineer.

Any damaged shop-applied coatings shall be repaired in accordance with this Section. In the event that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

D. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings. Inspect each pipe and fitting prior to lowering into trench to ensure there is no damage to the pipe, fitting or coatings. Repair any damage prior to installation. Clean ends of pipe and remove foreign material from inside of pipe and fittings.

E. Maintain 10 ft horizontal separation of water main from sewer piping in accordance with local code.

F. Lay pipe in straight line and center pipe within trench. Relay pipe that is out of alignment.

G. Horizontal and vertical pipe bending, angles and joint deflections

1. All ells shall be one of the following standard angles: 11.25, 22.5, 45, 60 or 90 degrees. No other ell angles shall be allowed.

2. Actual horizontal and vertical angles required in the field shall be accomplished by a combination of allowable DI ells, and/or pipe deflection (i.e. pipe bending for fused pipe or joint deflection for jointed pipe).

a. At most locations, the plan and profile sheets show horizontal bends without specifying whether the horizontal bend is to be accomplished by DI ells or joint deflection of jointed PVC pipe. At such locations, the method of bending is at Contractor's option, provided all design requirements set forth in the Drawings and Specifications are met.

b. If the Contractor chooses to use DI ells at any given location, the required length of restrained pipe must be used on both sides of the bend, whether the restraint length is shown on the plan and profile sheet, or not.

3. Lateral pipe bending forces shall be isolated from all fittings.

4. PVC pipe deflections may be made either at joints or by pipe bending, as allowed by AWWA C605.

a. For jointed PVC pipes 12-inch diameter or smaller, pipe bending shall be allowed, provided that such bending complies with AWWA C605 and/or pipe manufacturer's minimum allowable bending radius, whichever is more stringent.

b. For jointed PVC pipes 14-inch diameter or larger, deflections shall be made at the pipe joints only.

c. For all pipe diameters, jointed PVC pipe joint deflection shall not exceed 1 degree per joint.

5. Steel and ductile iron pipe deflections shall be made at joints, provided pipe manufacturer's allowable deflection limits are not exceeded.

6. Mechanical Joints: contractor to abide by manufacturer's recommended maximum allowable deflection

H. Install HDPE pipe per AWWA C605.

1. Allow all HDPE pipe to acclimate to sub-surface soil temperature prior to connecting pipe to any fitting or appurtenance.

2. Heat Fusion Joining: Joints between plain end pipes and fitting shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. Either procedure used must be recommended by the pipe and fitting manufacturer.

3. Polyethylene pipe and fittings may be joined together or to other materials by means of:
   a. Flanged connections (flange adapters and back-up rings);
   b. Mechanical coupling designed for joining polyethylene pipe or for joining polyethylene pipe to another material;
   c. MJ adapters; or
   d. Electrofusion.

4. Mechanical bolted joining may be used where the butt fusion method cannot be used. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring. Mechanical joint joining will be accomplished using either a

molded mechanical joint adapter or an ID stiffener and restraint. Either mechanical joint joining method will have a ductile iron mechanical joint gland.

5. ID Stiffener and Restraint: A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ adapter is used.

6. Mechanical Joint and Flange Installation: Mechanical joint and flange connections shall be installed in accordance with the manufacturer's recommended procedure. MJ adapter and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment.

7. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical coupling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

8. Do not perform fusions during adverse weather conditions, including high wind, any amount of blowing dust or precipitation events. Protect exposed pipe faces after facing and surface preparation from blowing dust. Engineer shall have the right to shut down fusing operations if weather conditions are not suitable or if weld quality is suspect. Contractor shall not be entitled to additional compensation for any such additional testing or shutdowns; however, shut-downs required by the Engineer through no fault of the Contractor (i.e. due to weather) shall be considered excused weather delays.

9. In the event of inclement weather, a tent, shelter, weld screen may be used to protect the fusion environment from dust, precipitation and heater plate variance. Any such enclosures must be approved by the Engineer. Engineer reserves the right to reject such enclosures and shut down operations if the enclosures do not adequately protect the pipe faces or fusion environment.

10. HDPE pipe may be welded into strings ("tie-in joining") and dragged into place, provided that pipe manufacturer's recommendations for maximum length, dragging velocity and other criteria are met.

11. All HDPE pipe butt fusions shall be performed in accordance with PPI Technical Report TR-33 and ASTM F2620 (latest edition). To the extent that these standards allow for accelerated cooling of HDPE butt fusion welds using chilled air, such methods may be used. However, all welds must be made in strict accordance with PPI and ASTM standards.

12. Internal weld beads from all HDPE welds (on both pipe and fittings) shall be completely removed prior to installation, using Engineer-approved method for weld bead removal.

13. Protect HDPE at all times during handling, storage, transport, cutting and fusion from oil contamination.

14. Polyethylene pipe fusion machine data loggers:
    a. All polyethylene pipe fusion machines shall be equipped with data loggers to record, at a minimum, joint temperature, pressure and time.
    b. Data loggers shall be used during all joint fusions.
    c. The Contractor shall provide data on any and all fusion joints upon request of the Owner or Engineer.

I. Horizontal and vertical pipe line and grade

1. The horizontal and vertical lines and grades shown on the Drawings indicate the intent of the design. Actual horizontal and vertical lines and grades in the field may deviate from those shown on the Drawings, provided all of the following conditions are met:
    a. Actual minimum slope of pipe shall not be less than 0.00100 ft/ft.
    b. Actual maximum slope of pipe shall not be greater than 0.40000 ft/ft, except where otherwise noted on the Drawings.
    c. Direction of pipe slope shall not differ from that shown on Drawings.
    d. Minimum pipe cover of 4 feet shall be maintained throughout the project.
    e. Additional minimum cover or specific minimum vertical clearances called out on the Drawings at specific locations, such as wash crossings, road crossings or pipeline crossings, shall be maintained.
    f. In the case of horizontal bends, the outer wall of the pipe must remain at least 12 horizontal feet within the permanent right-of-way boundaries.
    g. At bends near casings, pipe bending and/or off-set from centerline shall be done on the far side of the PI from the casing, to maximize the length of straight pipe in the sleeve on each side of the casing.
    h. In certain locations, the pipe elevation and/or slope must remain as shown on drawings to facilitate pipe draining, maintain pressures, or other performance criteria. In such cases, deviation from the Drawings may not be allowed.
    i. All deviations from the Drawings shall be documented by the Contractor and must be approved in advance by the Engineer.
    j. All other specifications shall be met.
    k. Any exceptions to the foregoing conditions must receive prior written approval by the Engineer.
2. No high points of any magnitude shall be allowed without an approved air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.
    a. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid.
    b. Additional air valves or pipe re-installation required due to high points caused through fault of the Contractor shall be provided at no additional

cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

J. Install pipe to bear on the trench bottom along entire length of pipe. For jointed pipe, excavate bell holes in the bottom of the trench to prevent the bell from coming into contact with the sub-grade.

K. Do not lay pipe in wet or frozen trench.

L. Direction of pipe bells may be reversed for ease of installation, provided that all pipe material and installation meets applicable AWWA, ASTM, NTUA and material manufacturer's standards. On grades greater than 10%, install jointed pipe uphill.

M. Pipe expansion and contraction

1. Install pipe to allow for expansion and contraction without stressing pipe or joints.

N. Do not allow trench water, dirt, debris or other foreign material to enter the pipe during or after installation.

1. Keep pipe ends sealed after joining pipes, both while pipe string is laying on top of ground and after pipe is lowered into trench.

2. Close pipe openings with watertight plugs during work stoppages.

O. Install tracer wire continuous, taped to top of pipeline; coordinate with Sections 31 23 17 and 31 23 23.

P. Install metal-backed detectable water marker tape continuous over top of pipe, buried 18 inches above pipe; coordinate with Section 31 23 17 and 31 23 23.

Q. Install thrust blocks at locations indicated on Drawings. Installation of thrust blocks shall not relieve the Contractor of responsibility to provide pipe restraints as indicated on Drawings and Specifications.

R. Flanged Joints: Not to be used in underground installations except within accessible structures or as shown on Drawings.

S. All pipes, fittings and appurtenances must remain within designated permanent rights-of-way. All construction activities must remain within the right-of-way or temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

T. Embed pipe within 100 feet behind pipe-laying operations, unless otherwise permitted by the Engineer.

U. Do not backfill pipe prior to as-built surveying; refer to Section 02 21 13 - Surveying.

3.5 INSTALLATION - TAPPING SLEEVES AND GAUGES

A. Install tapping sleeves and gauges in accordance with Drawings and in accordance with manufacturer's instructions.

3.6 THRUST RESTRAINTS

A. Install tie rods, clamps, setscrew retainer glands, or restrained joints. Protect metal restrained joint components against corrosion by applying a bituminous coating, or by concrete mortar encasement of metal area. Do not encase pipe and fitting joints to flanges.

B. Install thrust blocks or restrained fittings in accordance with Drawings and in accordance with manufacturer's instruction.

C. Install thrust blocks, tie rods, and joint restraint at dead ends of water main.

3.7 BACKFILLING

A. Backfill trenches for piping in accordance with Section 31 23 23.

3.8 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.9 TAPPING EXISTING WATER DISTRIBUTION FACILITIES

A. Obtain permission to tap from the NTUA. A blank Permission to Tap application form is provided in this Specification and the Appendices. Contractor shall not connect to existing system without written permission from NTUA and the Engineer to proceed with connection to the existing system.

B. Coordinate with NTUA's designated representative regarding schedule, means and methods, maximum allowable shut-off time, water usage rates (both gpm and gpd) and other parameters stipulated by NTUA.

C. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water.

D. Perform all work in conformance with the tapping permit and all written and verbal instructions from NTUA personnel, including notification and coordination with NTUA, maximum water usage rates, time and duration of shut-offs, and disinfection requirements.

E. Minimize shut-off time during connections to existing facilities. Contractor shall have all tools and materials for actual field conditions as well as foreseeable problems on hand in order to minimize shut-off time.

F. Taps on existing NTUA pipelines shall be by cut-in tees, with NTUA's approval. Wet taps shall not be permitted.

G. Prevent contamination of existing facilities with trench water, mud, debris, chemicals or other substances.

H. All new materials shall be thoroughly cleaned and disinfected with a strong (200 ppm) chlorine solution prior to connecting to existing NTUA facilities.

3.10 INITIAL FILLING OF PIPELINE

A. "Initial filling" refers to first introduction of water and evacuation of air in the pipeline.

B. Initial filling of pipeline shall not exceed maximum instantaneous flow rate (in gpm.

3.11 PIPELINE RIGHT-OF-WAY GRADING

A. Establish finished grade to provide a minimum of four (4) foot of cover over the pipe. Measure depth of cover from final surface grade (not including dirt mound) to top of pipe barrel.

1. At certain locations such as wash crossings, road crossings, utility line crossings or to prevent high points, the Drawings indicate greater than 4 ft minimum cover. At such locations, Contractor shall maintain the site-specific minimum cover.

B. Mound soil over top of pipe in accordance with Drawings, except at wash crossings, road crossings, or where prohibited by landowner.

C. Do not place fill material or raise the finished grade above existing grade in the flow lines of washes or surface water drainages, regardless of size.

D. Finished grade along pipeline right-of-way and temporary construction easement shall have a maximum longitudinal slope of 4:1 and maximum side slope of 4:1, unless otherwise noted on Drawings.

E. The pipeline right-of-way shall be leveled from side-to-side to slow down surface run-off from causing erosion rills perpendicular to the pipeline, as well as to make the ROW accessible to the Owner for future maintenance.

1. The entire right-of-way shall be re-seeded and reclaimed after construction. Do not build any new roads. Refer to Section 32 92 19 – Seeding for re-seeding requirements.

2. The right-of-way shall not be open to the general public and shall have minimal impact on the environment. Upon completion of construction, the right-of-way shall be reclaimed to visually blend in with the surrounding environment and minimize its visual impact.

F. All construction activities, including clearing and grading, must remain within the designated right-of-way and temporary construction easement. Do not encroach on adjacent properties, biologically sensitive areas, or culturally sensitive areas.

3.12 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. The Contractor shall be required to hydrostatic pressure test all water mains, appurtenances and plumbing trains.

1. Perform testing in accordance with applicable standards:

a. PVC pipe: Simultaneous hydrostatic pressure and leakage test. The system shall be pressure tested in accordance with AWWA C605 and M23, with the exceptions noted below:

1) Test pressure: In accordance with test pressure summary table provided within an Exhibit to Contract Documents.

2) In no case shall the test pressure exceed the manufacturers' recommended maximum safe test pressure for the pipe, fittings or appurtenances.

3) Test duration: 2 hours minimum.

a) Engineer may require longer duration test (up to 24 hours) if there is any doubt as to integrity of a particular section of pipe or appurtenances.

b. Ductile iron pipe: AWWA C600

c. Steel pipe: AWWA C200

2. Hydrostatic pressure testing of main line shall be performed in sections between each pair of adjacent isolation valves. Do not skip any isolation valves in delineating test sections, without express written permission by Engineer.

3. No observable leakage is allowed. Measurable leakage must be within the maximum allowable limits set forth by applicable AWWA and ASTM standards.

4. Any leaks detected during testing shall be repaired. After repairs are completed, another full duration test shall be performed on the section of the pipeline to which the repairs were made.

5. All air must be vented from the pipeline prior to pressurization.

6. The pipeline must be fully restrained prior to pressurization, including permanently installed items and any temporary appurtenances used for testing.

7. All hydrostatic pressure tests must be witnessed by NTUA personnel. Contractor is responsible for coordination of testing schedule with NTUA to allow NTUA's representative to be present.

C. Testing of field welds on steel pipe and fittings shall be by ultrasonic or radiographic method in accordance with AWS D1.1.

1. The Engineer reserves the right to demand evidence of welder's certification for all personnel performing field welding of steel pipe and fittings.

D. Compaction Testing: Refer to Section 31 23 23 – Backfill.

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the Owner.

3.13 TOLERANCES

A. Line and grade surveying tolerances:

1. Flange alignment tolerances as specified in AWWA C207 and AWWA M11.

END OF SECTION

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Valves.
2. Air Valves.
3. Inflow Preventors.
4. Meter pits & cans.
5. Valve boxes.

B. Related Sections:
1. Section 03 05 00 - Basic Concrete Materials and Methods.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 23 - Backfill.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Gate Valve Assemblies:
1. Basis of Measurement: Each.
2. Basis of Payment: Includes excavation, gate valves, adaptors, fittings, valve boxes, lids, collars, accessories, and backfill.

B. Air Valves:
1. Basis of Measurement: By the unit.
2. Basis of Payment: Includes excavation, meter pit, air valve assembly, fittings, accessories, backfill and compaction.

C. Flush Valve Assemblies:
1. Basis of Measurement: Each.
2. Basis of Payment: Includes excavation, 2-inch piping, 2-inch gate valve assembly as shown on plans, above-grade discharge pipe, gravel pack at weep hole, accessories and backfill.

1.3 REFERENCES

A. American Water Works Association (AWWA):
1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
2. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
3. AWWA C515 - Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.
4. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.

B. National Sanitation Foundation (NSF):
   1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

C. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):
   1. 801 - Installation of Water Transmission, Collector, and Distribution Lines.
   2. 802 - Installation of Water Service Lines.

1.4 SUBMITTALS

A. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions and parts lists.

B. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of all valves. Provide completed Water Valve Cards for each valve installed per NMSSPWC Section 801.4.

B. Provide Operation and Maintenance Data for each type of valve installed.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with Navajo Tribal Utility Authority (NTUA) standards and the National Fire Protection Act (NFPA).

B. All piping, fittings, valves and any other potable water system appurtenances shall comply with the “Reduction of Lead in Drinking Water Act”, in effect as of 2014, or any subsequent revision thereof.

C. Valves: Mark valve body with manufacturer's name and pressure rating.

1.7 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years’ experience.

1.8 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

B. Deliver and store valves in shipping containers with labeling in place.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

D. Coated valves and appurtenances shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

E. Coated valves shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or valves shall not be used.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.10 COORDINATION

A. Coordinate work with NTUA, or other utilities within construction area.

1.11 MAINTENANCE MATERIALS

A. Furnish two (2) tee wrenches to Owner (required length) for each valve type.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall be American made, unless otherwise specified.

B. All non-stainless steel and iron valves and appurtenances shall be fusion bonded epoxy coated, interior and exterior, conforming to AWWA C550 and NSF 61.

C. All valves and coatings shall be NSF 61-certified.

2.2 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. Mueller Company
    a. A-2361
2. Substitutions: Approved Equal

B. Resilient Wedge Gate Valves: AWWA C515, NSF 61, American-made; ductile iron.

1. Resilient seats.
2. Stem: Non-rising bronze stem.
3. Operating Nut: Square; open counterclockwise unless otherwise indicated.
4. Gearing
    a. Bevel geared for horizontal installation.
    b. Spur geared for vertical installation.

5. Valve Ends:
    a. Mechanical joint or flanged, as indicated on Drawings.
    b. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern, unless otherwise noted on Drawings.
    c. Pressure rating not less than that of valve body.
6. Working pressure rating: 350 psi.
7. Pressure testing: Seat test – 525 psi for 15 seconds, test seat from each side of valve separately per UL262. Shell test pressure: 700 psi.
8. Inside and outside of valve fully coated with Fusion Bonded Epoxy, 10 mils nominal, conforming to AWWA C550 and NSF 61 requirements.

C. Where waterline is buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut matches depth of operating nuts on valves installed at four-foot depth.

2.3 BALL VALVES

A. Stainless steel ball valves as accessories to other assemblies
1. Size: 3-inch or less as shown on Drawings
2. May be imported or domestic
3. Manufacturers:
    a. Milwaukee Valve
    b. Apollo
4. Approved equal
5. Working Pressure: Not less than 250 psi
6. Inlet/Outlet: FNPT, or as shown on Drawings
7. Full-port unless indicated on drawings or otherwise approved by Engineer.
8. All stainless steel construction, including body, tailpiece, ball, ball retainer, stem, handle, handle nut, packing nut, and lock washer.
9. Typical Actuators:
    a. Valves shown on Drawings with hand-levers shall come equipped with lever-type handle, one-quarter turn to open and close. Handle length and range of motion shall allow handle to be located in the most accessible location without interference with any other object.
    b. Valves with curb stop style operating nuts are required where shown on Drawings.

2.4 COMBINATION AIR VALVES

A. Manufacturer:
1. Val-Matic Valve and Manufacturing Corporation, Model # 201C.SV, Single Body Type.

2. Substitutions: Not permitted

B. Working pressure: 200 psi

C. Test Pressure: 300 psi

D. Inlet: 1” NPT

E. Cast iron body, cover and baffle; stainless steel trim, float, and fasteners.

F. Seat: Resilient Buna N.

G. Valve to perform functions of air release, pipe fill air exhaust and vacuum relief.

2.5 INFLOW PREVENTORS

A. Inflow Preventor for a 1-inch Combination Air Valve (Single Body Type):

1. Manufacturer

a. Valmatic Model 1300 Series

2. Female NPT thread

3. Materials

a. The upper and lower chambers shall be constructed of ASTM A536, Grade 65-45-12 ductile iron.

b. Float checks and trim shall be constructed of Type 316 stainless steel.

c. Resilient seats shall be EPDM with fiberglass reinforcement.

4. Redundant float actuated closure members.

5. Heavy duty basket type screen.

6. FBE coated wall bracket shall be provided.

7. Stainless steel braided hose to attach to Air Valve.

2.6 VALVE BOXES

A. 12-inch diameter Valves and Smaller: Cast iron, two-piece, slip type.

B. Valves larger than 12-inch diameter: Domestic cast iron, three-piece, slip type; round base.

C. Where waterline is buried at a depth greater than 4 feet, provide valve box extensions as required.

D. Cast iron lid marked “Water”.

E. Heavy duty, traffic rated.

F. Locking Lids

2.7 METER CANS & PITS

A. Meter Box for Combination Air Release Valves:

1. Body material LLDPE

2. 30” inner diameter, 3/8” wall thickness, length per detail drawing.

B. Contractor responsible to ensure compatibility between meter pit / box, flange, ring, and cover.

2.8 PRE-CAST CONCRETE VAULT

A. Size per drawings.

B. Pre-cast concrete sections conforming to ASTM C858 and ASTM C478 (for circular vaults).

1. Bell and spigot joints.
2. Symmetrical reinforcement only.
3. Soil-tight gasket.

C. Concrete shall conform to Section 03 05 00.

D. Concrete shall be 4000 psi.

E. Manufactured or cut to lengths shown on Drawings.

F. “Mouse hole” or circular cut-outs to accommodate main line pipe inside vaults shall be pre-cast and shall include epoxy coated wall sleeves.

G. Pre-fabricated reinforced flat, slab-type lids with hinged, lockable hatches as shown on Drawings.

H. Square access covers:

1. Manufacturers:
   a. Halliday Products, model and dimensions as shown on Drawings
   b. MSU Mississauga Ltd, model and dimensions as shown on Drawings
   c. Substitutions: OAE
2. Dimensions as shown on Drawings.
3. Load Rating: 300 lbs
4. Gasketed lid with channel system to divert water
5. Assisted opening with slam prevention system
6. Bituminous coating
7. Stainless Steel Hardware
8. Insulated Lid
9. Recessed Lockable Hasp and lifting handle

I. Foam insulation.

1. 2” minimum thickness
2. Spray Foam Insulation.
   a. 2-lb closed cell, two-component, rigid polyurethane.

b. R Value per inch of 6.6 or greater (K factor 0.15 or less).

c. Suitable for application to low temperature substrates (15°F).

d. Waterproof mixture in sealant

3. Sheet insulation may be considered by the Engineer as a substitute if demonstrated to meet or exceed the properties of spray foam insulation, including resistance to moisture build up or condensation behind the insulation. The burden to demonstrate the properties of any substitute shall be borne by the Contractor.

J. Safety Ladder

1. 6005T5 aluminum construction.
2. 5086 H116 Aluminum bracket.
3. Stainless steel bolts.
4. Shall be supplied with a locking and retractable safety post.
5. 10 ft tall, cut to suit application.

2.9 ACCESSORIES

A. Joint Restraints: “EBAA Iron, Megalug®”, or approved equal, for all pipe 4” diameter and greater, “EBAA Iron, Series 6500 and 7500”, or approved equal, for all pipe from 2” to 3-1/2” diameter, installation and spacing as per manufacturer's specifications.

B. Concrete for Thrust Restraints: Concrete type specified in Section 03 05 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
1. Notify Engineer not less than 48 hours in advance of proposed utility interruption.
2. Do not proceed without written permission from the Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

3.3 INSTALLATION

A. Gate Valves:

1. Install in accordance with AWWA standards and manufacturer's recommendations
2. Install valves in conjunction with pipe laying; set valves plumb.
3. Assemble complete valve assembly and place in open excavation at proper line and grade.
4. Provide buried valves with valve boxes or meter boxes installed flush with finished grade.
    a. Any valve box lids, meter can lids, or collars that do not meet grade requirements shown on Drawings shall be removed and replaced.
5. Install valve stem risers, collars and valve box extensions as required to match finished grade.
6. Gate valves and ball valves shall require the same joint restraint lengths as dead-ends of similar size and pipe material.

B. Combination Air Valve Assemblies

1. Install in accordance with AWWA standards and manufacturer's recommendations
2. After drilling into the main line, remove all pipe cuttings and other debris with a vacuum or other method approved by the engineer prior to installing the valve assembly.
3. Install air valve assemblies in vertical position.
4. Where indicated at high points in pipe on Drawings, install at actual high points, as determined by as-built pipeline survey data.
5. Secure assemblies to Unistrut as shown on Drawings to prevent lateral movement or stresses.

C. No high points in the pipe of any magnitude shall be allowed without an appropriate air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

1. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid. Contractor shall promptly report such conditions to the Engineer.
2. Additional air valves required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

D. FLUSH VALVE ASSEMBLIES

1. Components of flush valve assembly shall be as provided elsewhere in project specifications.

2. Steel piping underground shall be tape wrapped.
3. Steel piping above ground shall be painted blue.

E. Tracer Wire:

1. For direct buried valves with surface valve box lids, tape tracer wire to outside of valve box up to last section of box. Bring tracer wire into the valve box above the operating nut. Coil 18" tracer wire inside valve box under the lid.
2. For direct buried valves with valve box lids inside meter cans, bring tracer wire into the meter can outside of the valve box. Coil 18" tracer wire inside meter can.
3. For all valve vaults and meter pits, coil min. 24" tracer wire against wall on each side of vault.

3.4 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water transmission system in accordance with AWWA C605.

C. All valves shall be manually actuated through their full cycle to ensure proper operation prior to installation.

1. The Contractor shall provide the Engineer the opportunity to witness all valve actuations prior to valve installation.

D. Inspect coatings of all valves immediately prior to installation and repair all damaged coatings.

E. Properly align all pipes, valves and fittings prior to making connections. Do not install any pipes or fittings with internal longitudinal or shear stresses. Engineer reserves the right to disassemble any flange, joint, or union to check for internal stresses. Contractor shall correct any connection with internal stress at no additional cost to the Owner.

F. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes disinfection of potable water distribution and transmission system; and testing and reporting results.

B. Related Sections:

1. Section 01 00 00 - Basic Requirements
2. Section 33 11 00 - Water Utility Distribution Piping
3. Section 33 12 13 - Water Service Connections
4. Section 33 12 16 - Water Utility Distribution Valves

1.2 MEASUREMENT AND BASIS OF PAYMENT

A. Basis of Measurement: By the linear foot of pipe

B. Basis of Payment: Payment for pipeline disinfection will be made based on linear footage of mainline pipe, upon successfully passing bacteriological testing.

1. Disinfection of individual service lines shall be incidental to that bid item.
2. This includes all costs incidental to disinfection and testing, including chlorination, flushing, water for flushing, de-chlorination, sampling, sample transport, laboratory testing fees, and any other costs incidental to flushing, disinfection, and bacteriological testing activities.
3. Costs for passing bacteriological laboratory tests, for both mainline and service lines, shall be reimbursed using the Testing Allowance.
   a. Contractor shall be reimbursed for the cost of laboratory tests themselves only upon submittal of the invoice(s). The laboratory results of all tests shall be submitted directly to the Engineer.
   b. Contractor shall pay for all failed tests.

1.3 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites.
2. AWWA B301 - Liquid Chlorine.
3.
4. AWWA B303 - Sodium Chlorite.
5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
6. AWWA C651 - Disinfecting Water Mains.

B. New Mexico Administrative Code (NMAC) - Title 20, Chapter 7, Part 10:

1. Section 201: Application for Public Water System Project Approval.
2. Section 400: General Operating Requirements.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

C. Testing Plan: Contractor must submit proposed testing procedures specific to the project including laboratory name and contact information, testing/sampling locations, locations where flushing water will be obtained for the pipeline flushing, disinfection, and final flushing, method for disposal of de-chlorinated water and equipment to be employed for disinfection for approval by Engineer

D. Test Reports: Indicate results comparative to specified requirements.

E. Certificate: Certify cleanliness of water distribution system meets or exceeds specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Notarized affidavit confirming that disinfection has been completed according to the referenced AWWA standards.

D. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Fecal and Total Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.

E. Water Quality Certificate: Certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

1.7 QUALIFICATIONS

A. Testing Firm: Company specializing in testing potable water systems, certified by State of New Mexico.

B. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, and AWWA B303, Sodium Chlorite.

B. All chemicals shall be NSF/ANSI 60 certified disinfection chemicals.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

A. Coordinate with NTUA, IHS, and and the Engineer prior to filling, flushing or disinfecting the pipeline. Refer to Section 01 00 00 – Basic Requirements for coordination requirements.

B. Prior to disinfection, thoroughly flush the system with potable, disinfected water. Flushing may be accomplished either by gravity or by pumping, provided the pump is not damaged due to insufficient head. Any damage to the pump during flushing shall be the responsibility of the Contractor and shall be repaired or replaced at no additional expense to the Owner. A minimum flow velocity of 3 feet per second (fps) is required.

C. Introduce liquid chlorine into the system and perform disinfection in accordance with AWWA C651 using the continuous feed method, with the following modifications:

1. Initial chlorine concentration, as measured by water flowing out of representative points throughout the system, shall be at least 50 ppm.

2. Maintain disinfectant in system for 24 hours, or 48 hours if the temperature is less than 41 degrees Fahrenheit.

3. Upon completion of retention period required for disinfection but prior to collecting bacteriological samples, flush pipeline until chlorine concentration in water leaving pipeline is not more than 0.4 ppm.

D. Provide and attach required equipment to perform the Work of this section.

E. Flush, circulate, and clean until required cleanliness is achieved; use domestic water.

1. Contractor shall coordinate with NTUA and Engineer prior to using domestic water, to avoid interruption of service to existing customers. Contract shall not exceed maximum allowable instantaneous flow (gpm) or daily flow (gpd), as specified in the field by NTUA and Engineer.

2. Neutralize residual chlorine to levels normally associated with potable water prior to discharging water to the environment.

F. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.

G. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Disinfection, Flushing, and Sampling:

1. Disinfect and test pipeline installation in accordance with AWWA C651.

2. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that of the water used for flushing or 0.4 ppm, whichever is greater.

3. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory, approved by the Engineer, to sample, test and certify water quality suitable for human consumption, in accordance with AWWA C651.

a. At least one set of bacteriological samples shall be collected from every 1,200 LF of new waterline, plus one set at each end of the line, unless otherwise approved by NTUA and the Engineer.

b. Contractor shall install testing saddles, if needed to comply with spacing requirements for bacteriological testing under AWWA C-651 and NTUA's requirements. Such testing saddles are not shown on the plans, but shall be considered incidental to the project.

c. The number and locations of specific sampling sites shall be submitted by the Contractor and must be approved by the Engineer prior to sampling.

d. Bacteriological tests are typically only valid for 30 days. Two consecutive passing test results at every sample location must therefore be obtained within 30 days of Final Completion and Transfer of completed project to NTUA. Note that NTUA will not accept project transfer until all punch list items have been completed and the project has been inspected by NTUA personnel. NTUA typically requires 21 days notice prior to final inspection

and Transfer. Contractor is solely responsible for coordination with NTUA. If punch list inspection, Final Completion, and NTUA Transfer cannot be completed within 30 days of all bacteriological tests, regardless of the reason for delay, Contractor shall be responsible for re-testing at Contractor's expense.

4. Contractor shall not connect to existing system until all testing and disinfection is complete and shall obtain written permission from the Engineer to proceed with connection to the existing system.

C. Re-Disinfection:

1. In the event the performed water quality testing fails, the Contractor will disinfect the affected portions of the system again, and the approved testing laboratory shall sample, test and certify water quality as described in these specifications. Re-disinfection shall be performed at no additional cost to the Owner.

END OF SECTION

SECTION 33 13 13

WATER STORAGE TANK DISINFECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water tank disinfection.
2. Bacteriological testing.

B. Related Sections:

1. Section 09 97 14 - Water Storage Tank Painting.
2. Section 33 16 19 - Welded Steel Water Storage Tank.

1.2 REFERENCES

A. American Water Works Association:

1. AWWA C652 - Disinfection of Water Storage Facilities.

1.3 MEASUREMENT AND BASIS OF PAYMENT

A. Basis of Measurement: Lump sum for each tank.

B. Basis of Payment: Via separate bid item on the Bid Form. Bid item price shall include all work performed by Contractor and testing laboratory related to disinfection, testing and analysis.

C. The cost of laboratory testing for bacteriological testing shall not be allowed under the Testing Allowance.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal procedures.

B. Disinfection Procedure: Submit procedure description including type of disinfectant to and calculations indicating quantities of disinfectants required to produce specified chlorine concentration in accordance with Section 3 and 4 of AWWA C652.

C. Test Reports: Indicate results of bacteriological and residual chlorine laboratory test reports.

D. Manufacturer's Certificate:

1. Certify products meet or exceed specified requirements.
2. Certify disinfectants meet or exceed AWWA Standards requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C652.

B. Perform Work in accordance with State of New Mexico Environment Department standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store disinfectants in cool, dry place away from combustibles such as wood, rags, oils and grease.

B. Handle disinfectants with caution; protect skin and eyes from contact; avoid breathing vapors; wear gloves, aprons, goggles, and vapor masks.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for work conducted in hazardous atmosphere.

B. Neutralize disinfectant solution before disposal.

C. Legally dispose of disinfection solution off Project site.

D. Repair damage caused by disinfectant solution and disinfection procedures.

PART 2 PRODUCTS

2.1 DISINFECTANTS

A. Chlorine Forms: In accordance with AWWA C652, Section 4.2.

B. All chemicals shall be NSF/ANSI 60 certified disinfection chemicals.

PART 3 EXECUTION

3.1 EXAMINATION

A. Conduct inspection of tank interior before beginning disinfection.

1. Verify tank is clean and free of polluting materials.

2. Verify tank pipe and vent connections are properly made and clear of obstructions.

3. Verify paint is thoroughly cured in accordance with paint manufacturer's instructions.

3.2 PREPARATION

A. Protect aquatic life and vegetation from damage from disinfectant solution purged from tank.

3.3 APPLICATION

A. Welded Steel Tanks

1. Use Chlorination Method 1, 2, or 3 for disinfecting tank as specified in Section 4.3 of AWWA C652.

B. Glass Fused Tanks

1. Use Chlorination Method 1 or 3 for disinfecting tank as specified in Section 4.3 of AWWA C652.
2. Disinfection shall not take place until tank sealant is fully cured (see article related to Sealants above).

3.4 FIELD QUALITY CONTROL

A. Section 01 00 00 - Testing, adjusting and balancing requirements.

B. Collect samples of water from filled tank for bacteriological analysis in accordance with Section 5.1 of AWWA C652; take inlet and outlet water samples.

C. Test water samples for bacterial contamination, residual chlorine, in accordance with State Health Standards for potable water.

D. When water samples fail to meet State Health Standards for potable water perform the following corrective measures until water quality conforms to State Health Standards:

1. Inlet and Outlet Water Sample Failure: Eliminate source of contamination in water supply, repeat disinfection, and retest water quality.

2. Outlet Water Sample Failure: Repeat disinfection, and retest water quality.

END OF SECTION

SECTION 33 16 19

WELDED STEEL WATER STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section of the specifications consists of furnishing all plant, labor, equipment and materials in performing all operations in connection with the manufacture, delivery and erection of factory epoxy primed and field epoxy coated welded steel water storage tanks to the height and capacity specified, complete with foundation design and construction, and appurtenances, subject to the terms and conditions of the contract, and in strict accordance with this section of the specifications and the applicable drawings.

Section Includes:

1. Welded steel water storage tanks.
2. Tank foundations.

B. Related Sections:

1. Section 01 00 00 - Basic Requirements
2. Section 03 30 00 - Basic Concrete Materials and Methods.
3. Section 09 97 14 - Water Storage Tank Painting.
4. Section 26 42 10 – Impressed Current Cathodic Protection.
5. Section 31 23 17 - Trenching.
6. Section 31 23 23 - Backfill.
7. Section 33 11 00 – Water Utility Distribution Piping.
8. Section 33 13 13 - Water Storage Tank Disinfection.

1.2 REFERENCES

A. Subsurface data:
1. See Section 01 00 00 Basic Requirements for any geotechnical reports and subsurface data and/or reports available.

B. American Concrete Institute:

1. ACI 318 - Building Code Requirements for Structural Concrete.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

D. American Society of Mechanical Engineers:

1. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

E. American Water Works Association:

1. AWWA D100 (latest revision) - Welded Steel Tanks for Water Storage. All references in this Section to AWWA D100 shall be understood to mean AWWA D100 (latest revision).

1.3 DEFINITIONS

A. PURCHASER used in AWWA D100 means Owner.

1.4 SYSTEM DESCRIPTION

A. Design, fabricate, and erect welded steel water storage tanks and accessories. Design and construct steel retaining ring or reinforced concrete ring wall foundation, and cathodic protection system, complete in place.

1.5 DESIGN REQUIREMENTS

A. Design in conformance with requirements listed in AWWA D100 (latest revision) as noted, supplemented, or modified below:

1. Capacity:

a. Nominal capacity shall be as indicated on Drawings.
b. All tank capacities shown on drawings are nominal sizes, actual tank volumes shall be within 2% of the nominal value.

2. Approximate tank dimensions are as indicated on Drawings.
a. Actual heights of tank overflow and inlet riser, if present, shall be verified and adjusted by Contractor in field to meet the requirements and tolerances called for on the Drawings.
b. The carbon steel tank shall have the dimensions shown in the Drawings. Vendor to quote on the nearest standard size welded tanks of manufacture meeting the requirements and tolerances described herein and on the Drawings.

3. The tank wall plate thickness shall be a minimum of ¼”.

4. Bottom capacity level (BCL) and top capacity level (TCL) above top of column foundations.

5. Roof: Welded conical roof with rafter support.

6. Location of Site: As indicated on Drawings.

7. Access Roads: As indicated on Drawings.

8. Snow Loading: As per AWWA D100, (latest revision).

9. Lateral Design:
a. Wind and Seismic Loading: As per AWWA D100, (latest revision). The load producing the higher stresses comparing wind and seismic will control the dynamic portion of design.
b. The Contractor shall include sloshing wave calculations as part of their design submittals, and size the height of the tank accordingly to provide the calculated freeboard.

10. Tank low level is defined as level when emptied through specified discharge fittings unless otherwise indicated on Drawings.

11. Cathodic protection shall be impressed current type. Refer to the following Section:
    a. Section 26 42 10 – Impressed Current Cathodic Protection.

B. Design and construct foundation based upon data and recommendations provided in Subsurface (Geotechnical) Investigation Report.

1.6 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. All required parts of the tank submittal indicated in this section shall be submitted in a single complete bound package. Each separate part of the package shall be sectionalized and tabbed.

C. Construction shall be governed by the Drawings showing general dimensions and construction details. After approval by the Engineer of detailed erection drawings prepared by the Contractor, there shall be no deviation from these drawings and specifications except upon written order or approval from the Engineer.

D. Shop Drawings: Signed and sealed by professional engineer licensed in the State in which the tank is to be constructed. Indicate the following:

1. Tank Shop Drawings:
    a. Complete plan, elevation, and sectional drawings showing critical dimensions.
    b. Structural plate and support member sizes and thickness.
    c. Weld types and sizes.
    d. Water supply and overflow piping details including fittings, expansion joints, and pipe support methods.
    e. Exterior ladder safety device details.
    f. Handrail details.
    g. Access hatch details.
    h. Level indicator details.
    i. Vent details.
    j. Other appurtenances as indicated on plans or as provided by manufacturer.
    k. Cathodic protection details.

2. Tank Foundation Shop Drawings:
    a. Submit specification for foundation describing all material to be used, configuration, compaction requirements, etc. prepared by professional engineer licensed in the State in which the tank is to be constructed.
    b. If proposed foundation is constructed of concrete, indicate the following:

1) Ingredients, reinforcement, air content, slump, placement and consolidation, curing and finishing.

2) Submit concrete design mix including ingredient proportions, minimum cement content, and water/cement ratio.

3) Submit drawings of reinforcing bars including bar lists.

E. Product Data:

1. Submit data for expansion joint fittings and other pipe specialty fittings.

2. Submit data for ladders and ladder safety devices.

3. Submit data for cathodic protection components.

F. Design Data: Submit structural calculations for tank, tank foundation, and cathodic protection, signed and sealed by professional engineer licensed in the State in which the tank is to be constructed.

G. Test Reports: Submit radiographic films, identified to shell plate diagrams, at completion of the Work.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

I. Certificates:

1. Submit names and qualifications of welders, welding operators and tackers before performing welding.

2. All certifications must be valid at the time the work is to be performed.

J. Manufacturer's Field Reports: Certify foundation, anchor bolts, and tank have been properly installed and leveled.

K. The intent of these specifications is to provide the Owner with a water storage tank of the dimensions stated, requiring minimum maintenance. Alternative submittals will be accepted, provided the installation offered can be shown to be “equal” to the specified standard of quality, beyond reasonable doubt.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual location layout and final configuration of elevated tank and accessories.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA D100.

1.9 QUALIFICATIONS

A. Fabricator: Company specializing in performing work of this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum five years experience, approved by Engineer.

C. Welders, Welding Operators, and Tackers: ASME Section IX qualified within previous 12 months. American Welding Society (AWS) certification must be valid as defined by AWS,

with certification maintenance forms submitted every six months as per the AWS Code of Acceptance.

D. AWWA D100, (latest revision)- Welders Credentials: Refer to AWWA D100, (latest revision).

E. Design ground supported water tank and foundations under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State in which the tank is to be constructed.

1.10 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Pre-Construction Conference.

B. Convene minimum one week prior to commencing work of this section.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Contractor responsible to field survey tank overflow weirs.

1.12 COORDINATION

A. Section 01 00 00 - Basic Requirements: Coordination requirements.

B. Section 02 21 13 – Surveying: Coordination requirements.

C. Coordinate work with connecting to water transmission system.

1.13 MAINTENANCE MATERIALS

A. Section 01 00 00 - Basic Requirements: Operation and maintenance data requirements.

B. Furnish a safety harness for ladder safety rail system.

PART 2 PRODUCTS

2.1 WATER STORAGE TANK

A. Furnish materials complying with this specification and standards specified in AWWA D100, (latest revision).

2.2 TANK CONSTRUCTION

A. In conformance with requirements listed in AWWA D100, (latest revision) as noted, supplemented, or modified below:

1. The tank wall plate thickness shall be a minimum of ¼”.

2. Carbon Steel:

a. Sheet. Carbon steel sheets shall conform to, or be at least equal to, hot-rolled quality per ASTM A570 Grade 40 with a minimum yield strength of 40,000 psi.

b. Plate. Carbon steel plates shall conform to, or at least be equal to, the requirements of ASTM A36 with a minimum yield strength of 36,000 psi.

c. Structural Shapes. Carbon steel structural shapes shall conform to ASTM A36.

3. Aluminum: 5052-H32, 6061-T6 typical grades (limited size).

4. Stainless Steel: 304, 316, 316L, 317 typical grades.

5. All carbon steel plates, supports, members and miscellaneous parts, except bolts, shall be coated in accordance with Section 09 97 14. Bolts shall be stainless steel.

6. Pipe and Fittings for Fluid Conductors: AWWA D100, (latest revision)- Steel Pipe for Fluid Conductors: Modify to indicate only welded joints for conductors are acceptable.

7. Balcony: AWWA D100, (latest revision).

8. Manways, Ladders and Other Accessories: AWWA D100, (latest revision):

   a. Section 5.1 - Steel Riser: Provide manways as shown on Drawings. Manways shall have a minimum I.D. of 30" and shall be located as indicated on Drawings.

   b. Section 5.4 - Ladders: Provide tower, outside and roof ladders.

9. Pipe and Pipe Connections:

   a. AWWA D100, (latest revision):

      1) Provide inlet pipe with diameter as indicated on Drawings. Extend pipe through bottom of tank.

      2) Provide removable steel silt stop with same coating as tank interior and mechanical joint gland.

   b. Provide other accessories as indicated on Drawings.

10. Tank Floor: Floor to slope upwards 1% towards center to prevent "oil canning".

11. Removable Silt Stop: AWWA D100, (latest revision) Provide removable silt stop.

12. Overflow: AWWA D100, (latest revision)- Overflow. Provide welded joint steel overflow pipe as indicated on Drawings suitably supported and extending to grade level; diameter of overflow as indicated on Drawings. Provide overflow weir box designed to handle the maximum anticipated flowrate (at high water level) as indicated on Drawings.

13. Roof Ladder: As indicated on Drawings and designed to meet OSHA Standards, and AWWA D100, (latest revision). Ladder must extend to 2' off the ground.

14. Fall Arrest Systems, Rest Platforms, Roof-Ladder Handrails or Other Safety Devices: AWWA D100, (latest revision) and OHSA Standards (latest revision).

   a. Safety Devices: Provide have a personal fall arrest system complying with OSHA Standards, along entire ladder length.

   b. Provide anchor points for operator to connect lanyards, "pelicans" or similar personal safety devices, complying with OSHA standards, at three points along roof of tank: near top of ladder, between center of tank and roof hatch, and near center of tank.

c. Ladder shall be secured with a locking ladder guard for at least the first 10-feet of the ladder.

15. Special Vent Required for Screening of Tank Vent: AWWA D100, (latest revision) - Vent. Mushroom vent above maximum water level of sufficient size to accommodate maximum inlet and outlet water flow. The overflow pipe shall not be considered a tank vent. Provide aluminum, fiberglass, or bronze insect screen, 24-mesh. Vent shall be frost proof. Maximum water flow as follows:

    a. Vent capacity: Maximum anticipated flowrate (at high water level) as indicated on Drawings.

16. Hatch: Provide tank roof hatch with curbed, upward opening 30" square manway, unless indicated otherwise on Drawings. The curb shall extend at least 4 inches above the tank. The hatch cover lip shall be hinged and provisions made for locking. The hatch cover lip should extend for a distance of 2 inches down on the outside of the curb.

17. Water Level Indicator: A water level indicator shall be furnished including target, cable, floats, channel, guides, etc., as required for complete assembly.

18. Target cables shall be provided with guides to prevent cables from tangling with target.

19. Additional Accessories: AWWA D100, (latest revision) - Additional Accessories.

20. Butt-Joint Welds: AWWA D100, (latest revision) - Welding. Modify to indicate lap welds tack welded on one side are not permitted. Seal welding is required.

21. Written Report Certifying Work: Prepare and submit as specified in AWWA D100, (latest revision).

22. Submit radiographic film and test segments.

23. Complete-Joint-Penetration Welded Shell Butt-Joints: Inspection as specified in AWWA D100, (latest revision).

24. Surface Preparation: Refer to Section 09 97 14.

25. Seal Welding: AWWA D100, (latest revision). Provide seal welds for lap joints in wet areas including interior roof surfaces.

26. Soil Investigation and Foundation: AWWA D100, (latest revision). Soil data available for review.

27. Pile-Supported Foundation: AWWA D100, (latest revision). When required, in accordance with manufacturer's design.

28. Effect of Buoyancy on Foundation Design: AWWA D100, (latest revision).

29. Concrete: ACI 318.

30. Vertical Distance from Finished Ground Level to Crown of Inlet and Outlet Pipes at Tank Foundation: AWWA D100, (latest revision). As indicated on Drawings.

31. Specification Sheet for Seismic Data: AWWA D100, (latest revision).

32. Vertical Acceleration: AWWA D100, (latest revision).

33. AWWA D100, (latest revision)

a. Reinforcing Steel: Modify to use only Grade 60.

2.3 REINFORCEMENT

A. Reinforcing Steel Bars: ASTM A615/A615M, Grade 60, ACI 318, in accordance with Section 03 20 00, as applicable.

2.4 CONCRETE

A. The tank foundation shall be designed by the tank manufacturer based upon the recommendations of a geotechnical engineer to safely sustain the structure and its live loads. The tank foundation design shall be stamped by the tank manufacturer's Professional Engineer licensed in the State in which the tank is to be constructed.

B. Concrete: ACI 318, minimum compressive strength 4,000 psi at 28 days, in accordance with Section 03 30 00, as applicable.

2.5 INLET AND OUTLET PIPE

A. Inlet, outlet, and overflow connections shall conform to sizes and locations specified on Drawings.

B. Inlet and Outlet Pipe: ASTM A53/A53M, Grade B, Schedule 40, steel pipe, welded joints.

C. Coatings: Refer to Section 09 97 14 – Water Storage Tank Painting.

2.6 OVERFLOW PIPE

A. Overflow Pipe: ASTM A53/A53M, Grade B, Schedule 40, steel pipe, welded joints.

B. Coatings: Refer to Section 09 97 14 – Water Storage Tank Painting.

2.7 OTHER MATERIALS

A. Furnish other materials in accordance with AWWA D100, (latest revision) to complete installation.

2.8 FABRICATION

A. AWWA D100, (latest revision)- Shop Fabrication: No changes or modification to this Section.

2.9 DELIVERY

A. All tanks, structures and miscellaneous parts shall be packaged for shipment in such a manner as to prevent abrasion or scratching.

B. Delivery will be accomplished on specially designed, self-loading trailers featuring air-ride suspension. Silos will be unloaded by vendor and left in a horizontal position.

C. Final location of water storage tank shall be verified onsite by Owner.

2.10 SOURCE QUALITY CONTROL

A. Section 01 00 00 - Quality control requirements.

B. Inspect and test welds as follows:

1. Examine weld joints in accordance with AWWA D100, (latest revision).
2. Comply with procedure requirements of AWWA D100, (latest revision) prior to proceeding with radiographic work.
3. Immediately notify Engineer of weld locations failing to meet standards of AWWA D100, (latest revision).
4. Repair and reinspect defective welds until acceptable.
5. Tank weld testing is not covered by the testing allowance. All weld testing shall be incidental to the cost of the tank.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify elevations and grading for tank and location of tank.

C. Refer to Section 31 22 13 for rough grading and Section 31 23 23 for backfill requirements.

3.2 INSTALLATION

A. Install tank and tank foundations in accordance with AWWA D100 and the following:

1. AWWA D100, (latest revision) - Field Painting and Disinfecting:

a. Field paint. Refer to Section 09 97 14.

b. Areas rendered inaccessible after tank erection such as the spaces between roof plates and rafters shall receive the full coating system prior to erection and/or assembly.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Testing, adjusting and balancing requirements.

B. Inspection and Testing:

1. Hydrostatic Testing:

a. Test completed and cleaned tank for liquid tightness by filling tank to its overflow elevation with water provided by Owner.

b. Correct leaks disclosed by this test.

c. Drain and legally dispose test water off site.

2. Field Welds: Tested and inspected in accordance with AWWA D100, (latest revision) - Field Inspection.

3. Concrete testing for foundation in accordance with Section 03 05 00, if applicable.

4. Independent NACE inspection of coatings in accordance with Section 09 97 14.

C. Cathodic protection system installed but not to be activated until after 11th month inspection.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish field representative experienced in installation of tank to supervise installation.

1. Furnish Installation Certificate attesting tank, tank foundation, and anchor bolts are properly installed and leveled.

3.5 GUARANTEE

A. The water storage tank furnished under these specifications shall be guaranteed for a period of one year from the date of final acceptance thereof against defective material, design or workmanship, which guaranty shall include a rust-free condition of the structure for the same period. In the event of failure of any part or parts during the guaranty period due to the above causes, the affected part or parts shall be replaced promptly, upon notice by the Owner, with new parts, at the site of installation, by and at the expense of the Contractor. The labor incidental to installing replacement or repair portions shall be furnished by the Contractor. The Bidder shall submit with his bid a complete and comprehensive outline of all applicable warranty information for the product they intend to use.

3.6 CLEANING

A. Section 01 00 00 - Final cleaning requirements.

B. Clean interior and exterior of tank to remove debris, construction items, and equipment.

C. Disinfect tank in accordance with Section 33 13 13.

END OF SECTION

SECTION 44 44 16

CHLORINATION EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Vacuum operated sonically regulated gas feed system with flow proportional switchover, capable of automatic and manual adjustment.

2. Equipment for Chlorination:

a. Gas Chlorinator System
1) Vacuum regulator with automatic switchover
2) Control unit.
3) Automatic controls.
4) Vacuum monitor.
5) Ejector.
6) Chlorine solution diffuser assembly.
7) Chlorine vent and vacuum tubing.
8) Electronic two cylinder scale.
9) Chlorine gas detector.

b. Chlorine booster pump.

c. Self-contained breathing apparatus and hard case.

B. Related Sections:

1. Section 22 11 05 - Chlorination Facility Plumbing.

2. Section 26 27 33.1 Chlorinator and Well Instrumentation and Controls.

1.2 REFERENCES

A. ASTM International:

1. ASTM D1785 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

3. ASTM D2467 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

5. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based for Controlled Outside Diameter.

6. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

7. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 PERFORMANCE REQUIREMENTS

A. Project operational parameters:
1. Anticipated water supply treatment requirements for initial build out of system:
a. 30 – 100 GPM (57 GPM typical); 2 ppm chlorine dosage.
2. Potential future increased water system treatment requirements:
a. Up to 250 GPM; 1 ppm chlorine dosage.

B. Chlorination system capacity of 100 pounds per day (ppd) of chlorine, or less, depending on appurtenances (including metering tubes) installed.
1. Appurtenances (including metering tubes) sized and installed for a maximum capacity of 4 ppd.
a. Adjustable feed range 1:20 of maximum capacity indicated above.
1) Capable of controlling within ±4% of the indicated feed rate via automatic flow proportional control or manual adjustment.

C. Chlorination equipment supplier shall submit calculations verifying that equipment submitted is appropriate for achieving dosage for the operational parameters identified above.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Submit detailed certified dimensional shop drawings for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.

2. Submit complete listing of items being provided and schematic diagram of each system. Include in schematic diagram tag marks for each item of equipment cross-referenced to chlorine system equipment list. Include specialty valves and fittings on schematic and list.

C. Product Data:

1. Submit complete information concerning materials of construction, fabrication, and protective coatings.
2. Submit calculations for verification of system sizing as indicated in Performance Requirements of this Section.

D. Test Reports:

1. Submit certified field performance test results.

E. Manufacturer's Installation Instructions:

1. Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.
2. Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate equipment has been installed in accordance with manufacturer’s instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the contract documents and manufacturer’s recommendations.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section.

B. Installer: Company specializing in performing work of this section.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

D. Protect systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities, in immediate or adjacent areas.

1.11 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule work after concrete work for support pad and prior to connecting piping work.

1.12 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation and start-up with Engineer.

1.13 WARRANTY

A. Section 01 00 00 - Execution Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 GAS CHLORINATOR SYSTEM

A. Manufacturers:

1. Regal (Chlorinators Incorporated) Model 216 Flow Proportional Switchover System with Gas Detector, Vacuum Monitor, and Dual Cylinder Scale.
   a. Additional manufacturer requirements for specific components of the System are provided in subparagraphs that follow.

2. Substitutions: Section 01 00 00 - Product Requirements.
   a. Any substitutions are subject to NTUA approval.

B. System shall meet or exceed the Performance Requirements identified previously in this Section.

C. VACUUM REGULATOR WITH AUTOMATIC SWITCHOVER

1. Manufacturers:
   a. Regal Model 216

2. Each cylinder mounted vacuum regulator with integrated automatic switchover shall be rated for 100 pounds per day (ppd).
   a. Regulator shall be designed to reduce full supply pressure to a vacuum without venting.
   b. Built-in switchover capability shall change over to a new supply as the on-line supply is depleted.
   c. When the switchover is accomplished gas shall continue to be drawn from the former source until the container is empty.
   d. A separate switchover device will not be acceptable.

3. Provide regulators with the following:
   a. Integral self-aligning yoke.
   b. Mechanical detent to keep the standby gas supply ready for on-line service.
   c. Internal pressure relief.

1) Spring loaded, diaphragm actuated pressure relief valve.
d. Gas vent.
e. Gas inlet filter.
f. Vent line connectors.
g. Vacuum line connections.
h. Off position to isolate the diaphragm and internal components from atmospheric air when the operator changes containers.
i. Reset knob to return supply indicator back to standby when gas source is replenished.
j. Selector knob and icons to indicate the chlorine gas container status.
k. Easy to read indication of stand-by, operating, empty, and off position.

D. CONTROL UNIT
1. Manufacturers:
a. Regal 7500 Remote Meter/Rate Valve Assembly
2. Control unit shall consist of a 5 inch rotameter with a V-notch rate valve.
3. Rotameter tube shall be serviceable without removing the frame from its mounting.

E. AUTOMATIC CONTROLS
1. Manufacturers:
a. Regal SmartValve Model 7001
2. Each gas feeder shall be provided with an integral automatic control system consisting of a dedicated electronic controller, a V-notch positioner, a 5 inch rotameter, and a V-notch chamber.
3. The positioner shall move the V-notch and shall contain a reversible motor with thermal overload protection, mechanical override, feedback potentiometer, selectable contacts, and front accessibility for service.
4. The positioner and controller shall be housed in NEMA 4X enclosures.
5. Flow Proportional Controller
a. The Flow Proportional Controller shall be microprocessor based with a NEMA 4X enclosure.
b. It shall accept a 4-20 mA process variable input signal.
c. The user interface shall include a membrane keypad and backlit LCD display.
d. Dosage can be set from 10 to 400% of input.
e. An isolated 4-20 mA output signal shall be provided for control, flow or actuator position.

F. VACUUM MONITOR
1. Manufacturers:
a. Regal Vac 2000
2. Provide dual function vacuum monitor switch to sense low or high gas vacuum condition on chlorine gas line. Switch shall be designed for chlorine service applications.
3. Monitor shall be mounted on control panel adjacent to chlorine feeder and shall sense the vacuum level between the injector and rotameter assembly.

4. Provide three digit LED digital display of system vacuum. Unit to operate within range of 0 to 30 in Hg.
5. Include the following:
   a. Three alarm outputs.
   b. Two high or and low vacuum alarm contacts.
   c. One normally open-normally closed latching output relay.
6. Provide 1 to 100 second adjustable delay for latching alarm relay.
7. Adjustable low alarm within range of 0 to 10 in Hg. Adjustable high alarm within range of 20 to 30 in Hg.
8. Provide LED indicator for each alarm condition.
9. Enclosure: NEMA 4X.

G. EJECTOR
1. Manufacturers:
   a. Regal (Chlorinators, Inc.): Model A-940
      1) Confirm back pressure with Engineer during submittal review.
2. Gas feeder shall have a PVC 3/4 inch fixed throat ejector rated 100 ppd to generate the operating vacuum for the system.
3. Ejector shall include built-in double check valve protection to prevent water from back flooding into the vacuum regulator.
4. Ejector shall include an integral mounting bracket, capable of mounting in either the vertical or horizontal plane.

H. CHLORINE SOLUTION DIFFUSER ASSEMBLY
1. Manufacturers:
   a. Chemical Feed Systems, Inc.
   b. Municipal Treatment Equipment, Inc.
   c. Approved Equal
2. Type: Pipe insertion.
   a. Size and number of orifices in diffuser to disperse chlorine solution along entire length of diffuser to ensure adequate mixing of solution with water flowing through pipe.
3. Diffuser assembly shall be constructed of schedule 80 PVC.
4. Diffuser assembly shall incorporate a tru-union mounted isolation ball valve with TFE seats and Viton o-rings, as manufactured by Spears or Asahi. An additional Viton seal shall be installed between the isolation ball valve and the diffuser union to provide a water tight seal around the diffuser tube while it is being inserted or withdrawn from the process line.

I. CHLORINE VENT AND VACUUM TUBING
1. Flexible Polyethylene Tubing: Tubing, pipe and fittings shall conform to all applicable standards of The Chlorine Institute.
   a. PE tubing shall be suitable for use in Chlorine Service Piping Systems from Vacuum to 6 PSIG.
2. Supply and install tubing with diameter and ratings appropriate for the application and Performance Requirements, identified in this Section.

J. ELECTRONIC TWO CYLINDER SCALE

1. Manufacturers:
   a. Force Flow Chlor-Scale 150 Model GR150-2.
2. Scales:
   a. A quantity of two (2) chlorine scales shall be provided and shall be of the digital readout/electronic load cell type.
   b. Scale platform shall be constructed of non-corrosive PVC plastic and sized to accept 150 lb. cylinders from 10-1/4 to 10-1/2 inches diameter.
   c. Platform height shall be no more than 1-5/8 inches to allow easy handling and unloading of cylinders.
   d. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact, and UV light.
   e. Scale shall be of the single load cell design.
   f. Weight shall be transferred via a pivoted platform to a single stainless steel canister load cell of the electronic strain gauge type.
   g. Load cell shall be mechanically sealed with o-rings.
   h. Potted-type load cells shall not be accepted.
   i. Flexible cable shall connect the load cell to the indicator to allow easy remote installation of the readout.
   j. Cable length shall be 10 feet.
   k. Cylinder chaining bracket shall be wall mounted and use a double coil chain and a spring loaded snap hook to sure cylinder.
   l. Chaining bracket shall have an integral tool rack for storing cylinder change-out tools.
3. Indicator:
   a. Indicator shall monitor 2 channels.
   b. The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure.
   c. All operations shall be keypad operated and menu driven in order to avoid compromising the NEMA 4X seal at anytime.
   d. The alphanumeric LCD readout shall have backlighting for readability in low light conditions.
   e. Power requirement shall be 110-220 VAC.
   f. A 6 digit numerical display shall give operator the ability to monitor chemical by weight (lb or kg) or volume (gallons or liters).
   g. A bar graph display shall read 0-100% for the net contents.
   h. dual mode TARE key shall allow user to enter tare weight of the vessel or enter the net weight of the chemical depending on application needs.
   i. A diagnostics menu shall allow recalibration without the need to apply field weight tests.
   j. A user adjustable filter function shall stabilize display in the event of vibration from pumps or mixers in the immediate vicinity of the scale.
   k. Indicator shall output net weight via a 4-20 mA signal and full scale output shall be user adjustable via the keypad.
   l. Indicator shall have four adjustable set points to display low or high level conditions on the indicator.
4. Scale shall carry a full five (5) year factory warranty; “Limited” warranties shall be considered unacceptable.

5. Full scale accuracy shall be better than 1%.

K. CHLORINE GAS DETECTOR

1. Manufacturers:
   a. ATi series A14/A11 Chlorine Gas Detector
   b. Siemens/Wallace & Tiernan Model Acutec 35 with Auto-Test facility

2. Gas detection system shall detect presence of chlorine gas in the ambient atmosphere.
   a. Range: 0-10 ppm chlorine
   b. Power Requirements: 85-255 VAC, 50/60 Hz; 1 Amp - self-regulating.
   c. Ambient Temperature: 0 to 105 degrees F continuous; -10 to 120 degrees F intermittent.
   d. Humidity: 0-99% non-condensing.
3. Alarms:
   a. Gas detector shall have two (2) independent alarm set points for Warning Level and Alarm Level, each adjustable from 5% to 100% of range.
   b. Alarm indicators shall be High Intensity LED Bars with WARNING indicator non-latching and ALARM indicator latching function.
   c. Gas detector shall have three (3) assignable alarm relays for either alarm setpoint 10A at 120 VAC, 5A at 250 VAC, resistive, SPDT configurable for normal/fail-safe, latching/non-latching, and fast/slow operation.
   d. Alarm relay and indicator reset shall be activated from front panel switch or through remote set.
   e. Sensor alarm shall indicate loss of sensor/transmitter input or failure of sensor Auto-Test.
   f. Sensor alarm shall have front panel indicator and relay, 10A at 120 VAC, 5A at 250 VAC, resistive SPDT factory set to fail-safe operation.
   g. Gas detector shall have an integral audible alarm horn with a weatherproof 12 VDC piezoelectric horn 85-dB output signal for local alarming.
   h. Gas detector shall be equipped with a power failure alarm relay for loss of AC input power, 10A at 120 VAC, 5A at 250 VAC, SPDT resistive.
4. Sensor/Transmitter:
   a. Sensor shall be electrochemical gas diffusion type.
   b. Sensor shall be fitted with an integral gas generator that automatically tests the sensor daily with an electrochemically produced gas sample.
   c. Sensor/transmitter shall be in a remotely mounted NEMA 4X enclosure.
   d. Gas sensor shall be capable of being remotely mounted up to 1,000 feet to receiver.
   e. 25 feet of two wire cable shall be provided.
   f. Sensor operating life shall be 2 years.
   g. Sensor storage life shall be 1 year.
5. Monitor Concentration:
   a. Display shall be 4 digit LED, sunlight readable.
   b. Output signal shall be isolated 4-20 mA DC, 1000 ohms maximum load.
6. Enclosure:

a. NEMA 4X polystyrene with knockouts on four sides for 1/2-inch FNPT conduit hubs.
b. Four conduit hubs shall be provided.
c. Enclosure shall have universal mounting brackets for wall mounting.
d. Enclosure shall have a clear, hinged polycarbonate window with push-button latches to provide easy access to the control modules.

2.2 CHLORINE BOOSTER PUMP

1. As specified on Drawings.

2.3 SELF-CONTAINED BREATHING APPARATUS AND HARD CASE

A. Manufacturers:

1. Self-contained breathing apparatus: Survivair Cougar Model #6888888.
2. SCBA hard case: MSA Model # 983867.
3. Substitutions: Section 01 00 00 - Product Requirements.

B. Self-contained Breathing Apparatus:

1. Open-circuit, positive pressure self-contained breathing apparatus suitable for use in chlorine gas atmosphere.
2. Certified by NIOSH to provide a nominal service time of 30 minutes.
3. Low-pressure (2216 psig) aluminum air cylinder containing 30 minute air supply.
4. NIOSH-approved facepiece.
5. First stage regulator.
6. Second stage regulator.

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify layout and orientation of equipment, accessories and piping connections.

3.2 INSTALLATION

A. Install equipment and accessories as indicated on Drawings.

B. Install chlorine vent and vacuum tubing in Schedule 80 PVC pipe to location outside of building wall. Install turned down elbow and terminate with fine mesh insect screen.

C. Cleaning:

1. Clean portions of chlorine system to remove cutting oil, grease and other foreign materials; do not use hydrocarbons or alcohols, for cleaning residuals from these materials.

2. Before use, dismantle and clean new valves or other equipment received in oily condition. Test valves with clean dry air at 150 psi for seat tightness before installation.

3. Dry chlorine piping before use. Use steam and dry air. When steam and dry air are not available purge completed system with dry cylinder air or nitrogen to remove moisture.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Preliminary Leakage Testing:
   1. With the exception of components design to operate under vacuum, pressurize chlorine system with nitrogen to at least 150 psig. With system under pressure, test each joint and connection for leaks by application of soapy water to each joint and connection.
   2. Vacuum test components designed to operate under vacuum to locate and correct any air leaks. Do not subject these components to positive pressure.

C. Final Leakage Testing: Test automatic chlorinators first to ensure chlorinators are operational. Use chlorinators to evacuate system in event leaks are found. Perform in the following sequence:

   1. Check unions and pipe connections in chlorine system for tightness.

   2. Open header and auxiliary valves one turn.

   3. Soak rag with strong ammonia water (commercial 26 Be) and swab each joint and connection.

   4. Momentarily open one chlorine cylinder valve to pressurize system to approximately 10 psig then shut off tight; observe chlorine leaks evident by formation of dense white smoke.

   5. When leaks are found, turn on automatic chlorinators to evacuate system, then repair leaks; retest joints and connections after repairs are made.

D. Performance Testing: Test each piece of chlorination equipment under design conditions for two to four hours to demonstrate proper functioning and automatic regulation of system; test alarms and signal generation; exercise equipment control and manual override where applicable; demonstrate equipment safety features.

E. Equipment Acceptance: Adjust, repair, modify or replace components failing to perform as specified and rerun tests; make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish services of manufacturer's representative experienced in installation of products supplied under this specification for one half day at project site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

C. Furnish Installation Certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.5 SPARE PARTS

A. Contractor shall supply the following spare parts to NTUA, at a location to be specified by NTUA within 75 miles of the project site:

1. Two (2) SCBA units with hard cases
2. Four (4) PM Kit – RK216 vacuum regulator
3. Two (2) PM Kit – standard injector
4. Two (2) PM Kit- 5” rotameter
5. Two (2) Orifice V-notch Teflon
6. 50 LF 3/8” OD PE tubing

END OF SECTION