RECLAMATION

Managing Water in the West

Cutter Lateral

Reach 22B

Navajo Gallup Water Supply Project

New Mexico

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

SPECIFICATIONS

APRIL 2016

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U.S. Department of the Interior
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SPECIFICATIONS

APRIL 2016

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION

A. Work is located approximately 18 miles SE of Bloomfield, NM in San Juan County.

1.02 DEFINITIONS

A. When specifications use a word or term defined in Federal Acquisition Regulations (FAR), definition of the word or term shall be in accordance with FAR sections in effect at the time solicitation was issued.

1.03 PRINCIPAL COMPONENTS OF WORK

A. Provide:

1. 16 miles of line pipe and appurtenant features.
2. 2 pre-manufactured pump stations.
3. 2 bladder style air chambers.
4. 2 steel regulating tanks.
5. 0.3 miles of gravel roadway.
6. Electrical and SCADA systems.

1.04 SPECIFICATIONS REQUIREMENTS

A. Requirements in Division 1, General Requirements, apply to Divisions 2 through 53.

B. Imperative statements in these specifications are Contractor requirements, unless otherwise stated.

C. Where specifications are written in streamlined form, words “shall be” are included by inference where a colon (:) is used within sentence or phrase.

1.05 ACRONYMS

A. The following acronyms apply to specifications Divisions 1 through 53:

1. CO: Contracting Officer.
2. COR: Contracting Officer’s Representative.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 14 10
USE OF SITE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. Cleaning Manual-12 — Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species (Technical memorandum No. 86-68220-07-05) 2012 Edition, Available online at: http://www.usbr.gov/mussels/prevention

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 14 10-1, Land Use and Landscape Rehabilitation Plan:

1. For each Contractor use site on Government land.

a. Show use location and extent of impact. Uses include but are not limited to the following:

1) Buildings and service areas including offices, shops, warehouses, storage areas, fuel and oil storage areas, and fabrication yards.

2) Parking areas, temporary roads, and haul routes.

3) Utilities including air, power, and water lines; fire hydrants; and compressor station.

4) First-aid and medical facilities.

5) Areas for processing, storing, and disposing of waste materials from construction operations.

6) Temporary fences.

b. Describe methods to preserve, protect, and repair, vegetation (such as trees, shrubs, and grass) and other landscape features on or adjacent to jobsite, which are not to be removed and which do not interfere with work

required under this contract. Include methods to mark work area limits, protect disturbed areas, and prevent erosion.

c. Describe methods to protect, and repair if damaged, existing improvements and utilities at or near jobsite.

d. Describe methods for removing temporary structures and facilities, cleanup, and rehabilitating site after completion of construction activities.

2. Submit revised drawings of changes in use of Government land made during design and erection stages or after use of Government land is in operation.

1.04 PROJECT CONDITIONS

A. ROW or Easements as shown on drawings may be used for required construction facilities.

1. Refer to "Staging Area" on drawing 1695-529-60077 for approved location of construction trailers.

B. When private land is used for construction facilities, or other construction purposes, make necessary arrangements associated with use of private land.

C. Location, construction, operation, maintenance, and removal of construction facilities on Government land will be subject to approval of COR.

D. Do not interfere with work of other contractors, Navajo Nation or Government in vicinity, or with reservations made by Government for use of such land.

E. Housing for construction personnel will not be permitted.

F. Natural Conditions:

1. Ambient Temperature Range: Minus 15 degrees C to 30 degrees C.

2. Relative Humidity: 0 to 90 percent.

3. Altitude: 6,770 feet.

4. Wind:

a. Maximum sustained: 45 knots.

b. Maximum gust: 60 knots.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GOVERNMENT TRAILER

A. Furnish for COR:

1. Space for trailer and testing laboratory.
2. Electrical service for trailer and testing laboratory.
3. Portapotty and weekly cleaning services.
4. Parking for 4 vehicles.

3.02 CLEANING

A. Construction equipment:

1. Before bringing on site, clean construction equipment to remove dirt, vegetation, and other organic material to prevent introduction of noxious weeds, and invasive plant and animal species.
2. Contractor cleaning procedures shall result in equipment being cleaned as well or better than procedures described in Cleaning Manual.
3. COR will inspect construction equipment following procedures described in Cleaning Manual before allowing equipment onsite.

3.03 RESTORATION

A. Restore Contractor use areas to pre-construction condition.

B. Restore temporary construction roads to original contours and make impassable to vehicular traffic when no longer required.

C. After completion of work, regrade and scarify Government land used for construction purposes and not required for completed installation so that surfaces blend with natural terrain and are in a condition that will facilitate revegetation, provide proper drainage, and prevent erosion.

D. Seed disturbed areas of Government land used for construction purposes and not required for completed installation in accordance with Section 32 92 20 - Seeding.

END OF SECTION

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SECTION 01 31 19
PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 31 19-1, Written Summary:

1. Written summary of upcoming submittals work and traffic plans. Provide work schedule for next 3 weeks.

C. RSN 01 31 19-2, Off Easement Land Use Coordination:

1. Show expanded use location and extent of impact.
2. Request cultural approvals.
    a. In accordance with Section 01 57 90 - Preservation of Historical and Archeological Data.
3. Request or revise Environmental Permits. In accordance with:
    a. Section 01 57 20 - Environmental Controls.
    b. Section 01 57 30 - Water Pollution Control.
    c. Section 01 57 60 - Protected Species.
4. Do not use proposed land until approved by COR.
    a. Approvals may require up to 6 months
5. Requirement does not apply to existing commercial facilities.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. No time extension shall be granted for Contractor's use of land outside Construction Easement.

3.02 PROJECT COORDINATION

A. Coordinate work with COR, other Bureau of Reclamation staff, Bureau of Indian Affairs, and other local, state, Tribal and Federal Agencies as needed.

1. Navajo Agricultural Products Industries.
2. Oil and Gas Companies.
3. Environmental Services Contractor.
4. Navajo Tribal Utility Authority.
5. Navajo Nation Department of Fish and Wildlife.
6. Reach 22A Contractor: Meridian Contracting Inc.
7. Cultural Resources Contractor.
8. Bureau of Land Management.
9. Huerfano Chapter.

B. Facilitate on-site work of above listed agencies.

3.03 MEETINGS

A. Following meetings are considered significant, but do not relieve Contractor from responsibility of other meetings required by contract.

1. Preconstruction Meeting.
    a. Meet with Government prior to start of construction. Provide, as a minimum, Project Manager or Project Superintendent for Preconstruction Meeting. Review includes:
        1) Use of premises by Contractor, Government, and public.
        2) Construction facilities and controls.
        3) Access to work and haul routes.
        4) Temporary utilities.
        5) Survey layout.

6) Security.

7) Housekeeping procedures.

8) Schedules and sequence of work.

9) Procedures for testing.

10) Procedures for maintaining record documents.

11) Special Site Requirements.

a) Archeological: Refer to Section 01 57 90 - Preservation of Historical and Archaeological Data.

b) Biological: Refer to Section 01 57 60 - Protected Species.

c) Environmental: Refer to:

i. Section 01 57 20 - Environmental Controls.

ii. Section 01 57 30 - Water Pollution Control.

12) Roles and responsibilities:

a) Government organization and personnel.

b) Contractor organization and personnel.

c) Subcontractors.

d) Proposed work schedule.

13) Contract requirements:

a) Progress payments.

b) Invoices.

c) Differing site conditions.

d) Changes.

e) Superintendence by Contractor.

f) Payment for mobilization and preparatory work.

g) Submittal procedures.

h) Emails, faxes, and telephone calls.

2. Preconstruction Safety Meeting:

a. Meet with COR prior to start of construction.

b. Review:

1) Safety requirements.

2) Monthly joint safety policy meetings.

3) Weekly toolbox safety meetings.

4) Safety program.

5) Job hazard analysis.

6) Required safety inspections.

7) Government will monitor Contractor's operations for compliance with RSHS.

3. Progress Meetings:

a. Meet weekly with Government to review:

1) Progress made.

2) Difficulties in performing work.

3) Resolution necessary to meet specifications requirements.

4) Status of contract documents (RFI's, submittals, etc.

5) Updating of progress reports.

6) Other items as determined by COR.

7) 3 week look ahead schedule review.

b. Develop meeting agenda and minutes.

B. SCADA Design Coordination Meetings.

END OF SECTION

SECTION 01 31 30
CONTRACT DOCUMENT MANAGEMENT SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Contract Document Management System:

1. Payment: Lump sum price offered in the Price Schedule.

1.02 DEFINITIONS

A. CDMS: Contract Document Management System.

1. Contract Documents include, but are not limited to:
   a. Specifications.
   b. Contract Drawings.
   c. Submittals.
   d. RFCs : Request for Change (Contractor generated document).
   e. RFIs: Request for Information (Contractor generated document).
   f. RFPs: Request for Proposal (Government generated document).
   g. CMs: Contract Modifications.
   h. Contractor Proposals.
   i. Value Engineering Proposals.
   j. Government Inspection Reports.
   k. Invoices and Progress Payments.
   l. Contract Schedules.
   m. Meeting Agendas and Meeting Minutes.
   n. Letters and Memos.

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

B. RSN 01 31 30-1, Approval Data:

1. System provider experience, number of systems operating, references.
2. Documentation of system capabilities.
3. Instructions for system use.

C. RSN 01 31 30-2, Final Data:

1. DVD or CD of documents uploaded to CDMS.

1.04 QUALIFICATIONS

A. System provider: At least 5 years successful performance in providing required services.

1.05 CDMS REQUIREMENTS

A. Capable of generating, storing, tracking, categorizing, and managing Contract Documents.

B. Access:

1. Web-based:

a. Contract Documents are stored and accessed by authorized individuals via an internet site.

b. Compatible with web browsers MS Internet Explorer, Apple Safari, Mozilla Firefox and Google Chrome.

2. Ability to upload Contract Documents and make available for user download in supported file formats, minimum:

a. Adobe Acrobat.

b. MS Word.

c. MS Excel.

d. MS Project.

e. Oracle Primavera P6 Project Manager.

f. Autodesk AutoCAD Civil 3D.

3. Allow Contract Documents to be prepared by Contractor or by Government.

a. Preparing organization will control access of documents. See Document Security and Backup paragraph below.

4. Contractor and Government shall each have a project manager for CDMS.

a. Each project manager shall have capabilities to assign users within their organization and to assign user rights which control access to documents based on user class and document type.

b. Each organization shall be capable of defining its access hierarchy.

c. Inclusion of users will be prerogative of organizational project manager.

d. Government shall be able to create and modify project properties (i.e. Contractor, project location, description, bid amount, project directory, etc).

5. Send email notifications automatically sent to selectable users when new documents are submitted and available for viewing, or alerts are generated. Examples:
    a. Updates to project information (e.g. entry of a new submittal);
    b. Changes to project information (e.g. approval of a submittal);
    c. Alerts (e.g. submittal under review for greater than 15 days without action).
6. Ability to link files; examples:
    a. RFP linked to a CM.
    b. Submittal linked to a Specification Section or Drawing.

C. Reports:

1. Generate reports that list and sort documents by status, examples include:
    a. Submittals that have been approved.
    b. Invoices paid to date.
    c. RFIs under review.
2. Generate alerts when documents requiring action approach or exceed allowable time.
3. Generate customizable summary reports, examples include:
    a. Submittal Turn-around.
    b. RFI Turn-Around.
    c. CM Processing Turn-Around.
    d. Total CM costs.
    e. Total CM Request Exposure.
4. Reports shall be printable, exportable as searchable pdf or printer friendly HTML, and exportable to Excel, XML, or CSV.
5. Ability to link from an item in a report directly to item by clicking on it.
    a. For example: in a submittal report, clicking on a submittal that is 15 days old takes you directly to information on that submittal.
6. Capable of producing a complete and logically organized set of documents within CDMS in both pdf and xml format.

D. Document Security and Backup:

1. SSL encryption for secured data exchange between browser and server (Secure access to documents and information).
2. Allow document access security until authoring party chooses to share it with others.

a. Show parties that have access to a document.

b. Extent of document sharing shall be determined by authoring party.

c. Once documents are shared, track documents so that changes cannot occur without a record of changes.

3. Backup/Archiving to FTP site of documents to which an organization has access on a regular (minimum monthly) basis.

a. Backups shall be in pdf format.

4. Documents downloadable to FTP sites where Government and other organizations can each access their own data confidentially.

E. General Tracking and Control:

1. Group documents into categories (Submittals, RFC, RFI, RFP, CM, Payments, Daily Inspection Reports, Meeting Minutes).

2. Track:

a. When documents were received or returned, as well as status of documents (e.g. Under Review; or Returned, Approved or Rejected, etc.).

b. Document changes including who entered or changed document and date change was made.

c. When a reviewer has opened an item.

F. Submittal Tracking and Control:

1. Ability to create master list of submittals ("Schedule of Submittals").

2. Supply standard submittal form for entering information. Allow customizing of standard submittal form. Contractor shall be able to enter submittal summary information (required submittal number, title, description, due date, and specification section shall be required fields) and then upload submittal data in electronic format.

3. Track date received, date response due, date returned, and approval status.

a. Status designations may be modified to fit Government standard designations - A/AAN/PAR/NA/ACK (Approved/Approved As Noted/Partially Approved - Resubmit/Not Approved/Acknowledged).

4. Supply Submittal Tracking form for Government to enter review comments and action taken. CDMS shall allow customizing of submittal tracking form.

a. Allow for Government to route submittal to third parties by generating design-review transmittals with each submittal package item, to track status of individual sub-items within submittal package, and to route each sub-item to appropriate reviewers.

5. Ability to generate automatic notification after specified days without response.

G. RFI Tracking and Control:

1. Supply standard RFI form to enter information.
2. Ability to create or attach documents to the RFI form or links to other documents within CDMS.
3. Ability for Government to route RFI to appropriate reviewers and for reviewers to enter comments into standard response form.

H. Inspection Reports Tracking and Control:

1. Ability to attach Government standard inspection and report forms into CDMS and ability to create customizable inspection forms in CDMS. Typical forms:
   a. Daily Inspection Report (DIR).
   b. Survey requests.
   c. Plant inspection reports.
   d. Testing reports.
2. Ability to link or attach photos to forms and link forms to other documents within CDMS.

I. Contract Modifications:

1. Supply standard Contractor Proposal form with ability to attach documents and link to other documents within CDMS.
2. Supply ability to upload Government's standard CM form and RFP forms, or create an acceptable alternative, to enter information.
3. Ability to attach documents to these forms, and link to other documents within CDMS.
4. Ability for Contractor to respond to RFP and CM form with Cost & Time impacts.
5. Ability to track date CM issued and date responded, with automatic notification after specified days without response.

J. Cost Tracking and Payment Request Management:

1. Ability to import payment bid items cost from a MS Excel spreadsheet.
2. Ability to edit percent complete and payment amount each month. Format to be spreadsheet, e.g. items available for editing at once, rather than needing to edit one item at a time, save, open next item and edit that, etc.

K. Correspondence:

1. Ability to generate letters and memos.
   a. Ability to attach documents to letters and memos, and to reference other documents within CDMS.

b. CDMS shall ability automatically assign sequential numbers to letters and memos.

2. Ability to generate responses to letters and memos.

a. System automatically generates memo suffixes, e.g. 1st response to Memo 32 to be 32.1, 2nd response to be 32.2, etc.

3. Official correspondence from Government to Contractor shall contain Government's official letterhead and corresponding logos.

4. Ability to generate meeting agendas and meeting minutes and to attach documents to minutes.

a. CDMS shall automatically assign sequential meeting numbers.

L. Miscellaneous Tracking and Controls. Ability to:

1. Generate reports tracking RFCs, RFIs, RFPs, CMs, Submittals, Payments, Memos, DIR's, survey requests, plant inspection reports and testing reports.

2. Filter logs based on criteria:

a. Submittals: Specification Section, Days Out, Status (A/AAN/R&R/ ACK/RWR).

b. RFI's: Days out, Status (Open/Closed), Specification Section/Dwg No., Responsibility/Ball-In-Court.

3. Sort Logs based on a criteria, e.g. for Submittal, Specification Section, Days Out, Status, or other criteria determined by the COR.

4. Supply forms to match Government's CM Form and Progress Payment Form or other forms when needed.

5. Track Cost Exposure with links to RFI and CM requests.

6. Measure productivity benchmarks on a project such as computing average review days for RFIs and submittals, categorize CMs, and track total CM percentages by category.

7. Keyword search of documents in database.

8. Allow online Payment Requests by Contractor.

M. Budget and Funding Source Tracking:

1. Ability to enter funding sources and assign contract line items to multiple funding sources.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 IMPLEMENTATION

A. Have CDMS in place and operating before Contractor transmits Contract Documents to Government, except RSN 01 31 30-1, Approval Data.

1. CDMS operation includes COR, or other authorized Government representative, having program control to assign users and user rights to Government personnel to access appropriate areas of system.

B. Input Schedule of Submittals before making submittals. Include:

1. RSNs listed in Table 01 33 00A - List of Submittals.
2. Scheduled submittal date.

C. Provide a report of submittal status monthly or as requested by COR. Submittal status report shall be in a table format and include:

1. Required Submittal Number (RSN).
2. Section Title.
3. Submittal Title.
4. Date Submitted.
5. Date of Response.
6. Approval Status (Approved-Complete, Approved as Noted - Resubmit, Received, Not Approved).
7. Days in Review.
8. Due Date.

D. Keep CDMS operational until final project closeout.

END OF SECTION

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SECTION 01 32 10
CONSTRUCTION PROGRAM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Costs:

1. Developing Baseline Schedule: Include in the price offered in the Price Schedule for Mobilization and Preparatory Work.
2. Updating and Using Construction Program: Include as part of Contractor's overhead.

1.02 DEFINITIONS

A. Schedule: The Critical Path Method (CPM) of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the project.

B. Project Calendar(s): Cross reference of numerical work days with calendar days. Project calendars serve as the basis for day/date conversion and assign work days and non-workdays.

C. Resources: Equipment, labor or crews, materials, subcontractors, fabricators, manufacturers, and consultants.

D. Out of Sequence Work: An activity that starts before its predecessor activities are completed.

1.03 REFERENCE STANDARDS

A. Associated General Contractors of America (AGC)

1.	AGC Manual-04	Construction Planning and Scheduling Manual

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

1. Furnish database files in format compatible with Oracle Primavera P6 Professional Project Management.
2. Furnish schedule and analysis data on DVD or USB drive.

3. Upon request, provide information and data used to develop and maintain the Construction Program to the CO.

B. RSN 01 32 10-1, Representative Information:

1. Designation of authorized representative to develop and maintain Construction Program. Include resume with training and experience.

C. RSN 01 32 10-2, Baseline Schedule:

1. Construction Program/Schedule database.
2. Definition of project calendars.
3. Primavera layout file (.plf).
4. Gantt chart (Bar chart) for project on 11 by 17 inch print(s) and in portable document format (.pdf).
5. Activity report including logic constraints consisting of predecessors, successors, and constraint dates.
6. Tabular listings of resources and resource limitations used to produce baseline schedule. Correlate resources with schedule assumptions and offered price. Resource listings may be independent of schedule database.
7. Narrative explanation of project schedule development. Include impacts of resource limitations and weather conditions on project schedule development. Include planned number of work hours per day and hours per day for subcontractors.

D. RSN 01 32 10-3, Updated Schedule Reports:

1. Construction Program database with updated activity and milestone data.
2. Definition of project calendars if revised from baseline calendars.
3. Primavera layout file (.plf).
4. Gantt chart for project on 11 by 17 inch print(s) and in portable document format (.pdf).
5. Narrative report specifically stating status of project.
   a. When negative float exists, cite specific actions and conditions which caused "behind schedule" condition and provide proposed course of action to complete the project within the specified delivery time. When float changed from previous month’s updated schedule, explain reason for change.
   b. List of Contractor-initiated changes to current schedule stating reason for action taken and unresolved issues relating to the Construction Program. Government reserves the right to reject Contractor-initiated changes to

current schedule which negatively impact Government action which was initiated on the basis of current schedule.

c. Discuss contract milestones and significant activities that were started, continued, or completed during the update period or scheduled during the next update period.

6. Submittal Register:

a. List submittals as listed in Table 01 33 00A.

b. Update Submittal Register monthly to include submittals and revised submittals. Register fields shall include RSN name and number, date submitted, date of response, status (e.g., approved, not approved, resubmittal required).

c. This register document is separate from scheduling database.

E. RSN 01 32 10-4, Time Impact Analysis:

1. Construction Program database with proposed revised activity and milestone data.

2. Proposed revised schedule due to change or delay. Highlight or list added, changed, or deleted activities.

3. Primavera layout file (.plf).

4. Gantt chart for project on 11 by 17 inch print(s) and in portable document format (.pdf).

5. Narrative report explaining results and conclusions.

1.05 QUALIFICATIONS

A. Representative: Experienced in developing and maintaining construction schedules and knowledgeable of activities and progress on-site to develop and maintain accurate and reliable schedules.

1.06 GENERAL

A. Develop, maintain, and use Construction Program to plan, monitor, evaluate, and report accomplishment of work.

1.07 SCHEDULES

A. Prepare construction schedules using Critical Path Method outlined in AGC Manual. Use a computer software program to perform mathematical analysis of scheduling data.

1. Prepare schedule based on required sequence and interdependence of activities. Logically sequence activities.

2. Prepare detailed activity network for accomplishing required work organized by Work Breakdown Structure (WBS). Utilize WBS in lieu of activity codes for

organization of schedule. If activity codes are utilized in addition to WBS, use unique activity code names assigned as project codes rather than global codes.

3. Activities except "Award" shall have predecessor activities and activities except "Contract Complete" shall have successor activities.

4. Meet contract requirements; milestone(s) in accordance with the clause at FAR 52.211-10, Commencement, Prosecution, and Completion of Work; and relevant clauses and specification sections. Include interim milestone dates, Government interface dates, contract completion date, and other time or seasonal constraints specified in contract documents.

5. Include work of subcontractors, Government interfaces, and contract milestones.

6. Adjust Construction Program/schedule for seasonal weather conditions. Provide a narrative explaining the expected weather and plan for incorporation in schedule. Consider work influenced by high or low ambient temperatures or precipitation. Utilize Primavera P6 calendars to depict historical weather days that impact work. Assign weather calendars to work impacted by weather.

7. Define activities to level of detail resulting in their durations being no greater than 20 workdays.

    a. Durations for administrative activities (e.g., submittals and reviews) fabrication, manufacturing, and typical level of effort activities (e.g., dewatering, storm water management) will not be subject to workday duration limitation.

8. Include separate activities for submittal preparation and submittal reviews when submittal addresses work that involves significant quantities, long lead times, is on the critical path or near critical path, or as requested by the COR. Assign Government submittal review activities to a seven-day calendar with durations as specified in Section 01 33 00 - Submittals. Include Required Submittal Number (RSN) in activity description.

9. Include separate activities for fabrication or manufacturing when work involves significant quantities, long lead times, is on the critical path or near critical path, or as requested by the COR.

10. Include contract title, contract number, and Contractor's name on transmittal cover sheet and each sheet of Gantt chart.

11. For each activity on Gantt chart, display activity identification number, activity description, planned or original duration, start date, finish date, total float, and calendar identification. Do not display early start and late start fields.

12. Include table of abbreviations used in the schedule, listed and defined alphabetically.

13. Use finish to start logic relationships between activities. Do not utilize start to start, finish to finish, or start to finish logic relationships. Do not use negative lead or lag times.

14. Use durations in units of whole workdays.

15. Provide best estimate of time required to complete activity considering quantity of work, work conditions, location of work, and planned resources for activity.

16. Equate durations of Government reviews and other identified actions to maximum number of calendar days specified in their respective paragraphs.

17. Establish workday calendar(s) and use these in the schedule to translate activity's workday duration into calendar dates. Use unique calendar names; do not use software default calendar names. Save calendars as project calendars, not global calendars.

B. Baseline Schedule:

1. Represents Contractor's as-planned approach to accomplishing the work. Do not include actual start dates, percent completes, or actual finish dates.

C. Updated Schedule:

1. Meet monthly with COR at Government's project office, or at a location approved by the COR, to review progress made to end date of progress payment period. Establish dates that activities were started and completed and remaining duration for each activity started but not completed during the period.

a. Discuss and mutually agree upon changes to the schedule.

b. Out-of-sequence activities are not allowed. Revise logic to reflect change in work plan.

c. Finalize updated Construction Program database with mutually agreed upon changes.

2. Following receipt of executed contract modification, incorporate activity data stipulated in modification into current schedule for inclusion in next scheduled progress update. Provide appropriate logic relationships for revised activities.

3. Assign a unique project file name for each schedule update.

1.08 TIME IMPACT ANALYSIS

A. Provide time impact analysis for contract changes (e.g., change order, proposed modification, or value engineering change proposal) to support a claim or request for equitable adjustment to the contract due to delay or accelerated schedule.

B. The CO may use time impact analysis to determine if time extension or reduction to contract milestone dates is justified.

1. Time impact analysis is required for contract changes whether the Contractor's current schedule milestone dates are the same as, earlier than, or later than, those required under the contract.

2. Changes, additions, or deletions to activities; activity durations; activity time frames; or activity predecessors and successors will not automatically determine that extension or reduction of contract time is warranted or due the Contractor.

3. Time extensions for performance will be considered only to the extent that the Contractor's current scheduled milestone dates exceed contract milestone dates.

C. Float is not for exclusive use by or benefit of either the Government or the Contractor.

D. Perform time impact analyses using data in most recent approved schedule update prior to change or delay event.

1. Prepare proposed revised schedule and narrative description describing and highlighting changes or delays.

2. Prepare summary comparing results of two schedule analyses: One using current schedule data from last approved updated schedule prior to event requiring analysis, and one using proposed schedule data incorporating changes or delays.

a. Show contract milestones and activities whose periods of performance have shifted as result of change which affects production and/or manufacture schedules, material orders, construction seasons, and labor and/or equipment utilization.

b. For activities directly affected by change or delay, include the current and proposed items:

1) Activity description.

2) Types and quantities of major pieces of equipment, principal manpower, and pacing materials (materials that affect activity start, duration, or finish).

3) Activity duration.

4) Narrative containing rationale used in developing the proposed logic relationships and activity data.

c. Data date for impacted schedule used in comparison shall be the same as approved updated schedule data date.

d. Base schedule comparisons on status of work and available float at time the CO directs or proposes change to the work, the Contractor submits a value engineering change proposal, or when a delay occurs as shown in approved updated schedule.

1.09 REVIEW AND EVALUATION

A. Baseline Schedule:

1. Within 21 calendar days after receipt of baseline schedule:

a. CO will approve or not approve proposed baseline schedule.

b. Upon request from the CO, meet with COR for a joint review of proposed baseline schedule.

c. If schedule is not approved, revise and resubmit within 7 calendar days following date of rejection letter.

2. Do not proceed with onsite work, except mobilization and surveying, until baseline schedule has been approved by the Government.

B. Updated schedules:

1. Government will require 14 calendar days after receipt of each monthly updated schedule to review and approve or not approve updated schedule.

2. Submit updated schedule at least 7 days prior to the submission of each invoice request for progress payment.

3. If updated schedule is not approved, revise and resubmit updated schedule within 7 calendar days following date of rejection letter.

C. Failure to include elements of the work in schedules will not release Contractor from completing required work under the contract.

D. Performance will be evaluated by the Government using approved CPM schedules.

1.10 FAILURE TO COMPLY

A. Failure to comply with requirements of this Section shall be grounds for determination by the CO that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within specified time.

B. The CO may terminate the Contractor's right to proceed with the work, or separable part of it, in accordance with default terms of this contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 33 00
SUBMITTALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME Y14.1-12	Decimal-inch Drawing Sheet Size and Format

B. National Institute of Building Sciences (NIBS)

1.	NIBS NCS-14	United States National CAD Standards, Version 6

1.03 DEFINITIONS

A. Days: Calendar days.

B. Required Submittal Number (RSN): Identifies items to be submitted together as a complete submittal.

C. Submittal Types, as listed in Table 01 33 00A - List of Submittals:

1. A - Action:
    a. Government will respond as to adequacy of submittal.
    b. Action Submittals: Considered “shop drawings” within the terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction.
2. I - Informational:
    a. Government will acknowledge receipt of Informational submittals.
    b. Government may reject an Informational submittal when the submittal does not satisfy contract requirements. Correct mistakes or deficiencies in rejected Informational submittals and resubmit.
    c. Informational Submittals: Considered “shop drawings” within terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction, except that approval by Government is not required.

1.04 SUBMITTAL REQUIREMENTS

A. In case of conflict between requirements of this section and requirements included elsewhere in these specifications, requirements included elsewhere take precedence.

B. General:

1. Prepare in English.
2. Label with contract number and title, and RSN.
3. Measurement Units: US Customary Units.
4. Electronic Documents:
    a. Searchable .pdf.
    b. Includes submittals which are not drawings or photographs.

C. Drawings:

1. Minimum Identification in Title Block:
    a. Contract number and title.
    b. Contractor's or supplier's title and drawing number.
    c. Date.
2. Reserve 3 by 3 inch space next to title block for review stamps.
3. Size: D size (22 inches by 34 inches) as defined by ASME Y14.1.
4. Draw to scale using computer drafting or drafting equipment, unless otherwise specified.
    a. Computer drafted drawings:
        1) In accordance with NIBS NCS.
        2) Electronic file format: Compatible with AUTOCAD, Version 2015 or later.
        3) Compile using "eTransmit" utility in AUTOCAD.
    b. Drawing prepared with drafting equipment, when allowed: Lettering shall be neat.
5. Drawings Designated as "Government Format" in Specifications:
    a. Computer drafted.
    b. Government will provide an electronic AutoCAD format template.
    c. Title block and sheet format:
        1) As shown on standard drawing 40-D-7102.
        2) Government will provide template.

3) Government will provide specific title block information to be used.

6. Final Drawings:

a. Computer drafted.

b. Government will provide an electronic AutoCAD format template.

c. Show as-built changes, including revision dates, made during installation. Indicate changes by clouding.

7. Electronic Files:

a. On CD or DVD discs.

D. Product Data:

1. Mark manufacturer's data for commercial products or equipment, such as catalog cut sheets.

a. Identify manufacturer's name, type, model, size, and characteristics.

b. Illustrate that product or equipment meets requirements of specifications.

c. Mark items to be furnished in a manner that will photocopy (no highlighter).

d. Strike through items that do not apply.

E. Certifications:

1. Certifications by a Registered Professional: Signed and sealed by registered professional.

2. Manufacturer’s Certifications: Signed by authorized representative of manufacturer.

F. Manuals:

1. Copies:

a. Printed copies: Bound and indexed.

b. Electronic copies: Searchable Adobe pdf on CD or DVD discs.

1) Bookmark longer files to assist in navigating file.

2) Electronic files may be submitted as separate parts of a manual. After each separate electronic file is approved, compile each approved electronic file to assemble an entire manual which shall be consistent with a single final manual submittal.

2. Contents:

a. Parts identification lists, lists of special tools, and accessories.

b. Schematics and wiring diagrams.

c. Detailed instructions for installing, operating, lubricating, and maintaining equipment.

d. As-built drawings, photographs, and test records or reports if required by the specifications.

G. Photographs:

1. Include negatives or digital files on CD or DVD in .jpeg or similar format.

H. Samples and Color Selection Submittals:

1. Label with complete manufacturer's product and color identification.

2. Include type and quantity of materials specified in the referenced section in each "set" of samples.

3. Samples: Representative of product to be installed. Xerographic sheets for color selection are not acceptable.

4. Color Chips: Sample paint chips. Ink color reproductions are not acceptable.

5. Label each sample, sample kit, set of color chips, or color chart with contract number and title.

6. Government will select architectural color and pattern after product approval.

1.05 SUBMITTALS PROCEDURES

A. Submit only checked submittals. Submittals without evidence of Contractor's approval will be returned for resubmission.

B. Submit complete sets of required materials for each RSN as specified in "Submittals Required" column in Table 01 33 00A - List of Submittals. A complete set includes listed items for RSNs with multiple parts.

C. Submit sets specified in "Sets to be sent:" columns in Table 01 33 00A - List of Submittals.

1. Submittals identified with "CDMS" in the "Sets to be sent" column shall be submitted electronically in accordance with Section 01 31 30 - Contract Document Management System.

D. Include the following information in transmittal letters:

1. Contract number and title.

2. RSN for each attached submittal.

3. Responsible code.

4. Number of sets for each RSN.

5. Identify submittal as initial or resubmittal.

E. Resubmittal of submittals not approved:

1. Mark changes such that they are readily identifiable and show revision date.
2. Describe reasons for significant changes in transmittal letter.
3. Resubmit returned submittals within 28 days after receiving the comments, unless otherwise directed.
4. Requirements for initial submittals apply to resubmittals.

1.06 REVIEW OF SUBMITTALS

A. Time Required:

1. Submittal review will require 21 days for review of each submittal or resubmittal, unless otherwise specified.
2. Time required for review of each submittal or resubmittal begins when complete sets of materials required for a particular RSN are received and extends through return mailing postmark date.

B. Time in Excess of Specified:

1. CO may extend contract completion date to allow additional time for completing work affected by excess review time.
   a. Time extension will be to extent that excess review time caused delay to contract completion date.
   b. Time extension will not exceed time used in excess of specified number of days for review of submittals or resubmittals.
   c. Concurrent days of excess review time resulting from review of 2 or more separate submittals or resubmittals will be counted only once in extending contract completion date.
2. No time extension will be allowed if Contractor fails to make complete action submittals in sequence and within time periods specified.
3. Adjustment for delay will be made only to the extent that:
   a. Approval was required under the contract, and.
   b. Requests for approval were properly and timely submitted and were approved.
4. Adjustment will be subject to terms of paragraphs (b) and (c) of clause at FAR 52.242-14, Suspension of Work; however, no such delay shall be deemed to be a “suspension order” as term is used in that clause.

C. Return of Submittals:

1. Return of submittals will be by CDMS response or hard copy, as applicable.
2. Action Submittals: 1 set of submittals required for action will be returned either approved, approved with comments or not approved.

a. Revise and resubmit submittals not approved.

b. Do not change designs without approval of CO after drawings, documentation, and technical data have been approved.

3. Informational Submittals: Government will acknowledge Informational submittals.

a. Informational submittals will not be returned when they satisfy contract requirements.

b. Informational submittals that do not satisfy contract requirements may be returned for resubmittal or additional information may be requested.

1.07 HARD COPY TRANSMITTALS

A. Addresses for codes listed in Table 01 33 00A - List of Submittals:

1. Contracting Officer, Bureau of Reclamation, Attn UC-840, 125 South State St, Room 6107, Salt Lake City, UT 84138-1147.

2. Construction Engineer, Bureau of Reclamation, 1235 La Plata Hwy, Farmington, New Mexico, 87401.

3. Technical Service Center, Bureau of Reclamation, Attn: 86-68510, P.O. Box 25007, Denver CO 80225-0007; Express Mail: Sixth and Kipling, Building 67, Room 152.

B. Send original transmittal letter with appropriate number of sets to office listed in "Responsible Code" column in Table 01 33 00A - List of Submittals.

1. Responsible codes starting with "86-6" are located in Technical Service Center. Send these submittals to the TSC address shown above.

C. Send copy of transmittal letter with appropriate number of sets to offices that are not responsible code, but show "Sets to be sent" in Table 01 33 00A - List of Submittals.

D. When "Sets to be sent" is 0, send a copy of transmittal letter to that office.

E. Submittals required by specifications, but not listed in Table 01 33 00A - List of Submittals:

1. Submit in accordance with this section.

2. Submit to CE unless otherwise specified.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 01 33 00A. - List of Submittals

* Submittal Types: A - Action, I - Information
** CO indicates Contracting Officer, CE indicates Construction Engineer, and TSC indicates Technical Service Center. CDMS indicates Contract Document Management System.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
01 14 10-1	Use of Site	Land Use and Landscape Rehabilitation Plan	At least 28 days before use of Government land	A	CE	CDMS		
01 31 19-1	Project Management and Coordination	Written Summary	Monthly once on-site construction begins	A	CE	CDMS		
01 31 19-2	Project Management and Coordination	Off Easement Land Use Coordination	At least 4 months prior to use of land	A	CE	CDMS		
01 31 30-1	Contract Document Management System	Approval Data	Within 7 days of Award	A	CE	0	1	0
01 31 30-2	Contract Document Management System	Final Data	Within 14 days of completion of work	I	CE	0	2	2
01 32 10-1	Construction Program	Representative Information	Within 7 days after receipt of Notice of Award	I	CE	CDMS		
01 32 10-2	Construction Program	Baseline Schedule	Within 21 days after receipt of Notice to Proceed	A	CE	0	5	3
01 32 10-3	Construction Program	Updated Schedule Reports	With monthly requests for progress payments.	A	CE	CDMS		
01 32 10-4	Construction Program	Time Impact Analysis	Within 28 days after CO directs a contract change, with any proposal for a future modification, with any value engineering proposal, or with any request or claim for an equitable adjustment to the contract	A	CE	CDMS		
01 35 10-1	Safety Data Sheets	Complete LHM and SDS	At least 14 days before jobsite delivery of hazardous material	I	CE	CDMS		
01 35 10-2	Safety Data Sheets	Updated LHM and SDS	At least 14 days before jobsite delivery of hazardous material not previously listed	I	CE	CDMS		

Table 01 33 00A. - List of Submittals

* Submittal Types: A - Action, I - Information
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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
01 35 20-1	Safety and Health	Emergency Action Plans Written Program and Training Records	At least 21 days before beginning onsite work	A	CE	CDMS		
01 35 20-2	Safety and Health	Job Hazard Analyses (JHA)	At least 28 days before beginning onsite work	A	CE	CDMS		
01 35 20-3	Safety and Health	Exposer Assessment Form	At least 28 days before beginning onsite work	A	CE	CDMS		
01 35 20-4	Safety and Health	Monthly Accident Summary Report	First day of each month. See paragraph 3.8 of RSHS.	A	CE	CDMS		
01 35 20-5	Safety and Health	Respirator User Documentation	At least 30 days before beginning onsite work	A	CE	CDMS		
01 35 20-6	Safety and Health	Crane Training Certificates	At least 28 days before beginning onsite work	A	CE	CDMS		
01 35 20-7	Safety and Health	Other Training Certificates, as applicable	At least 28 days before beginning onsite work	A	CE	CDMS		
01 35 22-1	First-Aid	Medical Facilities Plan	Submitted and approved before start of operations	A	CO	CDMS		
01 35 30-1	Contractor‘s Onsite Safety Personnel	Resume	At least 14 days before beginning on-site construction	I	CE	CDMS		
01 35 30-2	Contractor’s Onsite Safety Personnel	Safety Inspection Reports	Once each week	I	CE	CDMS		
01 46 20-1	Testing Agency Services	Testing Agency Services Plan	At least 28 days before testing is required	A	CE	CDMS		
01 55 00-1	Vehicular Access and Parking	Initial Digital Recording	At least 21 days before beginning on-site work	A	CE	0	1	0
01 55 00-2	Vehicular Access and Parking	Post Construction Digital Recording	At least 21 days before leaving site.	A	CE	0	1	0
01 55 00-3	Vehicular Access and Parking	Post Repair Digital Recording	Within 14 days of making repairs.	A	CE	0	1	0
01 55 20-1	Traffic Control	Traffic Control Plan	At least 60 days before affecting public traffic.	A	CE	CDMS		

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
01 55 20-2	Traffic Control	Permit Applications	At least 60 days before affecting public traffic	A	CE	CDMS		
01 55 20-3	Traffic Control	Permits	At least 14 days before affecting public traffic	I	CE	CDMS		
01 56 10-1	Protection of Existing Installations	Plan for Protecting Existing Installations	At least 28 days before start of onsite construction work	A	CE	CDMS		
01 56 15-1	Protection of Existing Utilities	Utility Owner Acknowledgment	At least 28 days before start of onsite construction work	A	CE	CDMS		
01 56 15-2	Protection of Existing Utilities	Utility Investigation	At least 7 days after completing investigation	I	CE	CDMS		
01 57 20-1	Environmental Controls	Copy of Applicable Air Quality Permit	At least 14 days before beginning on-site work	I	CE	CDMS		
01 57 30-1	Water Pollution Control	Updated Stormwater Pollution Prevention Plan (SWPPP)	At least 28 days before commencing construction activities	A	CE	CDMS		
01 57 30-2	Water Pollution Control	Spill Prevention Control and Countermeasure (SPCC) Plan	At least 28 days before delivery or storage of oil	A	CE	CDMS		
01 57 50-1	Tree and Plant Protection	Protection Plan	At least 28 days before commencing on site construction work	A	CE	CDMS		
01 57 90-1	Preservation of Historical and Archeological Data	Alternate Use Area or Borrow Area	At least 28 days before commencing on site construction work	A	CE	CDMS		
01 71 20-1	Surveying	Surveying Plan	At least 28 days before beginning survey work	A	CE	CDMS		
01 71 20-2	Surveying	Resume	At least 28 days before beginning survey work; At least 28 days before personnel change	I	CE	CDMS		
01 71 20-3	Surveying	Accuracy Check Results	At least 28 days before beginning work	I	CE	CDMS		
01 71 20-4	Surveying	Completed and Reduced Survey Notes	Within 2 days of completing and reducing notes	I	CE	CDMS		
01 71 20-5	Surveying	Original Field Survey Books	Weekly	I	CE	CDMS		

Table 01 33 00A. - List of Submittals

* Submittal Types: A - Action, I - Information
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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
01 71 20-6	Surveying	Quantity Survey Notes and Computations	Accompanying progress payment requests	I	CE	CDMS		
01 71 20-7	Surveying	Workday's Survey Notes	At conclusion of workday if requested by Government	I	CE	CDMS		
01 74 00-1	Cleaning and Waste Management	Waste Production and Disposal Plan	At least 28 days before starting onsite work	I	CE	CDMS		
01 74 00-2	Cleaning and Waste Management	Waste Production and Disposal Records	Within 7 days of waste disposal	I	CE	CDMS		
01 74 00-3	Cleaning and Waste Management	Environmental Consultant Resume	At least 28 days before beginning environmental assessment	I	CE	CDMS		
01 74 00-4	Cleaning and Waste Management	Environmental Site Assessment	Within 14 days of completion of work	I	CE	CDMS		
01 78 30-1	Project Record Documents	Progress As-built Drawings	Within 14 days of completion of structures or every 14 days whichever is fewer.	I	CE	0	1	1
						CDMS		
01 78 30-1	Project Record Documents	Final As-built Drawings	Within 14 days of completion of work	I	CE	0	1	1
						CDMS		
03 20 00-1	Concrete Reinforcing	Reinforcement Diagrams and Lists	At least 42 days before placing concrete	A	86-68530	CDMS		
03 30 00-1	Cast-In-Place Concrete	Approval Data	At least 42 days before placing concrete	A	86-68530	CDMS		
03 30 00-2	Cast-In-Place Concrete	Certifications	At least 42 days before placing concrete	A	86-68530	CDMS		
03 30 00-3	Cast-In-Place Concrete	Cementitious Materials Certification and Test Reports	At least 42 days before placing concrete	A	86-68530	CDMS		
03 30 00-4	Cast-In-Place Concrete	Test Reports	At least 42 days before placing concrete	A	86-68530	CDMS		
03 48 00-1	Precast Concrete Structures	Product Drawings and Data	At least 42 days before casting first structure	A	86-68120	CDMS		

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
03 48 00-2	Precast Concrete Structures	Mix Design	At least 42 days before casting first structure	I	86-68530	CDMS		
03 48 00-3	Precast Concrete Structures	Curing, Handling and Storage Requirements	At least 42 days before casting first structure	A	86-68530	CDMS		
03 63 00-1	Epoxy Grout	Approval Data	At least 42 days before placing grout	A	86-68530	CDMS		
04 22 10-1	Reinforced Concrete Unit Masonry Assemblies	Approval Data	At least 42 days before beginning construction with concrete masonry units	A	86-68120	CDMS		
04 22 10-2	Reinforced Concrete Unit Masonry Assemblies	Sample Kit	At least 42 days before beginning construction with concrete masonry units	A	86-68120	0	0	1
04 22 10-3	Reinforced Concrete Unit Masonry Assemblies	Certifications	At least 42 days before beginning construction with concrete masonry units	A	86-68120	CDMS		
04 22 10-4	Reinforced Concrete Unit Masonry Assemblies	Mix Design	At least 42 days before beginning construction with concrete masonry units	A	86-68120	CDMS		
04 22 10-5	Reinforced Concrete Unit Masonry Assemblies	Instructions	At least 42 days before beginning construction with concrete masonry units	A	86-68120	CDMS		
05 21 00-1	Steel Joists	Approval Drawings, Data, and Certification	At least 42 days before fabricating joists	A	86-68120	CDMS		
05 21 00-2	Steel Joists	Welder Qualifications	At least 42 days before fabricating joists	A	86-68120	CDMS		
05 21 00-3	Steel Joists	Inspection Reports	Within 30 days of completing inspection	A	86-68120	CDMS		
05 30 00-1	Metal Roof Deck	Approval Drawings and Data	At least 42 days before installing roof deck	A	86-68120	CDMS		
05 30 00-2	Metal Roof Deck	Welder Qualifications	At least 42 days before installing roof deck	A	86-68120	CDMS		

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
07 41 13-1	Preinsulated Metal Roof Panels	Sample and Color Sample Kit	At least 42 days before installing panels	A	86-68120	0	0	1
07 41 13-2	Preinsulated Metal Roof Panels	Product Data and Shop Drawings	At least 42 days before installing panels	A	86-68120	CDMS		
07 41 13-3	Preinsulated Metal Roof Panels	Closeout Maintenance Data	Within 14 days of installing panels	A	86-68120	CDMS		
07 42 13-1	Preinsulated Metal Wall Panels	Sample and Color Sample Kit	At least 42 days before installing panels	A	86-68120	0	0	1
07 42 13-2	Preinsulated Metal Wall Panels	Product Data and Shop Drawings	At least 42 days before installing panels	A	86-68120	CDMS		
07 42 13-3	Preinsulated Metal Wall Panels	Closeout Maintenance Data	Within 14 days of installing panels	A	86-68120	CDMS		
08 34 53-1	Security Doors and Frames	Approval Drawings and Data	At least 42 days before installing doors	A	86-68120	CDMS		
08 34 53-2	Security Doors and Frames	Instructions	At least 42 days before installing doors	A	86-68120	CDMS		
08 71 00-1	Door Hardware	Approval Data	At least 42 days before installing hardware	A	86-68120	CDMS		
08 71 00-2	Door Hardware	Instructions	At least 42 days before installing hardware	A	86-68120	CDMS		
09 65 10-1	Rubber Wall Base	Approval Data and Color Sample Kit	At least 42 days before installing wall base	A	86-68120	CDMS		
09 65 10-2	Rubber Wall Base	Instructions	At least 42 days before installing wall base	A	86-68120	CDMS		
09 96 20-1	Coatings	Approval Data	At least 42 days before beginning coating work	A	86-68540	CDMS		
09 96 20-2	Coatings	Final Approval Data	At least 42 days before beginning coating work	A	86-68540	CDMS		
09 96 20-3	Coatings	Contractor Testing Data for “Shop or Field Applied” Coatings	At least 42 days before beginning coating work	A	86-68540	CDMS		
10 14 26-1	Utility Markers	Utility Marker Plan	At least 42 days before start of construction activities	A	CE	CDMS		

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
22 11 35-1	Pre-Manufactured Pump Station	Pre-construction Data and Drawings	At least 42 days before fabrication or procurement	A	86-68410	CDMS		
22 11 35-2	Pre-Manufactured Pump Station	Manufacturer Post Production Testing Results	At least 42 days before fabrication or procurement	A	86-68410	CDMS		
22 11 35-3	Pre-Manufactured Pump Station	Manufacturer On-site Testing Results and Final Documents	At least 42 days before fabrication or procurement	A	86-68420	0	1	1
						CDMS		
22 13 16-1	Foundation and Building Drainage Piping	Approval Data	Within 42 days after Notice to proceed	A	86-68410	CDMS		
23 05 93-1	Testing, Adjusting, and Balancing for HVAC Equipment	Approval Data	Within 42 days after Notice to proceed	A	86-68410	CDMS		
23 05 93-2	Testing, Adjusting, and Balancing for HVAC Equipment	Certified Testing Adjusting and Balance Reports	Within 14 days of final testing	A	86-68410	CDMS		
23 33 10-1	Duct Accessories	HVAC Accessories Approval Data	Within 42 days after Notice to proceed	A	86-68410	CDMS		
23 33 10-2	Duct Accessories	HVAC Accessories Final Data	Within 14 days of final testing	A	86-68410	CDMS		
23 34 00-1	HVAC Fans	Approval Data	Within 42 days after Notice to proceed	A	86-68410	CDMS		
23 34 00-2	HVAC Fans	Final Data	Within 14 days of final testing	A	86-68410	CDMS		
23 82 39-1	Unit Heaters	Approval Data	Within 42 days after Notice to proceed	A	86-68410	CDMS		
23 82 39-2	Unit Heaters	Final Data	Within 14 days of final testing	A	86-68410	CDMS		

Table 01 33 00A. - List of Submittals

* Submittal Types: A - Action, I - Information
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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	Sets to be sent: **		
						CO	CE	TSC
25 00 01-1	Control and Monitoring	Approval Data - Monitoring and Control Systems Technical Specialist Work Summary	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 01-2	Control and Monitoring	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 01-3	Control and Monitoring	Approval Data - Software Development Documentation	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 01-4	Control and Monitoring	Check Prints	At same time as equipment is shipped to the site	A	86-68450	CDMS		
25 00 01-5	Control and Monitoring	Approval Data - Final Drawings, Documentation, and Operations and Maintenance Manuals	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 02-1	Programmable Controller	Approval Drawings	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 02-2	Programmable Controller	Approval Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
25 00 02-3	Programmable Controller	Final Drawings, Documentation, and Operations and Maintenance Manuals	Within 28 days after installation	I	86-68450	CDMS		
25 08 10-1	Automation System Testing, Acceptance, and Training	FAT Procedure and Start Date	At least 42 days before beginning test	A	86-68450	CDMS		
25 08 10-2	Automation System Testing, Acceptance, and Training	FAT Test Report	Not more than 28 days after test	I	86-68450	CDMS		
25 08 10-3	Automation System Testing, Acceptance, and Training	SPAT Procedure and Start Date	At least 42 days before beginning test	A	86-68450	CDMS		

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						CO	CE	TSC
25 08 10-4	Automation System Testing, Acceptance, and Training	SPAT Test Report	Not more than 28 days after test	I	86-68450	CDMS		
25 08 10-5	Automation System Testing, Acceptance, and Training	OAT Procedure and Start Date	At least 42 days before beginning test	A	86-68450	CDMS		
25 08 10-6	Automation System Testing, Acceptance, and Training	OAT Report	Not more than 28 days after test	I	86-68450	CDMS		
25 08 10-7	Automation System Testing, Acceptance, and Training	Training Plan	No less than 42 days before first commissioning is scheduled to begin	I	86-68450	CDMS		
26 05 10-1	Conductors and Cables	Approval Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
26 05 10-2	Conductors and Cables	Field Test Reports	Not more than 30 days after test	I	86-68430	CDMS		
26 05 13-1	Medium-Voltage Power Cable System	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
26 05 13-2	Medium-Voltage Power Cable System	Field Test Reports	Within 14 days after tests are completed	I	86-68430	CDMS		
26 05 20-1	Grounding and Bonding	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
26 05 20-2	Grounding and Bonding	Test Reports	Within 14 days after tests are completed	I	86-68430	CDMS		
26 05 33-1	Raceways and Boxes	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
26 13 26-1	Medium-Voltage Metal-Clad Switchgear	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		

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						CO	CE	TSC
26 13 26-2	Medium-Voltage Metal-Clad Switchgear	Wiring Diagrams	Within 14 days after tests are completed	I	86-68430	CDMS		
26 13 26-3	Medium-Voltage Metal-Clad Switchgear	Check Prints	At same time as equipment is shipped to the site	A	86-68430	CDMS		
26 13 26-4	Medium-Voltage Metal-Clad Switchgear	Factory Test Reports	Within 14 days after tests are completed	I	86-68430	CDMS		
26 13 26-5	Medium-Voltage Metal-Clad Switchgear	Field Test Reports	Within 14 days after tests are completed	I	86-68430	CDMS		
26 13 26-6	Medium-Voltage Metal-Clad Switchgear	Final Drawings	Within 14 days after installation	A	86-68430	CDMS		
26 13 26-7	Medium-Voltage Metal-Clad Switchgear	Operation and Maintenance Instruction Book	Within 14 days after installation	I	86-68430	CDMS		
26 22 12-1	Dry-Type Transformers	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		
26 22 12-2	Dry-Type Transformers	Operation and Maintenance Instruction Book	Within 14 days after installation	I	86-68430	CDMS		
26 24 41-1	Distribution Panelboards	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		
26 24 41-2	Distribution Panelboards	Approval Layouts	Within 42 days after Notice to proceed	A	86-68430	CDMS		
26 24 41-3	Distribution Panelboards	Test Data	Within 14 days after tests are completed	I	86-68430	CDMS		
26 27 40-1	Wiring Devices	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		

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						CO	CE	TSC
26 42 10-1	Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems	Certification and Data	At least 42 days before procuring materials	A	86-68540	CDMS		
26 42 10-2	Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems	Final Data	Within 7 days of final testing	A	86-68540	CDMS		
26 42 11-1	Submerged Galvanic Anode Cathodic Protection System for Welded Tanks	Certification and Data	At least 42 days before procuring materials	A	86-68540	CDMS		
26 42 11-2	Submerged Galvanic Anode Cathodic Protection System for Welded Tanks	Final Data	Within 7 days of final testing	A	86-68540	CDMS		
26 42 12-1	Bolted Tank Submerged Galvanic Anode Cathodic Protection System	Certification, Design, and Manufacturer’s Data	At least 42 days before procuring materials	A	86-68540	CDMS		

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						CO	CE	TSC
26 42 12-2	Bolted Tank Submerged Galvanic Anode Cathodic Protection System	Final Data	Within 7 days of final testing	A	86-68540	CDMS		
26 51 00-1	Interior Lighting	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		
26 52 00-1	Emergency and Exit Lighting	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		
26 56 00-1	Exterior Lighting	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS		
27 15 00-1	Communicat ions Cabling	Approval Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
27 15 00-2	Communicat ions Cabling	Approval Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
27 20 01-1	Radio Equipment	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
27 20 01-2	Radio Equipment	Operations and Maintenance Manual	Within 30 days after installation	I	86-68450	CDMS		
27 30 01-1	Telephone Equipment	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
27 30 01-2	Telephone Equipment	Check Prints	Within 14 days after installation	A	86-68450	CDMS		
27 30 01-3	Telephone Equipment	Operations and Maintenance Manual	Within 30 days after installation	I	86-68450	CDMS		
27 30 01-4	Telephone Equipment	Field Operational Checkout Test Report	At least 42 days before beginning test	I	86-68450	CDMS		
28 10 01-1	Security and Surveillance Equipment	Approval Drawings and Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
28 10 01-2	Security and Surveillance Equipment	Test Procedure and Start Date	At least 42 days before beginning test	I	86-68450	CDMS		
28 10 01-3	Security and Surveillance Equipment	Test Report	Not more than 28 days after test	I	86-68450	CDMS		
28 10 01-4	Security and Surveillance Equipment	Check Prints	At same time as equipment is shipped to the site	A	86-68450	CDMS		

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						CO	CE	TSC
28 10 01-5	Security and Surveillance Equipment	Final Drawings and Operations and Maintenance Manuals	Within 28 days after installation	I	86-68450	CDMS		
28 31 00-1	Fire Detection and Alarm	Approval Data	Within 42 days after Notice to Proceed	A	86-68450	CDMS		
28 31 00-2	Fire Detection and Alarm	Testing Procedure and Notification	At least 42 days before beginning test	I	86-68450	CDMS		
28 31 00-3	Fire Detection and Alarm	Test Reports	Not more than 28 days after test	I	86-68450	CDMS		
28 31 00-4	Fire Detection and Alarm	Training Materials	Within 28 days after installation	I	86-68450	CDMS		
28 31 00-5	Fire Detection and Alarm	Operation and Maintenance Instruction Book	Within 28 days after installation	I	86-68450	CDMS		
31 02 10-1	Water for Dust Abatement	Meter Calibration	At least 42 days before beginning on-site work	A	CE	CDMS		
31 02 30-1	Dust Palliative	Proposed Application Area for Dust Palliative	At least 42 days before beginning on-site work	A	CE	CDMS		
31 23 02-1	Compacting Earth Materials	Test Results	Within 7 days after completion of tests	I	CE	CDMS		
31 23 70-1	Controlled Low Strength Material (CLSM)	Approval Data For CLSM Produced Without Native Soil	At least 42 days before placing	A	86-68530	CDMS		
31 23 70-2	Controlled Low Strength Material (CLSM)	Approval Data For CLSM Produced With Native Soil	At least 42 days before placing	A	CE	CDMS		
31 23 70-3	Controlled Low Strength Material (CLSM)	Contractor Field Quality Testing Results	Within 7 days of testing	A	CE	CDMS		
31 31 30-1	Soil-Applied Herbicide	Use Plan	At least 28 days before placing	A	CE	CDMS		

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						CO	CE	TSC
31 31 30-2	Soil-Applied Herbicide	Applier Certification	At least 28 days prior to beginning work	A	CE	CDMS		
31 37 00-1	Riprap	Approval Data and Test Results	At least 42 days before placing lining	A	CE	CDMS		
32 15 10-1	Gravel Surfacing	Gravel Certification	At least 42 days before placing surfacing	A	CE	CDMS		
32 15 10-2	Gravel Surfacing	Geofabric Installation	At least 42 days before placing surfacing	A	CE	CDMS		
32 15 10-3	Gravel Surfacing	Geofabric Certification	At least 42 days before placing surfacing	A	CE	CDMS		
32 31 10-1	Chain Link Fence	Certification	At least 42 days before installing fencing	A	CE	CDMS		
32 91 60-1	Erosion Control Blanket	Manufacturer's Information	At least 28 days before placing blanket	A	CE	CDMS		
32 91 60-2	Erosion Control Blanket	Installation Plan	At least 28 days before placing blanket	A	CE	CDMS		
32 92 20-1	Seeding	Seeding Plan	At least 28 days before seeding	A	CE	CDMS		
32 92 20-2	Seeding	Certifications	At least 28 days prior to beginning work	A	CE	CDMS		
33 05 21-1	Bored Utility Crossings	Placement Plan	At least 28 days prior to beginning work	A	CE	CDMS		
33 05 21-1	Bored Utility Crossings	Material Certification	At least 28 days prior to beginning work	A	CE	CDMS		
33 09 08-1	Probe Magnetic Flowmeter	Approval Data	At least 42 days before procurement	A	86-68410	CDMS		
33 09 08-2	Probe Magnetic Flowmeter	Final Data	Within 14 days prior to shipment to site	I	86-68410	CDMS		
33 09 08-3	Probe Magnetic Flowmeter	Test Reports	Within 14 days of completion of tests	I	86-68410	CDMS		
33 11 10-1	Pipeline General Requirements	Qualifications	At least 42 days before pipe fabrication or procurement	A	CE	CDMS		

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						CO	CE	TSC
33 11 10-2	Pipeline General Requirements	Pipelaying Diagrams	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 10-3	Pipeline General Requirements	Filling and Testing Plan	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 10-4	Pipeline General Requirements	Floatation Prevention Plan	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 12-1	Steel Line Pipe	Shop Drawings	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 12-2	Steel Line Pipe	Ventilation Plan	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 13-1	Ductile Iron Pipe	Shop Drawings	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 16-1	PVC Pressure Pipe	Shop Drawings	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 16-2	PVC Pressure Pipe	Pipe Manufacture Certification	Within 24 hours of taking measurements	A	CE	CDMS		
33 11 16-3	PVC Pressure Pipe	Test Results	Within 14 days of completion of tests	I	CE	CDMS		
33 11 18-1	HDPE Pressure Pipe	Heat Fusion Joint Operator Qualifications	At least 42 days before pipe fabrication or procurement	A	CE	CDMS		
33 11 18-2	HDPE Pressure Pipe	Shop Drawings	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 18-3	HDPE Pressure Pipe	Certification	14 days before shipping	A	CE	CDMS		
33 11 18-4	HDPE Pressure Pipe	Fusion Procedures	At least 42 days before pipe fabrication or procurement	A	CE	CDMS		

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						CO	CE	TSC
33 11 19-1	Fiberglass Pipe	Shop Drawings	At least 42 days before pipe fabrication or procurement	A	86-68140	CDMS		
33 11 19-2	Fiberglass Pipe	Joint Repair Plan	At least 42 days prior to delivery	A	86-68140	CDMS		
33 11 50-1	Pipe Crossings at Existing Utility Pipelines	Rubber Gasket Data	At least 42 days before pipe fabrication or procurement	A	CE	CDMS		
33 12 10-1	Valves and Equipment for Line Pipe Installations	Commercial Product Data	At least 42 days before fabrication or procurement	A	86-68140	CDMS		
33 12 10-2	Valves and Equipment for Line Pipe Installations	Service Manuals	Within 14 days after installation	I	86-68140	CDMS		
33 16 14-1	Air Chambers	Qualifications	At least 42 days before fabrication or procurement	A	86-68420	CDMS		
33 16 14-2	Air Chambers	Shop Drawings, Design Calculations, and Design Data	At least 42 days before fabrication or procurement	A	86-68420	CDMS		
33 16 14-3	Air Chambers	Surge Analysis	At least 42 days before fabrication or procurement	A	86-68420	CDMS		
33 16 14-4	Air Chambers	Commercial Products Data	At least 42 days before fabrication or procurement	A	86-68420	CDMS		
33 16 14-5	Air Chambers	Service Manuals	Within 14 days after installation	I	86-68420	CDMS		
33 16 50-1	Steel Tanks	Shop Drawings, Design Calculations and Design Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		
33 16 50-2	Steel Tanks	Qualifications	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		
33 16 50-3	Steel Tanks	Nondestructive Weld Test Reports	Within 7 days after installation.	I	86-68420	CDMS		
33 16 50-4	Steel Tanks	Commercial Products Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		

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						CO	CE	TSC
33 16 50-5	Steel Tanks	Final Drawings and Data	Within 14 days after installation.	I	86-68420	CDMS		
33 21 95-1	Metal Piping for Line Pipe Installations	Shop Drawings	At least 42 days before fabrication or procurement	A	86-68140	CDMS		
33 21 95-2	Metal Piping for Line Pipe Installations	Commercial Products Data	At least 42 days before fabrication or procurement	A	86-68140	CDMS		
33 21 95-3	Metal Piping for Line Pipe Installations	Final Drawings	Within 14 days after installation	I	86-68140	CDMS		
35 21 95-1	Steel Pipe	Shop Drawings	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		
35 21 95-2	Steel Pipe	Commercial Products Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		
35 21 95-3	Steel Pipe	Final Drawings	Within 14 days after installation	I	86-68420	CDMS		
35 22 15-1	Valves and Equipment	Commercial Product Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS		
35 22 15-2	Valves and Equipment	Service Manuals	Within 14 days after installation.	I	86-68420	CDMS		
35 42 35-1	Bank Protection	Samples	Within 14 days after tests are completed	A	86-68240	0	0	1
35 42 35-2	Bank Protection	Certifications	Within 14 days after tests are completed	A	86-68240	CDMS		
48 14 00-1	Solar and Electrical Equipment	Approval Data	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
48 14 00-2	Solar and Electrical Equipment	Approval Drawings	Within 42 days after Notice to Proceed	A	86-68430	CDMS		
48 14 00-3	Solar and Electrical Equipment	Test Report	Within 14 days after tests are completed	I	86-68430	CDMS		

END OF SECTION

SECTION 01 33 26
ELECTRICAL DRAWINGS AND DATA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Electrical Drawings and Data:

1. Payment: Lump sum price offered in the Price Schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME Y14.1-12	Decimal Inch Drawing Sheet Size And Format

B. International Electrotechnical Commission (IEC)

1.	IEC 61131-3-13	Programmable Controllers - Part 3: Programming Languages

C. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 315-75(1993)	Graphic Symbols For Electrical And Electronics Diagrams (Including Reference Designation Class Designation Letters)

1.03 SUBMITTAL PROCEDURES

A. In addition to the requirements in Section 01 33 00 - Submittals, prepare electrical drawings and data submittals in accordance with the following.

1. General:
   a. Complete, accurate in content, and legible.
   b. Schematic and wiring diagrams made expressly for this contract. Manufacturer’s typical drawings will not be accepted.
   c. After approval drawings and data have been returned approved, with or without comments, make no further changes in design without COR approval.
2. Drawings:
   a. Prepared using computer drafting equipment. Freehand sketches and hand-drafted drawings will not be accepted.
   b. Provide as PDF file.

c. Furnish with Government title block and in form as indicated on standard drawing 40-D-7102.

d. Government will provide specific title block information when drawings are submitted.

e. Indicate changes on revised drawings to distinguish them from previous submittals. Describe reasons for changes in submittal letters.

f. Ensure "As Built" wiring diagrams agree with actual equipment wiring and schematic diagrams.

g. Government may revise conductor or device designations on Contractor's drawings at no change in contract price or completion time.

3. The 1695-D-XXXX drawings included in these specifications are available in AutoCAD DWG format. The 40-D-XXXX and 104-D-XXXX drawings included in these specifications are available in Adobe PDF. With at least 14 days' notice, the Government will make drawing files available to the Contractor.

B. Approval Drawings and Manufacturer's Data:

1. General: Furnish with manufacturer's standard format, except as noted.

2. Manufacturer's Technical Catalog Data:

a. Provide technical data for each device or item of equipment.

b. Include manufacturer's name and address; catalog number, type, style, or model number; electrical ratings; and dimensions.

c. Where several items are listed on same sheet, indicate items being submitted for approval.

d. Demonstrate proposed device or item of equipment meets specifications requirements.

e. Mark catalog data sheet with appropriate Bill of Material (BOM) item number.

f. Assemble catalog data sheets into one enclosing cover with BOM index.

3. Equipment Layout Drawings:

a. Indicate dimensions of equipment.

b. Indicate location of devices and items of equipment including nameplates, terminal blocks, wiring ducts, bus, conduit entries, and other features in their relative physical location.

c. Indicate method of securing equipment to floor, or wall. Include dimensioned drawing of equipment channel base for floor-mounted equipment and method of attaching equipment to base.

d. Identify each device and item of equipment with a bill of material reference number.

4. Bill of Material List:
    a. Provide information on manufacturer, style, type, rating, quantity, and other identifying information for each device or item of equipment.
    b. Provide unique reference number for each device or item of equipment listed on bill of material.
5. Nameplate Lists: Provide information on type of material, size, and engraved lettering.
6. Schematic Diagrams:
    a. Schematic diagram to show all portions of the actual circuitry, regardless of where the circuitry is located.
    b. Format:
        1) Vertical ladder diagram form.
        2) Label rungs with sequential numbers starting with number 1.
        3) Locate rung numbers adjacent and to left of associated rung.
        4) Provide unique rung numbers for each circuit.
    c. Conductor designations: As indicated on drawings or as developed by Contractor. Contractor-developed conductor designations shall consist of:
        1) Circuit prefix.
        2) Rung number.
        3) Unique rung wire letter such as 5P15C (“5”-Unit Number, “P”-Protection Circuit, “15”-Rung Number, “C”-Unique Rung Wire Letter).
    d. Show device terminal and terminal block designations.
    e. Show functional operation and describe unusual or nonstandard operation.
    f. Show ratings and/or values of devices.
    g. Show contacts, including spare contacts, for motor contactors, auxiliary relays, timers, and protective relays.
    h. Show cross-referencing between other schematic and wiring diagrams.
    i. Show switch developments for control, selector, and limit switches.
    j. Device designations and symbols:
        1) As indicated on standard drawing 104-D-757, supplemented by IEEE 315 as needed.
    k. Include programmable logic, as applicable.
7. Programmable Logic:

a. When approved as a means of control logic, include with the schematic diagram submittals: PDF listings of the programmable logic program file written in a programming language specified by IEC 61131-3. Include color PDF screen shots of HMI displays, as applicable.

8. Wiring Diagrams:

a. Match with schematic diagrams.

b. Wireless connection (point-to-point) type:

1) Show equipment in its physical location as mounted on back, side, swing, and door panels. Show panel as viewed from wiring side of panel.

2) Indicate the location of each device with a double letter designation in bold face. This double letter matrix is to begin with AA in the upper left corner of each panel or door. Continuing this double letter matrix from a door to a panel or from panel to panel is not acceptable. Standard drawing 104-D-1165 shows a typical arrangement of the double letter matrix.

3) Indicate the location of each group of vertical terminal blocks with a single letter designation in bold face beginning with letter A. Locate terminal block number and wire designation on terminal block as shown on standard drawing 104-D-1165. The number of terminals in a single group of vertical terminal blocks may exceed twelve.

4) Identify panel destination of wires that leave a panel or door as shown on standard drawing 104-D-1165.

c. In addition to the double letter designation, show each item of equipment with designation indicated on schematic diagram.

d. Identify components such as fuses and resistors by value.

e. Show wiring of devices and items of equipment including terminal number.

f. Show cables, cable and individual wire designations, and connections to remote equipment. Standard drawing 104-D-1165 shows the manner in which external cables are to be shown. External cabling may not be fully known at the time of Approval Wiring Diagrams submittals. Therefore, wiring diagrams may be approved prior to connections to remote equipment are shown. All external cables must be shown on Wiring Diagram “Final drawings” (below).

C. Time-Current Characteristic and Equipment Coordination Curves:

1. Provide time-current characteristic curves for adjustable and non-adjustable protective devices.

2. Provide equipment coordination curves for:
    a. Equipment inrush current.
    b. Equipment full load current.
    c. Equipment thermal and mechanical damage.
3. Curves to be plotted on same log-log graph paper in order to illustrate degree of coordination, protection, and selectivity being provided.

D. Job Hazard Analysis (JHA):
1. Provide when the Government will be performing factory inspection.
2. Prepare JHA in accordance with 29 CFR 1910, Subpart I.
3. As a minimum include the following in JHA:
    a. Factory address and name of site visit contact person.
    b. Date of JHA.
    c. Purpose of JHA, for example “Visitor Safety Procedures”.
    d. Hazards:
        1) Types of hazards at factory.
        2) Safety procedures in or around high-voltage test labs.
        3) Safety procedures on factory floor.
    e. Personal protective equipment:
        1) List of equipment required.
        2) List of equipment provided by factory.
    f. Emergency response:
        1) Name and phone number of Factory Safety Officer.
        2) Employees trained in emergency conditions (CPR, First Aid).
        3) Factory fire protection/evacuation procedures.
        4) Nearest hospital or emergency room.
    g. Name, title and signature of factory official approving JHA.

E. Check Prints:
1. Schematic and wiring diagrams that show “As-Built” condition of equipment at time of shipment. Check prints to be made from latest approval drawings. Furnish 1 complete hard-copy set of full-size (D-size) drawings for Government use. Supply copies for their own use.
2. Schematic diagrams to include all device terminal points numbered and terminal block points identified.

3. Mark with changes and revisions made during installation and checkout of equipment.
4. Maintain separate, identical set of prints with field revisions for use in preparing final drawings.
5. As-shipped program file of any programmable logic.
6. Supply check prints for own use.

F. As-built Drawings:

1. Mark prints of electrical specifications drawings to indicate as-built changes made to equipment and systems during construction.
2. Provide for grounding and conduit systems, and single-line diagrams.
   a. Indicate as-built changes made during construction.
   b. Indicate dimensions of:
      1) Location of grounding electrodes.
      2) Location of embedded and direct buried grounding cables.
      3) Location of embedded and direct buried conduit.
   c. Single-line diagrams to show actual values and ratings of installed equipment.
3. Include revision dates.
4. Mark the drawings in the following colors:
   a. Red - Additions to original drawings.
   b. Green - Deletions to original drawings.
   c. Blue - Notations necessary for explanation of as-built markings.

G. Final Drawings:

1. Revised to reflect approval comments and “As-Built” condition of installed equipment at time of contract completion.
2. On Wiring Diagram Final Drawings, show all connections to remote equipment with external cabling as illustrated on standard drawing 104-D-1165.
3. Provide computer drawing files in AutoCAD (*.dwg) format for schematic diagram, wiring diagram, and equipment layout drawings. Compile using ‘eTransmit’ utility in AutoCAD for a complete package including support files.
4. Control software and support files for programmable logic

H. Test Reports:

1. Typed, 8-1/2 by 11 inch sheets.

2. Written certification by individual or authorized representative of organization performing the test.

3. Submit multi-page reports in bound folder or three ring binder.

I. Operation and Maintenance Instructions Books:

1. Include electronic copy:

a. Searchable Portable Document Format (.pdf) format on CD or DVD disk.

b. Conform to print copies.

c. Bookmark file(s) to aid in navigating.

2. Assemble each set of material into one or more books with enclosing covers.

3. Use double-sided copying for multi-page catalog data, maintenance instructions, operation instructions, etc.

4. Use single-side copying for half-size drawings.

5. Provide following:

a. Table of contents, which includes an index sheet with page or index tab number information for each device or item of equipment in book.

b. Manufacturer's operation and maintenance procedures; installation details, as necessary; and catalog data sheets for each device or item of equipment.

c. List of recommended spare parts and components.

d. Complete parts lists for all replacement parts.

e. Manufacturer's circuit breaker, fuse, and motor overload time-current characteristic curves.

f. Copies of test reports.

g. Copies of drawings and bills of material.

1) Revised to reflect “As-Built” condition.

2) Size: 11 by 17 inch.

h. List of settings for protective relays, adjustable circuit breakers, and motor overload relays.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 10
SAFETY DATA SHEETS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. LHM: List of Hazardous Materials.

B. SDS: Safety Data Sheet.

1. Referred to as Material Safety Data Sheets in the clause at 52.223-3, Hazardous Material Identifications and Material Safety Data - Alternate 1.

1.03 APPLICATION

A. For the purposes of this contract, “delivered under this contract” in paragraph (b) of the clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1, includes materials:

1. Delivered to Government.

2. Incorporated into work.

3. Used by the Contractor during contract performance at the jobsite.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 10-1, Complete LHM and SDS.

C. RSN 01 35 10-2, Updated LHM and SDS:

1. Comply with paragraph (e) of clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1.

1.05 DELIVERY

A. Do not deliver hazardous materials to jobsite which are not included on original or previously updated LHM and SDS before receipt of updated LHM and SDS by COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 20
SAFETY AND HEALTH

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. Code of Federal Regulations (CFR)

1.	29 CFR Part 1910	Occupational Safety and Health Standards
2.	29 CFR Part 1926	Safety and Health Regulations for Construction posted at: www.osha.gov

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. Safety Program:

1. Written safety program in accordance with of RSHS.
2. Cover all aspects of onsite and applicable off site operations and activities associated with this contract.
3. Follow the outline in Appendix B of RSHS.
4. Will not be accepted for review by the COR unless it addresses, in order, lettered and numbered per Appendix B, a narrative for each applicable item in the outline.
5. Generic company safety programs are not acceptable. The Safety Program must be site specific for this contract.
6. Shall be submitted and accepted prior to commencing onsite work, including mobilization.

7. The Safety Program Statement of Responsibility must state that "the contractor is responsible for ensuring that all work will be in compliance with Reclamation Safety and Health Standards and these specifications".

C. Submit the following supplements to, Safety Program in accordance with Section 01 33 00 - Submittals:

D. RSN 01 35 20-1, Emergency Action Plans Written Program and Training Records.

E. RSN 01 35 20-2, Job Hazard Analyses (JHA).

1. For each distinct phase of work under the contract.

F. RSN 01 35 20-3, Exposer Assessment Form.

1. If applicable.

2. Completed by a Certified Industrial Hygienist (CIH) or Certified Safety Professional (CSP).

3. Available at http://www.usbr.gov/pn/forms/ro-351.pdf.

G. RSN 01 35 20-4, Monthly Accident Summary Report:

1. Form 7-2218 or other acceptable form in accordance with RSHS.

H. RSN 01 35 20-5, Respirator User Documentation.

1. Submit documentation of medical qualifications less than 12 months old for all respirator users at the site.

2. Submit results of fit tests less than 12 months old for all users of tight fitting negative pressure respirators at the site.

I. RSN 01 35 20-6, Crane Training Certificates.

1. Qualifications for all riggers and signalpersons.

2. Crane Operator Qualifications:

a. Certifications for all crane and hoist operators.

b. Medical Qualifications to operate a crane in accordance with RSHS

J. RSN 01 35 20-7, Other Training Certificates, as applicable.

1. First Aid/CPR certifications for onsite foremen and/or safety personnel.

2. Proof of fall protection and prevention training for employees who work in elevated areas.

3. Proof of training for all contractor employees involved with confined space entry work.

4. Rope-Supported Work training certificates for Contractor rope team. Training shall be in accordance with RSHS Section 16.

5. Training certifications and experience for scaffolding competent person.

6. Training certifications and experience for excavation competent person.

1.04 SAFETY AND HEALTH

A. The Contractor shall not require persons employed in the performance of this contract, including subcontracts, to work under conditions that are unsanitary, hazardous, or dangerous to the employee's health or safety.

B. Provide and maintain a work environment and procedures that:

1. Safeguard the public and Government's personnel, and Contractor employees exposed to Contractor operations and activities.

2. Avoid interruptions of site operations and delays in project completion dates.

3. Control costs in contract performance.

C. Do not begin on site work, including mobilization, until the COR accepts the Safety Program.

D. Participate in Contractor Safety Program Review meeting prior to mobilization.

E. Minimum work crew shall consist of no less than two (2) people.

F. Develop Job Hazard Analyses for each distinct phase of work under the contract.

1. Do not begin a phase of work until a JHA is acceptable to COR and shared with construction employees.

2. Activities involving hazardous materials shall have the appropriate Safety Data Sheet(s) attached to the JHA.

G. Comply with RSHS and 29 CFR 1926.

H. Correct safety and health violations identified by the CO or the COR.

I. When the Contractor fails or refuses to correct a compliance directive, the CO or COR may issue an order to stop all or part of the work.

1. When satisfactory corrective action is taken, an order to resume work will be issued.

2. The Contractor shall not be entitled to extension of time or to claim for damage or to additional compensation by reason of either the directive or stop order.

3. Failure of the CO or the COR to order discontinuance of the Contractor's operations shall not relieve the Contractor of the responsibility for the safety of personnel and property.

J. Maintain accurate record of and report to the CO the following occurrences during performance of this contract:

1. Death.
2. Occupational disease.
3. Traumatic injury to employees or the public.
4. Property damage in excess of $2,500.

K. The rights and remedies of the Government provided in this section are in addition to any other rights and remedies provided by law or under this contract.

1. In the event there is a conflict between requirements contained in RSHS, specification paragraphs, Contractor's approved Safety Program, referenced safety and health codes, and standards, or the U.S. Department of Labor Construction Safety and Health Standards, promulgated under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327 et seq.), as amended, the more stringent requirement shall prevail.

L. Provide appropriate safety barricades, signs, and signal lights.

M. Perform all training as required by federal, state, and local regulations prior to any activity that requires it.

1. Training records must be submitted to the COR upon request.
2. In no case shall an employee perform work until all required training is complete.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 22
FIRST AID

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 22-1, Medical Facilities Plan:

1. Describe facilities for providing medical attention for injured or disabled employees.
2. Include onsite emergency facilities and ambulance service.

1.04 SERVICE

A. First-aid and medical facilities: In accordance with section 5 of RSHS.

B. Conform to most stringent requirement in cases of conflict between requirements of this section and requirements of RSHS.

C. Do not perform onsite work until first aid plans have been submitted, approved by the CO, and implemented on site.

1.05 AVAILABILITY

A. Make facilities and services available for providing emergency aid to employees, subcontractor employees, Government employees, and public.

B. Provide services free of charge to Government employees injured on job.

C. Government employees not injured on job and public may be charged fees for rendered services based on reasonable and established fee rates.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 30
CONTRACTOR'S ONSITE SAFETY PERSONNEL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedules for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 30-1, Resume:

1. Contractor's Onsite Safety Professional.

C. RSN 01 35 30-2, Safety Inspection Reports:

1. Include a list of noted deficiencies, their abatement dates, and follow-up action for jobsite activities.
2. Base inspection report on findings of jobsite walk-through with Government personnel.

1.03 QUALIFICATIONS

A. Contractor's Onsite Safety Representative:

1. Competent supervisory employee with appropriate level of safety related training and experience prior to start of the work.

1.04 APPLICATION

A. Designate an employee as the Contractor's Onsite Safety Representative prior to start of construction.

1. Safety Professional requirements may be met by retaining appropriate level of services of an acceptable safety consultant.

B. Contractor's Onsite Safety Representative Authorities, Duties, and Responsibilities:

1. Responsible for effectively implementing Contractor's Safety Program.
2. Full authorization to correct unsafe acts on the spot.
3. Prepare safety inspection reports.
4. Onsite during construction activities.

C. Safety Professional Duties and Responsibilities:

1. Review and approve Contractor's Safety Program prior to submittal.
2. Visit the site on an as-needed basis, but at a minimum of 1 time per week.

1.05 QUALITY ASSURANCE

A. Contractor's Onsite Safety Representative:

1. Effectiveness of Contractor's Onsite Safety Representative in prosecuting safety program will be subject to continued review and approval by CO.
2. Should Contractor's safety effort be considered inadequate, CO has option to require Contractor to employ a full-time qualified Safety Professional.

B. Safety Program:

1. Effectiveness of Contractor's Safety Program will be subject to continued review and approval by CO.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 10
REFERENCE STANDARDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Referenced editions of standard specifications, codes, and manuals form a part of this specification to the extent referenced.

B. These specifications take precedence when conflicting requirements occur between specifications and referenced standard.

1.03 JOBSITE REFERENCE STANDARDS

A. Maintain at fabrication site, access to referenced standard specifications, codes, and manuals required for work in progress at fabrication site. Make available for use by the Government.

B. Maintain onsite, access to referenced standard specifications, codes, and manuals required for onsite work in progress. Make available for use by the Government.

1.04 AVAILABILITY

A. Code of Federal Regulation (CFR):

1. Available online, authorized by the National Archives and Records Administration (NARA) and the Government Printing Office (GPO), at www.gpoaccess.gov/cfr/index.html.

B. Federal Specifications, Standards, and Commercial Item Descriptions; and Military Specifications:

1. Copies of Federal Specifications, Standards, and Commercial Item Descriptions may be obtained from GSA Federal Supply Service, see the provision at FAR 52.211-1, Availability of Specifications Listed in the GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29.
2. Copies of Military Specifications may be obtained from Department of Defense, see the provision at FAR 52.211-2, Availability of Specifications, Standards, and Data Item Descriptions Listed in the Acquisition Streamlining and Standardization Information System (ASSIST).

C. Bureau of Reclamation Documents:

1. Reclamation Safety and Health Standards (RSHS), 2009 edition with revisions, may be downloaded at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

a. Hard copies of RSHS, stock number 024-003-00204-6, may be purchased from The Superintendent of Documents at the U.S. Government Printing Office (GPO), phone number (202) 512-1800. Hard copies of RSHS are subject to revisions posted on the site shown above.

1) GPO online bookstore: http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=024-003-00204-6.

2. Bureau of Reclamation Standard Specifications are designated with an M-number. Copies of individual standards may be obtained from Bureau of Reclamation, Attn 86-68510, PO Box 25007, Denver CO 80225-0007. Specify standard(s) needed when requesting a copy.

3. Bureau of Reclamation manuals and other publications including significant scientific, technical, and engineering works are available from the National Technical Information Service (NTIS). Information regarding availability and pricing may be obtained by contacting NTIS at the following address:

United States Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
Telephone: (703)487-4650 or 1-800-553-6847

D. Industrial and Governmental Documents:

1. When a reference has a joint designation (e.g. ANSI/IEEE) these specifications generally cite the proponent organization (e.g. IEEE).

2. Addresses for obtaining industrial and governmental (other than Federal and Bureau of Reclamation specifications and standards) specifications, standards, and codes are listed in Table 01 42 10A - Addresses for Specifications, Standards, and Codes.

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AA	Aluminum Association 1400 Crystal Drive Suite 430 Arlington, VA 22202 www.aluminum.org	703-358-2960

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AABC	Associated Air Balance Council 1518 K Street NW, Ste 503 Washington, DC 20005 www.aabc.com	202-737-0202
AAMA	American Architectural Manufacturers Association 1827 Walden Office Square, Suite 550Schaumburg, Illinois 60173-4268 www.aamanet.org	847-303-5664
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, NW., Suite 249 Washington, DC 20001 www.aashto.org	202-624-5800 800-231-3475
ABMA	American Bearing Manufacturers Association 2025 M. Street, NW, Suite 800 Washington D.C. 20036-3309 www.americanbearings.org	202-367-1155
ACI	American Concrete Institute 38800 Country Club Dr. Farmington Hills, MI 48331-3439 USA www.concrete.org	248-848-3700
AGC	Associated General Contractors of America 333 John Carlyle Street, Suite 200 Alexandria, VA 22314 www.agc.org	703-548-3118
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601-2001 www.aisc.org	312-670-2400
AISI	American Iron and Steel Institute 25 Massachusetts Ave., NW, Suite 800 Washington, DC 20001 www.steel.org	202-452-7100

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AMCA	Air Movement and Control Association International, Inc. AMCA International 30 W. University Dr. Arlington Heights, IL 60004 www.amca.org	847-394-0150
ANSI	American National Standards Institute 1819 L. Street, NW. Washington, DC 20036 www.ansi.org	202-293-8020
APA/EWA	APA-The Engineered Wood Association P.O. Box 11700 Tacoma, WA 98411-0700 www.apawood.org	253-565-6600
ASME	American Society of Mechanical Engineers 3 Park Avenue New York, NY 10016-5990 www.asme.org	800-843-2763
ASTM	ASTM International P.O. Box C700 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 www.astm.org	610-832-9585
AWWA	American Water Works Association 6666 W. Quincy Ave. Denver, CO 80235 www.awwa.org	303-794-7711
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126 www.amweld.org	800-443-9353 305-443-9353
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 17th Floor New York, NY 10017 www.buildershardware.com	212-297-2122 Fax 212-320-9047

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
BICSI	Building Industry Consulting Services International 8610 Hidden River Pkwy Tampa, Florida www.bicsi.org	800-242-7405
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Rd. Suite B215 Columbia, MD 21046 www.chainlinkinfo.org	301-596-2583
HI	Hydraulic Institute 6 Campus Drive, First Floor North Parsippany, NJ 08807 pumps.org	973-267-9700
ICC	International Code Council 500 New Jersey Avenue, NW 6th Floor, Washington, DC 20001 www.iccsafe.org	888-422-7233
ICEA	Insulated Cable Engineers Association P.O. Box 1568 Carrolton, GA 80112 http://www.icea.net	
ICRI	International Concrete Repair Institute 3166 S. River Road, Suite 132 Des Plaines, IL 60018 www.icri.org	847-827-0830 Fax 847-827-0832
IEC	International Electrical Commission IEC Regional Centre for North America (IEC-ReCNA) 1740 Massachusetts Avenue, Suite D Boxborough, MA 01719. www.iec.ch	978-266 0414 Fax 978-266 0415
IEEE	Institute of Electrical and Electronics Engineers 3 Park Avenue,17th Floor New York, NY 10016-5997 www.ieee.org	212-419-7900

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ISO	International Organization for Standardization 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland www.iso.org	+41 22 749 01 11
MBMA	Metal Building Manufacturers Association 1300 Sumner Avenue Cleveland, OH 44115-2851 www.mbma.com	216-241-7333
MIC	Masonry Industry Council Mason Contractors Association of America 1910 South Highland Avenue, Suite 101 Lombard, IL 60148 www.masonryinstitute.org	630-705-4200
MPI	Master Painters Institute 2800 Ingleton Ave. Burnaby, B.C. Canada V5C 6G7 www.paintinfo.com	604-298-7578
MSS	Manufacturers Standardization Society 127 Park St. NE Vienna, VA, 22180-4602 msshq.org	703-281-6613
NACE	NACE International 1440 South Creek Drive Houston, TX 77084 www.nace.org	281-228-6200
NAPF	National Association of Pipe Fabricators, Inc. 1901 N.W. 161st Street Edmond, OK 73013 www.napf.com	888-798-1924 Fax 800-860-5700
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org	301-977-3695

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
NECA / NEIS	National Electrical Installation Standards 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814 www.neca-neig.org	301-657-3110
NEMA	National Electrical Manufacturers Association 1300 N 17th Street, Suite 1847 Rosslyn, VA 22209 www.nema.org	703-841-3200
NETA	International Electrical Testing Association 3050 Old Centre Ave., Suite 102 Portage, MI 49024 www.netaworld.org	269-488-6382
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	800-344-3555 617-770-3000
NIBS	National Institute of Building Sciences 1090 Vermont Avenue, NW., Suite 700 Washington, DC 20005-4905 www.nibs.org	202-289-7800
NSF	National Sanitation Foundation 789 N. Dixboro Road Ann Arbor, MI 48105 www.nsf.org	734 769 8010
NNOSHA	Navajo Nation Occupational Safety and Health Administration nnosha.org	928-871-6742
SAE	Society of Automotive Engineers International SAE World Headquarters 400 Commonwealth Drive Warrendale, PA 15096-0001 www.sae.org	724-776-04841 Fax 724-776-0790
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021 www.sdi.org	(847) 462-1930

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
SDI	Steel Door Institute 30200 Detroit Rd. Cleveland, OH 44145-1967 www.steeldoor.org	(440) 899-0010
SJI	Steel Joist Institute 3127 10th Ave., North Ext. Myrtle Beach, SC 29577-6760 www.steeljoist.org	(843) 626-1995
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Dr. Chantilly, VA 20151-1209 www.smacna.org	(703) 803-2980
SSPC	SSPC: The Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 www.sspc.org	800-837-8303 412-281-2331
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance	TIA/EIA
UL	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 www.ul.com	847-272-8800

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 46 00
QUALITY PROCEDURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. Government Contract Quality Assurance: (from FAR 46.101) Various functions, including inspection, performed by the Government to determine whether a contractor has fulfilled the contract obligations pertaining to quality and quantity.

B. Contractor Quality Assurance/Quality Control (QA/QC): Activities performed by the Contractor to ensure work conforms to contract requirements.

1. The clause at FAR 52.246-12 - Inspection of Construction, requires the Contractor to establish an inspection system to ensure quality.

2. Contractor QA/QC includes activities in addition to specified Contractor Quality Testing to ensure work conforms to contract requirements.

C. Contractor Quality Testing: Specified tests shall be performed by the Contractor.

1. The Government will evaluate results of these tests when determining acceptability of work.

2. The Contractor may use the test results as part of Contractor QA/QC.

a. The Government anticipates that these tests will be part of the Contractor's QA/QC program, however the tests do not relieve the Contractor of maintaining adequate quality system in accordance with the clause at FAR 52.246-12 - Inspection of Construction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 46 20

TESTING AGENCY SERVICES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for items of work requiring applicable testing agency services.

B. Progress Payments: If test reports are not submitted in a timely manner, the Contractor will be considered to be in non-compliance and delaying that phase of the work to which the testing applies. The CO may retain appropriate amounts of applicable progress payments.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C1077-14	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
2.	ASTM C1093-13a	Accreditation of Testing Agencies for Masonry
3.	ASTM D3740-12a	Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
4.	ASTM E329-14a	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
5.	ASTM E543-15	Agencies Performing Nondestructive Testing

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 46 20-1, Testing Agency Services Plan:

1. Names of agencies to perform sampling and testing.

2. Agency accreditation to perform specified testing or agency qualifications to perform specified testing.
3. Resumes of personnel performing tests.
4. Samples of report forms.
5. No change in the approved plan may be made without written concurrence by the COR.

1.04 QUALIFICATIONS

A. Testing agency organization:

1. Construction materials: Meet requirements of ASTM E329.
2. Concrete and concrete aggregates: Meet requirements of ASTM C1077.
3. Concrete masonry units: Meet requirements of ASTM C1093.
4. Soil and rock: Meet requirements of ASTM D3740.
5. Equipment: Calibrate measuring devices, laboratory equipment, and instruments at established intervals.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CONTRACTOR QUALITY TESTING

A. Employ accredited independent agency to perform sampling, testing, and reporting as required in the following Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 04 22 10 - Reinforced Concrete Unit Masonry Assemblies.
3. Section 31 23 02 - Compacting Earth Materials.
4. Section 31 23 70 - Controlled Low Strength Material (CLSM).
5. Section 32 15 10 - Gravel Surfacing.
6. Other sections as required.

3.02 GOVERNMENT CONTRACT QUALITY ASSURANCE

A. During the course of the work, the Government may perform quality assurance tests. Tests performed by the Government will be used to ensure compliance with contract requirements and not as replacement for specified Contractor quality testing.

1. Upon request, make measuring and testing devices available for use by the Government for verification tests.

2. If a conflict arises between Contractor quality testing results and Government quality assurance tests, Government testing results will take precedence over Contractor testing results.

END OF SECTION

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SECTION 01 51 00
TEMPORARY UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the price schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-12 National Electrical Safety Code (NESC)

1.03 TEMPORARY ELECTRICITY

A. Furnish electric power required for construction.

B. Furnish generators, transmission lines, distribution circuits, transformers, and other electrical equipment and facilities required for obtaining power and distributing power to points of use.

C. Comply with IEEE C2 clearances and spacing for temporary communications and supply lines.

D. Remove temporary equipment and facilities upon completion of work under this contract.

1.04 TEMPORARY WATER

A. Provide water required for construction purposes.

B. Obtain permits:

1. Navajo Agricultural Products Industry
P.O. Drawer 1318

Farmington, NM 87499

www.navajopride.com

Lionel Haskie

Telephone: 505-566-2636

Fax: 505-599-0572

2. Navajo Nation Water Code Administration
P.O. Box 678

Ft. Defiance, AZ 86504

www.watercode.navajo-nsn.gov

Melvin Badonie

Telephone: 928-729-4132

Fax: 928-729-4421

C. Arrange, pay and transport water for use during construction.

D. Use water which meets specified requirements for water used in concrete, soil-cement, masonry, grouting, and other permanent work.

E. Furnish means of conveying water to points of use.

1.05 TELEPHONE

A. Cellular service is available but may be intermittent in Blanco Canyon.

1.06 SANITARY FACILITIES

A. Restroom facilities will not be available to Contractor personnel.

B. Provide sanitary facilities.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 REMOVAL

A. Remove temporary equipment and facilities upon completion of work under this contract.

END OF SECTION

SECTION 01 55 00
VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REGULATORY REQUIREMENTS

A. Meet requirements established by jurisdictional authority for use of existing roadways and haul routes; including seasonal or other limitations or restrictions, payment of excess size and weight fees, and posting of bonds conditioned upon repair of damage.

B. Comply with applicable regulations for haul routes over public highways, roads, or bridges.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 55 00-1, Initial Digital Recording.

C. RSN 01 55 00-2, Post Construction Digital Recording.

D. RSN 01 55 00-3, Post Repair Digital Recording.

1.04 SITE CONDITIONS

A. Establish rights-of-way for access to work from existing roads.

1. In accordance with clause at FAR 52.236-10, Operations and Storage Areas, use only established roadways, parking areas, and haul routes; or temporary roadways, parking areas, or haul routes constructed by Contractor when and as authorized by CO.

2. Subject to clause at FAR 52.249-10, Default (Fixed-Price Construction), unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to maintain and repair existing roadways, parking areas, and haul routes: In accordance with requirements of jurisdictional authority.

B. Materials to construct, maintain, and repair temporary roadways, parking areas, and haul routes: As approved by COR.

C. Materials to maintain roadways and parking areas constructed under this contract and used by Contractor for construction work: In accordance with specified requirements for construction of those roadways and parking areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Investigate condition of available public or private roads for clearances, restrictions, bridge-load limits, bond requirements, and other limitations that affect or may affect access and transportation operations to and from jobsite.

3.02 RECORDS

A. Make preconstruction, post construction and post repair digital recordings of County Road 7007 and County Road 7425.

1. DVD format with a minimum 720p resolution.
2. Label:
    a. Contract number and title.
    b. Contractor’s name.
    c. Date recording is made.
    d. Preface video with this information.

B. COR will be present during recording. Notify COR at least 3 days prior to recording.

3.03 ESTABLISHED ROADWAYS AND PARKING AREAS

A. Established roadways and parking areas are available for Contractor's use subject to existing restrictions and approval of the COR.

3.04 TEMPORARY ROADWAYS AND PARKING AREAS

A. Roadways:

1. Construct temporary roadways for access from public thoroughfares to serve construction area, of a width and load-bearing capacity to provide unimpeded traffic for construction purposes.

2. Construct temporary bridges or culverts at stream crossings or cross-drainage channels to allow for unimpeded surface drainage.

B. Parking Areas:

1. Construct temporary parking areas to accommodate use of construction personnel.

2. Provide additional offsite parking when site space is not adequate.

3. Locate as indicated on drawings.

3.05 HAUL ROUTES

A. Perform work on rights-of-way established by Government as necessary to construct and maintain any roads, bridges, or drainage structures required for establishment and use of haul routes for construction operations.

B. Use existing available public highways, roads, or bridges as haul routes subject to applicable local regulations.

C. Minimize interference with or congestion of local traffic.

D. Provide barricades, flaggers, and other necessary precautions for safety of public where haul routes cross public highways or roads.

E. Detours: In accordance with Section 01 55 20 - Traffic Control.

3.06 MAINTENANCE

A. Maintain roadways, parking areas, and haul routes in a sound, smooth condition.

B. Maintain surfacing of gravel surfaced roads and parking areas until completion and acceptance of work under this contract. As approved by COR, defer until latest practicable date within specified completion period, placement of surfacing on roads or parking areas subject to heavy and deteriorating use by Contractor's construction operations or equipment.

C. Maintain surfacing of gravel surfaced roads and parking areas in a smooth condition until completion and acceptance of work under this contract.

D. Snow removal for convenience of Contractor or to facilitate work operations of Contractor is considered to be normal required maintenance.

3.07 REPAIR

A. Promptly repair ruts, broken pavement, potholes, low areas with standing water, and other deficiencies to maintain road surfacing and drainage in original or specified condition.

B. Notify contact below prior to making improvements.

1. New Mexico 811
   1021 Eubank Blvd NE

   Albuquerque, NM 87112

   http://www.nmonecall.org/

   Statewide: Dial 811 or 800-321-ALERT (2537) during regular business hours.

   By Fax: (505)260-1248 or (800)727-8809 24 Hours a day.

   By Web: Request a Line Spot 24 Hours a day.

2. San Juan County Public Works Department, if applicable.
   100 South Oliver Drive

   Aztec, NM 87410

   (505) 334-4314

   www.sjcounty.net

3.08 REMOVAL

A. Remove materials used to construct temporary roadways, parking areas, and haul routes prior to contract completion. Recycle salvageable materials as approved by COR.

END OF SECTION

SECTION 01 55 20
TRAFFIC CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

B. Cost:

1. Include water for dust abatement in the price in the Price Schedule for Water for Dust Abatement.

1.02 REFERENCE STANDARDS

A. Federal Highway Administration (FHWA)

1.	MUTCD, Part 6	Part 6, Temporary Traffic Control, Manual on Uniform Traffic Control Devices, 2009 Edition with Revisions 1 and 2, (http://mutcd.fhwa.dot.gov/kno_2009r1r2.htm)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 55 20-1, Traffic Control Plan.

C. RSN 01 55 20-2, Permit Applications.

D. RSN 01 55 20-3, Permits.

1.04 PROJECT CONDITIONS

A. Project includes crossings at: County Road (CR) 7007 and 7425.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Obtain permits from San Juan County. San Juan County Road information:

305 S. Oliver Drive
Aztec, NM 87410
Telephone: 505-334-4574

B. Road Closures:

1. Keep public roads open.
2. Private roads, per written agreement with owner.

3.02 TRAFFIC CONTROL

A. Meet requirements of MUTCD, Part 6.

B. Provide cones, delineators, concrete safety barriers, barricades, flasher lights, danger signals, signs, and other temporary traffic control devices as required to protect work and public safety.

C. Provide flaggers and guards as required to prevent accidents and damage or injury to passing traffic.

D. Do not begin work along public or private roads until proper traffic control devices for warning, channeling, and protecting motorists are in place in accordance with approved traffic control plan.

E. Maintain traffic flow and conduct construction operations to minimize obstruction and inconvenience to public traffic.

F. Provide unobstructed, smooth, and dustless passageway for two lane of traffic through construction operations.

G. Maintain convenient access to driveways, houses, and buildings along line of work.

H. Protect roads closed to traffic with effective barricades and warning signs. Illuminate barricades and obstructions from sunset to sunrise.

I. Remove traffic control devices when no longer needed.

3.03 DETOUR

A. Obtain COR approval prior to installing detours including Cultural Resources Clearance.

B. Construct and maintain detour to provide safe, continuous traffic flow during construction.

C. Limit detour use to 3 consecutive days without prior COR approval or as required by permits.

D. Obtain earth materials for detour embankments from required excavation or designated borrow sources. Construct stable compacted embankments.

E. Superelevate detour curves as directed by the COR.

F. Provide culverts and ditches as required to maintain surface drainage at detour.

G. Provide compacted gravel surfacing on detour.

H. Provide traffic control devices as required by MUTCD, Part 6.

I. Maintain detour in smooth, dust-free condition.

J. Remove the detour when no longer needed.

END OF SECTION

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SECTION 01 56 10
PROTECTION OF EXISTING INSTALLATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work, except as specified.
2. Costs for repair of installations damaged by the Contractor's operations are the Contractor's responsibility.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals:

B. RSN 01 56 10-1, Plan for Protecting Existing Installations.

1.03 PROJECT CONDITIONS

A. Drawings included in these specifications show items of existing materials and equipment but may not show all equipment and materials existing at the jobsite.

B. Obtain the location of embedded conduit, pipe, cable, ground mat, and other buried items before performing any drilling or cutting of concrete.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROTECTION

A. Provide protection for personnel and existing facilities from harm due to the Contractor's operations. Protection shall be subject to approval of the Government.

B. Arrange protective installations to permit operation of existing equipment and facilities by the Government while work is in progress.

3.02 REMOVAL OF PROTECTIVE INSTALLATIONS

A. Remove protective installations after purpose has been served. Materials furnished by the Contractor to provide protection remain property of the Contractor.

3.03 REPAIR

A. Repair, at Contractor's expense, damage to existing installations due to Contractor's operations or Contractor's failure to provide proper protection. At the Government's option, damage may be repaired by the Government, and the Contractor will be backcharged repair costs.

END OF SECTION

SECTION 01 56 15
PROTECTION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Utility Investigation:

1. Payment: For the lump sum offered in the Price Schedule.

B. Cost:

1. Include Utility Owner Acknowledgments offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-12	National Electrical Safety Code (NESC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 56 15-1, Utility Owner Acknowledgment.

1. Copy of notification acknowledgement to string conductors, overhead ground lines and installations across oil and gas utility companies' underground lines.

C. RSN 01 56 15-2, Utility Investigation.

1. As listed under "Utility Investigation" in this section.

1.04 PROJECT CONDITIONS

A. Drawings included in these specifications show existing utilities, but may not show all utilities existing at the jobsite.

B. Obtain location of buried conduit, pipe, cable, ground mat, and other buried items before excavating.

C. Unknown existing utility lines may cross pipeline alignment.

D. Government does not represent that location of known existing utilities shown on drawings are exact. It is Contractor's responsibility to determine actual location of and make provision for known and unknown utilities.

1. Verify locations, depths and clearances of both above and below ground utilities prior to excavation.

E. Ensure that each utility line is in service as required by each utility owner.

F. Coordinate work within existing pipeline and transmission line Rights-of-Way with owners and shall be responsible for costs associated with crossings. Obtain permission from Utility owners before procuring materials to be installed in Rights-of-Way.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Have New Mexico One Call locate utilities before doing underground work.

B. Navajo Tribal Utility Authority (NTUA) is not part of New Mexico One Call.

1. Have NTUA locate utilities before doing underground work. Contact Information:

Navajo Tribal Utility Authority
P.O. Box 170
Fort Defiance, AZ 86504
Telephone: 928-729-5721

C. Utility Investigation:

1. Determine height and voltage of overhead utility lines. Clearances in accordance with RSHS and OSHA, whichever is more stringent.

2. Determine location, elevations, diameters, and materials of each underground utility line by hydro-excavation or vacuum excavation. Test pits may be used when approved by the COR.

a. Submit to COR before beginning preparation of pipelaying diagrams required by Section 33 11 10 - Pipeline General Requirements and excavation work.

b. COR will determine if adjustment of pipeline grade and design is required and provide the Contractor with revised drawings.

3. Obtain permission from utility or gasline owner before performing physical utility investigation (potholing or test pits).

D. Coordinate with each utility line owner and schedule construction to adhere to each owner's in service, allowable out of service, and crossing requirements during construction.

E. Notify impacted property owner at least 2 working days before disturbing waterline that serves their property. Water service to property shall not be shut off for more than 8 hours.

F. No excavation will be permitted within 10 feet of gas lines when in service without written approval from gas company.

G. Protect and support existing utilities that intersect work area. Before commencing work, obtain approval and necessary permits from utility owners within project ROW.

H. Repair existing utilities damaged during construction as approved by COR and utility owner.

3.02 CLEARANCE

A. Obtain clearances required for construction operations: Contractor shall provide in accordance with RSHS.

3.03 INTERFERENCE WITH OPERATION OR MAINTENANCE

A. Do not interfere with operation or maintenance service on utilities, existing on date offers are received.

1. Provide for access to utilities in a manner satisfactory to owners and operators and the Government.

B. Provide required temporary structures; make necessary repairs, replacements, or similar operations; and furnish indemnity or other bonds.

END OF SECTION

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SECTION 01 56 20
EXISTING FENCES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rebuild fence with new material unless otherwise approved by COR.

B. Provide replacement materials of similar type, when necessary.

PART 3 EXECUTION

3.01 FENCE REMOVAL

A. Remove existing fences where necessary for performance of the work, only when authorized by the COR. Maintain fences, where designated, until work is completed or their removal is authorized.

3.02 TEMPORARY FENCES

A. Where fences are removed on rights-of-way, provide temporary fence protection for adjacent lands to prevent livestock from straying from or onto adjacent lands, complete with gates and cattle guards.

B. If the Contractor does not provide necessary temporary fencing or protection within a reasonable time after need for fencing or protection arises, the CO will cause the work to be performed and backcharge the Contractor for such work.

C. Remove temporary fences and protection as a part of cleanup operations prior to final acceptance of completed work.

3.03 FENCE REBUILDING

A. Where fences are removed to accommodate construction, rebuild at original locations.

B. Construct rebuilt fencing that is structurally sound and matches, or is better than, existing fencing installation.

END OF SECTION

SECTION 01 56 32
TEMPORARY SAFETY FENCE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in Price Schedule for other items of work.

PART 2 PRODUCTS

2.01 SAFETY FENCE

A. Fence:

1. High-density polyethylene grid.
2. Minimum height: 48 inch.
3. Color: Safety orange.
4. Recovered Material Content:
   a. 90 to 100 percent.
5. Postconsumer Content:
   a. 60 to 100 percent.

B. Posts: Steel fence posts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect fence around work areas at location approved by the COR.

B. Space posts 10 feet, maximum, on center.

C. Secure grid to posts.

3.02 MAINTENANCE AND REMOVAL

A. Maintain fence until work in area is complete and accepted by the COR.

B. Remove fence when no longer required.

END OF SECTION

SECTION 01 57 20
ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work, except as specified.
2. See Section 31 02 10 - Water for Dust Abatement, for measurement and payment for applying water used for dust abatement within the rights-of-way.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 57 20-1, Copy of Applicable Air Quality Permit.

1.04 REGULATORY REQUIREMENTS

A. Comply with Federal, Tribal, State, and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

D. Contractor shall be responsible for damages resulting from dust originating from Contractor operations in accordance with clause at FAR 52.236-7, “Permits and Responsibilities”.

E. The CO may stop construction activity in violation of Federal, Tribal, State, or local laws and additional expenses resulting from work stoppage will be responsibility of Contractor.

1.05 PERMITTING

A. Develop draft environmental permit applications not covered in other sections and forward to COR for review and submission by the Government to the relevant authorities having jurisdiction.

1.06 DUST CONTROL

A. Provide dust control and abatement during performance of work, as approved by COR.

B. Prevent, control, and abate dust pollution on rights-of-way provided by Government or elsewhere during performance of work.

C. Provide labor, equipment, and materials, and use efficient, environmentally acceptable methods to prevent dust nuisance or damage to persons, property, or activities, including, but not limited to, crops, cultivated fields, wildlife habitats, dwellings and residences, agricultural activities, recreational activities, traffic, and similar conditions.

D. Provide means for eliminating atmospheric discharges of dust during mixing, handling, and storing of cement, pozzolan, and concrete aggregate.

1.07 AIR POLLUTION CONTROL

A. Air Quality Permits are not required for control of fugitive dust generated as result of construction-related activities on a short term basis, however permits are required with specific emission sources tied to aggregate processing and batch plant operations releasing particulates to atmosphere.

B. Air Quality Permits are required for certain construction-related activities including, but not limited to, sandblasting, aggregate processing, or other processes which discharge pollutants into open air.

C. Air Quality Permits, and information concerning requirements, are available from: New Mexico Environmental Department, telephone: 505-827-2855 and the USEPA.

D. Use reasonably available methods and devices to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.

E. Do not operate equipment and vehicles that show excessive exhaust gas emissions until corrective repairs or adjustments reduce such emissions to acceptable levels.

1.08 NOISE CONTROL

A. Only construction activities approved by COR will be allowed between dusk and dawn.

1.09 LIGHT CONTROL

A. Shine direct stationary floodlights downward at an angle less than horizontal.

B. Shield floodlights so that floodlights will not be a nuisance to surrounding areas.

C. Direct lighting so that residences are not in direct beam of light.

D. Correct lighting control problems when they occur as approved by the COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 57 30
WATER POLLUTION CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. Code of Federal Regulations (CFR)

1.	40 CFR, Part 112	Oil Pollution Prevention

C. Public Law

1.	Sections 311, 402, and 404	Clean Water Act (Public Law 92-500, as amended)

D. U.S. Environmental Protection Agency (USEPA)

1.	EPA CGP-12	Stormwater Discharge Permit associated with a Construction Site including revisions. http://www.epa.gov/npdes/epas-2012-construction-general-permit-cgp-and-related-documents

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 57 30-1, Updated Stormwater Pollution Prevention Plan (SWPPP):

1. Modifications to draft SWPPP provided by Government which shall comply with requirements outlined in part 7 of Construction General Permit (CGP), dated 2012.

2. Include copy of permits.

C. RSN 01 57 30-2, Spill Prevention, Control, and Countermeasure (SPCC) Plan:

1. Submit to COR when SPCC Plan is required in accordance with 40 CFR, Part 112.

2. SPCC Plan is required where release of oil and oil products could reasonably be expected to enter into or upon navigable waters of the United States or adjoining shorelines in quantities that may be harmful (40 CFR, Part 110), and aggregate on site oil storage capacity is over 1,320 gallons. Only containers with capacity of 55 gallons and greater are included in determining on site aggregate storage capacity.

3. Reviewed and certified by a registered professional engineer in accordance with 40 CFR, Part 112, as required by section 311 of the Clean Water Act (Public Law 92-500 as amended).

4. Submit spill prevention plan for oil storage equal to or greater than 1,320 gallons. Spill Prevention Plan shall be stamped by a professional engineer to BOR for formal submittal and include:

a. Oil Storage Quantity.

b. Drawings of containment system.

c. Response plan to spill.

1.04 REGULATORY REQUIREMENTS

A. Construction Safety Standards:

1. Comply with sanitation and potable water requirements of section 7 of RSHS.

B. Laws, Regulations, and Permits:

1. Perform construction operations to comply, and ensure subcontractors comply, with:

a. Applicable Federal, State, and local laws, orders, regulations, and Water Quality Standards concerning control and abatement of water pollution; and terms and conditions of applicable permits issued by permit issuing authority.

b. If conflict occurs between Federal, State, and local laws, regulations, and requirements, the most stringent shall apply.

C. Contractor Violations:

1. If noncompliance should occur, verbally report noncompliance within 2 hours to the CO. Submit specific written information within 24 hours including corrective actions.

2. Violation of applicable Federal, State, or local laws, orders, regulations, or Water Quality Standards may result in the CO stopping site activity until compliance is ensured.

3. The Contractor shall not be entitled to extension of time, claim for damage, or additional compensation by reason of such a work stoppage.

4. Corrective measures required to bring activities into compliance shall be at the Contractor's expense.

1.05 REQUIRED PERMITS

A. Wastewater Discharge Permit:

1. Permit:

a. Prior to discharging wastewater or other pollutants, provide draft permit(s) to discharge pollutants as required under section 402 of Clean Water Act (Public Law 92-500 as amended), and New Mexico Environment Department, Surface Water Quality Bureau and Navajo Nation Environmental Protection Agency.

b. Submit permit applications to Government, for review and Government's submittal.

c. Government will support Contractor in obtaining permits, as deemed appropriate by Government.

2. Terms and Conditions: Comply with terms and conditions as stated in the permit.

3. Monitoring and Treatment:

a. Provide monitoring and water treatment to achieve compliance with permit conditions.

b. Provide recordkeeping required of permittee, as stated in the section 402 permit.

4. Sampling: Include sampling in monitoring required of the Contractor to meet section 402 requirements, as well as required laboratory tests to determine effluent characteristics.

5. Monitoring Results:

a. Provide monitoring results to appropriate agency as required by permit.

b. Send copies of information transmitted to appropriate agency to COR.

B. Stormwater Discharge Permit Associated With a Construction Site (EPA Construction General Permit):

1. Stormwater Pollution Prevention Plan:

a. Government will submit the plan drafted by the Contractor.

b. Comply with terms and conditions to maintain CGP.

2. Notice of Intent (NOI):

   a. Both Contractor and BOR will submit a NOI via the EPA's eNOI system (go to www.epa.gov/npdes/stormwater/cgpenoi) to obtain coverage under the construction general permit to control stormwater and certain regulated non-stormwater discharges associated with construction activity (including construction dewatering) as outlined in part 1 of the Final 2012 CGP as required under the provisions of the Clean Water Act, 33 U.S.C § 1251 and as amended by the Water Quality Act of 1987 (P.L. 100-4).

3. Monitoring and Water Treatment:

   a. Provide monitoring and water treatment to achieve compliance with applicable Water Quality Standards and CGP.

   b. Provide the recordkeeping required by the CGP associated with construction activity.

C. Stormwater Discharge Permit Associated With Industrial Activity:

1. Stormwater Discharge Permit:

   a. If construction activities will entail use of a mobile CLSM plant, concrete plant, or nonmetallic borrow areas, a stormwater discharge permit associated with industrial activity may be required.

2. Notice of Intent (NOI):

   a. Both Contractor and BOR will sign NOI to obtain coverage under a stormwater general permit to control stormwater discharges from industrial activity at the construction site as required under section 402 of Clean Water Act (Public Law 92-500, as amended) and/or New Mexico Environment Department, Surface Water Quality Bureau and/or Navajo Nation Environmental Protection Agency.

3. Terms and Conditions:

   a. Comply with terms and conditions to obtain and maintain the industrial stormwater discharge permit, including the preparation of a Pollution Prevention Plan.

4. Monitoring and Water Treatment:

   a. Provide monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards.

   b. Provide recordkeeping required by the stormwater discharge permit associated with industrial activity.

D. 404 Permit and 401 Water Quality Certification:

1. The Government will apply for a permit to discharge dredged or fill material into waters of the United States (including wetlands) as required under section 404 of the Clean Water Act (Public Law 92-500 as amended).

2. If a 404 permit is required, the Government will also obtain a CWA 401 water quality certification from the regulatory authority having jurisdiction: NMED, NNEPA, or EPA.

a. Coordinate with the Government and meet requirements of the 404 permit and 401 water quality certifications.

b. Provide documentation to support permit compliance, monitoring and close out.

1.06 CONTRACTOR RESPONSIBILITIES

A. Permits: Obtain permits in BOR and Contractor's name.

B. Monitoring:

1. Conduct monitoring in order to meet the requirements of the permits which may include:

a. Sampling,

b. Site inspections,

c. Required laboratory tests to determine effluent characteristics.

C. Reporting Results:

a. Provide monitoring results to appropriate agency as required by permit.

b. Send copies of information transmitted to appropriate agency to COR.

D. Recordkeeping: Retain records and data for life of project or as required by permits, whichever is longer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 POLLUTION CONTROLS

A. Control pollutants by use of sediment and erosion controls, wastewater and stormwater management controls, construction site management practices, and other controls

including Federal, Tribal State and local control requirements. As shown on approved SWPPP and as necessary to control pollutants.

B. Sediment and Erosion Controls:

1. Establish methods for controlling sediment and erosion which address vegetative practices, structural control, sediment controls, and operator controls as appropriate.

2. Institute stormwater management measures as required, including velocity dissipators, and solid waste controls which address controls for building materials and offsite tracking of sediment.

C. Wastewater and Stormwater Management Controls:

1. Pollution prevention measures:

a. Use methods of dewatering, unwatering, excavating, or stockpiling earth and rock materials which include prevention measures to control silting and loss of soil due to wind and water erosion, and which will intercept and settle runoff of sediment-ladened waters.

b. Prevent wastewater from general construction activities such as drainwater collection, aggregate processing, concrete batching, drilling, grouting, or other construction operations, from entering flowing or dry watercourses without the use of approved turbidity control methods.

c. Divert stormwater runoff from upslope areas away from disturbed areas.

2. Turbidity Prevention Measures:

a. Use methods for prevention of excess turbidity which include, but are not restricted to, intercepting ditches, settling ponds, gravel filter entrapment dikes, flocculating processes, recirculation, combinations thereof, or other approved methods that are not harmful to aquatic life.

b. Wastewaters discharged into surface waters shall meet conditions of permits.

c. Do not operate mechanized equipment in waterbodies without having first obtained a section 404 permit and 401 water quality certifications, and then only as necessary to construct crossings or perform the required construction.

D. Construction Site Management:

1. Contractor construction operations:

a. Perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes into streams, flowing or dry watercourses, lakes, wetlands, reservoirs, or underground water sources.

1) Pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.

b. Comply with 404 permit and 401 water quality certifications.

2. Stockpiled or deposited materials:

a. Do not stockpile or deposit excavated materials or other construction materials, near or on, stream banks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff, or can encroach upon the watercourse.

3. Petroleum product storage tanks management:

a. Place oil or other petroleum product storage tanks at least 100 feet from streams, flowing or dry watercourses, lakes, wetlands, reservoirs, and other water sources. Do not place petroleum product storage tanks within a watercourse's 100 year floodplain.

b. Do not use underground storage tanks.

c. Construct storage area dikes at least 12 inches high or graded and sloped to permit safe containment of leaks and spills equal to storage tank capacity located in the area plus sufficient freeboard to contain the 25 year rainstorm.

1) Line diked areas with an impermeable barrier at least 50 mils thick.

d. Areas for refueling operations: Lined with impermeable barrier at least 50 mils thick covered with 4 inches of soil.

END OF SECTION

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SECTION 01 57 50
TREE AND PLANT PROTECTION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work, except as specified.
2. Costs for repair or treatment of injured vegetation and replacement of trees or shrubs are the Contractor's responsibility.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 57 50-1, Protection Plan:

1. Description of protective barriers or other methods used to protect vegetation from damage or injury caused by construction operations.

PART 2 PRODUCTS

2.01 REPLACEMENT TREES AND SHRUBS

A. Species: Same as removed tree or shrub or other species approved by the COR.

B. Size: Same size as removed tree or shrub, or maximum practicable size that can be planted and sustained in the particular environment as approved by the COR.

PART 3 EXECUTION

3.01 PRESERVATION AND PROTECTION

A. Preserve natural landscape and preserve and protect existing vegetation not required or otherwise authorized to be removed.

1. Submit requests to remove vegetation not specifically required to be removed to the COR.

B. Conduct operations to prevent unnecessary destruction, scarring, or defacing of natural surroundings in the vicinity of the work.

C. Move crews and equipment within the rights-of-way and over routes provided for access to the work in a manner to prevent damage to grazing land, crops, or property.

D. Protect vegetation from damage or injury caused by construction operations, personnel, or equipment by the use of protective barriers or other methods approved by the COR.

E. Minimize, to the greatest extent practicable, clearings and cuts through vegetation. Irregularly shape authorized clearings and cuts to soften undesirable aesthetic impacts.

F. Do not use trees for anchorages except in emergency cases or as approved by the COR.

1. For such use, wrap the trunk with a sufficient thickness of approved protective material before rope, cable, or wire is placed.

2. Submit requests to use trees for anchorage, except for emergencies. Include description of protective material.

G. Use safety ropes where tree climbing is necessary; do not use climbing spurs.

3.02 REPAIR, TREATMENT, OR REPLACEMENT

A. The Contractor is responsible for injuries to vegetation caused by Contractor operations, personnel, or equipment.

B. Employ the services of an experienced arborist or licensed tree surgeon to direct repair, treatment, and replacement of injured vegetation. Submit qualifications of experienced arborist or licensed tree surgeon to COR prior to employment.

C. Repair or treat injured vegetation without delay and as recommended by and under direction of an experienced arborist or licensed tree surgeon.

D. Remove and dispose of trees or shrubs not required or otherwise authorized to be removed that, in the opinion of the COR, are injured beyond saving.

E. Replace removed tree or shrub with tree or shrub approved by the COR.

1. Plants that are protected species require multiple plants of same species be replaced for each plant removed. Replacements ratio/numbers in accordance with biological consultation, land ownership agreements, and revegetation plan. See Section 01 57 60 - Protected Species.

2. For a period of 1 year, guy as required, water, and maintain replacement trees and shrubs.

a. Remove and replace replacement trees or shrubs that die within the 1 year replacement period.

b. Maintain such replacements for a period of 1 year from the date of replacement.

END OF SECTION

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SECTION 01 57 60
PROTECTED SPECIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices in the Price Schedule for other items of work.

1.02 PROJECT CONDITIONS

A. Certain native species in the State of New Mexico are protected plant or animal species under State and Federal laws. Government has ascertained that:

1. Brack's Cactus and Aztec Gilia are protected species which may exist in areas to be disturbed by construction activities.
2. Migratory Birds and Raptors may exist in areas to be disturbed by construction activities.

B. The project is designed to comply with commitments of the:

1. Final Biological Opinion for Navajo-Gallup Water Supply Project as issued by U.S. Fish and Wildlife Service on February 26, 2009 as well as the Reaches 21 and 22 Environmental Assessment.
2. Finding of No Significant Impact (FONSI), issued in October 2015, issued by BLM.
3. FONSI issued by BOR in September 2015.
4. FONSI issued by BIA in October 2015.

C. Migratory Birds:

1. Government will survey vegetated areas to be disturbed for nesting migratory birds.
    a. Notify Government at least 7 days before an area is to be disturbed.
    b. Migratory bird surveys are required between March 15th through August 15st.
2. Notify COR 7 days before disturbing an area.
3. Do not disturb birds' active nests. Notify Government for a determination of migratory bird impacts.
    a. Avoid birds as directed by COR.

D. Brack's Cactus and Aztec Gilia:

1. If Brack's Cactus or Aztec Gilia is found in construction area, Government will monitor work in these areas.

a. Coordinate work in these areas with COR.

E. Raptors:

1. Government will conduct surveys immediately prior to construction within construction right-of-way and buffer zone for nesting raptors.
    a. Minimize disturbance to raptors.
    b. Government will conduct raptor surveys immediately prior to construction between January 15th and July 15th.
2. Notify COR 7 days prior to construction to allow for raptor nest surveys.
3. Do not disturb an active raptor nest.
    a. Government will notify Contractor of nest locations.
    b. No construction will be allowed within the above months within 1/4 mile of active nests.

F. Insert this section in subcontracts which involve performance of work in areas where protected species may occur.

G. In accordance with Federal and State law, Government may arrange for removal of protected species. Cooperate with those performing such removal. If these species are not removed, cooperate with and abide by protection plans developed by appropriate Federal or State entities to avoid damage to or disturbance of protected species.

1.03 REPLACEMENT PLANTS

A. Protected plant species shall not be removed or damaged by Contractor.

1. If inadvertent effects occur to protected species during construction:
    a. Notify Government:
        1) Verbal: Within 2 hours.
        2) Written: Within 24 hours.
    b. Cease work in affected work area until consultation commitments are completed.
2. Government, in consultation with Bureau of Land Management and State of New Mexico, will manage required removal/replacement planting in accordance with consultation commitments.
3. Replacement numbers/ratio in accordance with consultation commitments.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 57 90

PRESERVATION OF HISTORICAL AND ARCHEOLOGICAL DATA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Except as provided for an equitable adjustment, include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. Cultural resources: Includes prehistoric, historic, architectural, and traditional cultural properties. These include, but are not limited to, human skeletal remains, archaeological artifacts, records, and material remains related to such property.

B. Cultural items: Native American cultural items (i.e., funerary objects, sacred objects, objects of cultural patrimony, or human remains) for which protection is prescribed under the Native American Graves Protection and Repatriation Act (NAGPRA) - Public Law 101-601; 104 Stat. 3042, Section 3(d); and 43 CFR Part 10.4.

C. Human remains: Physical remains of the body of a person.

D. Funerary objects: Native American items that, as part of the death rite or ceremony of a culture, are reasonably believed to have been placed intentionally at the time of death or later with or near individual human remains.

E. Native American: Of, or relating to, a tribe, people, or culture that is indigenous to the United States.

F. Sacred Objects: Native American items that are specific ceremonial objects needed by traditional Native American religious leaders for the practice of traditional Native American religions by their present-day adherents. These items are specifically limited to objects that were devoted to a traditional Native American religious ceremony or ritual and which have religious significance or function in the continued observance or renewal of such ceremony.

G. Objects of cultural patrimony: Native American items having ongoing historical, traditional, or cultural importance central to the Indian tribe itself, rather than property owned by an individual tribal member. These objects are of such central importance that they may not be alienated, appropriated, or conveyed by any individual tribal member.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 57 90-1, Alternate Use Area or Borrow Area:

1. When use area or borrow area other than those approved is to be used, submit map showing location of unapproved use or borrow areas, for approval.

1.04 PROJECT CONDITIONS

A. Project site has been surveyed and an archeological clearance has been given for construction within ROW by agencies having jurisdiction: Navajo Nation Historical Preservation Department (NNHPD), State Historical Preservation Office (SHPO) and Bureau of Land Management (BLM).

B. Government will retain an Archeologist to monitor ground disturbing activity work within 100 foot, each side of known cultural sites.

1. Coordinate work with COR and Government Archeologist.

C. On-site Contractor personnel shall undergo cultural resource awareness training.

1. Government will provide training. Training will take approximately 1 hour. Schedule for training will be mutually agreed upon.

2. Inform on-site personnel of cultural resource requirements before initial groundbreaking takes place.

3. On-site personnel added after completion of cultural awareness training shall be informed by their management of cultural resource requirements before being allowed to work in project area.

4. Maintain training records.

D. Federal legislation provides for protection, preservation, and collection of scientific, prehistorical, historical, and archeological data, including relics and specimens, which might otherwise be lost due to alteration of terrain as a result of any Federal construction project.

E. Persons who, without permission, injure, destroy, excavate, appropriate, or remove historical or prehistorical artifact, object of antiquity, or archeological resource on public lands of the United States is subject to arrest and penalty of law.

F. Comply with federal and state laws when operating on non-Federal and non-Indian lands.

G. Attend weekly coordination meetings. Refer to Section 01 31 19 - Project Management and Coordination.

H. Discovery of Resources

1. When Contractor or parties operating or associated with Contractor, in performance of this contract discover cultural resources on ROW:
    a. Immediately cease work at that location.
    b. Verbally notify CO within 2 hours, giving location and nature of findings.
    c. Verbally notify USBR staff archaeologist within 2 hours. Telephone: 970-385-6500, in Durango, Colorado.
    d. Follow with written confirmation to the CO within 12 hours.
2. Do not disturb or damage cultural resources uncovered during construction activities. Provide cooperation and assistance to preserve findings for removal or other disposition by CO.
3. Do not resume work in the area of discovery until receipt of written notice to proceed from the CO.

I. Where appropriate by reason of discovery, the CO may order delays in time of performance or changes in work, or both. When such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

J. Mitigate cultural resources as directed by Government on lands outside of Permanent or Construction ROW, including private lands.
1. Coordinate Government cultural resource identifications and inspections.
    a. Obtain permission for Government access in arrangements for use of lands outside of ROW including private lands for use areas or borrow sources, access routes and areas of disturbance.

K. Insert this section in subcontracts which involve performance of work on jobsite terrain.

L. Obtain Government clearance before disturbing lands outside of ROW in accordance with Section 01 14 10 - Use of Site.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXCLUSION ZONE

A. Fence exclusion zones as directed by COR and in accordance with Section 01 56 32 - Temporary Safety Fence.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. When the Price Schedule includes a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the Price Schedule for the item.

2. When the Price Schedule does not included a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the Price Schedule for work for which the material is required.

1.02 DEFINITIONS

A. Essential Characteristics: As used in these specifications, the term "essential characteristics" is synonymous with the term "salient characteristics."

B. Salient Characteristics: Those qualities of an item that are essential to ensure that the intended use of the item can be satisfactorily realized.

1.03 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B1.1-03(2008)	Unified Inch Screw Threads, (UN and UNR Thread Form)
2.	ASME B1.20.1-13	Pipe Threads, General Purpose, Inch

B. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle manufactured products in accordance with manufacturer's instructions.

B. Store and protect manufactured products in accordance with manufacturer's instructions and RSHS. Obtain instructions from the manufacturer before delivery of materials to jobsite. Maintain a copy of instructions at jobsite.

C. Protect materials from adverse effects of moisture, sunlight, ultraviolet light, or weather during storage at jobsite.

D. Remove and replace damaged items with new items.

E. Store curing compounds, sealants, adhesives, paints, coatings, sealers, joint compounds, grouts, and similar products at the temperature and environmental conditions recommended by manufacturer.

1.05 MAINTENANCE

A. Extra Materials:

1. Furnish additional maintenance materials specified as "extra materials" in the specifications. Provide maintenance material identical to installed material and provide from the same manufacturer's production lot as installed material.
2. Package extra materials for storage and label with complete product identification on packaging.
3. Deliver extra materials to the Government at jobsite and place in storage as directed by the COR.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials required for completion of work.

B. Provide type and quality described in these specifications. Make diligent effort to procure specified materials from all available sources.

C. Furnish new materials conforming to referenced standards unless otherwise specified.

D. For materials not covered by these or referenced specifications, furnish materials of standard commercial quality.

E. If materials to be used deviate from or are not covered by recognized specifications and standards, submit, for approval, justification for and exact nature of the deviation, and complete specifications for materials proposed for use.

F. Make parts accurately to standard gauge where possible.

1. Use unified screw threads conforming to ASME B1.1 or ASME B1.20.1 for threads, including but not limited to those of bolts, nuts, screws, taps, pipes, and pipefittings.
2. For internal connections only, the Contractor may deviate from ASME standards, provided a complete set of taps and dies are furnished as required to facilitate repair or replacement.

G. Permanently mark fasteners with a symbol identifying the manufacturer and with symbol(s) indicating grade, class, type, and other identifying marks in accordance with reference or applicable standard.

2.02 SUBSTITUTIONS

A. If materials required by these specifications become unavailable, because of Government priorities or other causes, substitute materials may be used.

B. Obtain written approval to use substitute materials from the CO. State in the request for approval the amount of the adjustment, if any, to be made in favor of the Government.

C. The Government's determination as to whether substitution will be permitted and as to what substitute materials may be used, shall be final and conclusive.

D. If approved substitute materials are of less value to the Government or involve less cost to the Contractor than specified material, a contract adjustment will be made in favor of the Government. Where the amount involved or the importance of substitution warrants, a deductive modification to the contract will be issued.

E. No payments in excess of prices offered in the Price Schedule will be made because of substitution of one material for another or because of use of one alternate material in place of another.

2.03 WORKMANSHIP

A. Accurately manufacture and fabricate materials in accordance with best modern practice and requirements of these specifications, notwithstanding minor errors or omissions therein.

B. Use liberal factors of safety and adequate shock-absorbing features in designs, especially for parts subjected to variable stress or shock, including alternating or vibrating stress or shock.

C. Include provisions which prevent components from loosening for shock-absorbing features and parts subject to vibration.

2.04 GOVERNMENT CONTRACT SOURCE QUALITY ASSURANCE

A. Materials will be subject to inspection in accordance with clause at FAR 52.246-12 “Inspection of Construction” at following locations, as determined by the CO at:

1. Place of production or manufacture.
2. Shipping point.
3. Jobsite.

B. To allow sufficient time to provide for inspection, submit at time of issuance, copies of purchase orders, including drawings and other pertinent information, covering material on which inspection will be made as advised by the CO, or submit other evidence if such purchase orders are issued verbally or by letter.

C. Inspection of materials at locations specified above or waiving of inspection shall not be construed as being conclusive as to whether materials and equipment conform to contract requirements under the clause at FAR 52.246-12 “Inspection of Construction” nor shall the Contractor be relieved thereby of the responsibility for furnishing materials meeting the requirements of these specifications.

D. Acceptance of materials will be made only at the jobsite.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s recommendations unless otherwise specified.

3.02 GOVERNMENT CONTRACT FIELD QUALITY ASSURANCE

A. Final inspection and acceptance of materials will be made only at the jobsite after installation and testing.

END OF SECTION

SECTION 01 71 20
SURVEYING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 DEFINITIONS

A. GPS: Global Positioning System.

B. GNSS: Global Navigation Satellite Systems.

C. TPS: Terrestrial Positioning Systems such as total stations and automatic levels.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 71 20-1, Surveying Plan:

1. Describe work layout and survey methods.
2. Surveying schedule.

C. RSN 01 71 20-2, Resume:

1. Proof of Registration as a licensed surveyor or engineer in New Mexico.

D. RSN 01 71 20-3, Accuracy Check Results:

1. Accuracy check of Government-established primary control.

E. RSN 01 71 20-4, Completed and Reduced Survey Notes:

1. Copy of completed and reduced survey notes (electronic or paper) for a survey or portion of survey. Include ASCII coordinate files.

F. RSN 01 71 20-5, Original Field Survey Books.

G. RSN 01 71 20-6, Quantity Survey Notes and Computations:

1. Copies required for progress payment. Include itemized statement for work covered by notes and computations.

H. RSN 01 71 20-7, Workday's Survey Notes:

1. Copies when requested by Government.

1.04 PRIMARY CONTROL

A. Government will establish primary control to be used for establishing work lines and grades.

B. Primary control consists of bench marks and horizontal control points in work vicinity.

C. Government will provide complete listing and identification of primary control within 15 days after issuance of Notice to Proceed.

D. Check and verify primary control and resolve discrepancies with Government before beginning work.

E. Preserve and maintain primary control points until otherwise authorized. Government may reestablish damaged or destroyed primary control points and backcharge reestablishment cost to the Contractor.

1.05 QUALIFICATIONS

A. Surveyors: Experienced construction surveyors under supervision and direction of engineer or licensed surveyor with minimum of 5 years' experience in charge of construction surveys for construction similar in nature to that required by this contract.

PART 2 PRODUCTS

2.01 SURVEYING MATERIALS AND EQUIPMENT

A. Provide materials required for surveying work, including, but not limited to, stakes, spikes, steel pins, templates, platforms, and tools.

B. Except as required to be incorporated in work or left in place, surveying materials remain property of Contractor.

PART 3 EXECUTION

3.01 GENERAL

A. Surveyor shall be on site during construction activities to provide control of work.

B. Cultural Resources:

1. Obtain COR approval before entering site with a vehicle.

2. Refer to Section 01 57 90 - Preservation of Historical and Archeological Data if cultural resources are encountered.

3.02 LAYOUT OF WORK SURVEYS

A. Establish lines and grades for work layout from Government-established primary control points.

B. Establish measurements required for work execution to specified tolerances.

C. Provide stakes, markers, and other survey controls necessary to control, check, and guide construction. Place and mark controls so COR can monitor progress without the use of survey equipment.

3.03 QUANTITY SURVEYS

A. Perform surveys and computations to determine quantities of work performed or placed during each progress payment period.

B. Perform surveys necessary for the Government to determine final quantities of work in place. Final payment quantities will be based on the Government's original terrain data and submitted survey notes and computations.

C. Perform quantity surveys in presence of authorized Government representative, unless specifically waived. Notify the Government at least 24 hours before performing a quantity survey.

3.04 SURVEY REQUIREMENTS

A. Alignment and ROW Staking: Each 50 feet on tangent and each 25 feet on curves.

B. Slope Staking: Each 50 feet on tangent and each 25 feet on curves, stake every 10 feet in elevation on slopes.

C. Structures: Stake out of structures and checkouts before and during construction.

D. Roads: Blue tops each 50 feet on tangent and each 25 feet on curves.

E. Cross-sections: Original, final, and intermediate as required, for structure sites and other locations as necessary for quantity surveys. Survey borrow areas before and after removal of materials, but before final shaping.

F. As-builts: As required for structures and other features of work.

G. A licensed surveyor shall survey and stake the ROW boundaries.

3.05 ACCURACY

A. Degree of Accuracy:

1. Alignment of Tangents and Curves: Within 0.1 foot.
2. Structure Points: Set within 0.01 foot, except where installation or operation considerations require tighter tolerances.
3. Blue Tops: Set within 0.1 foot.
4. Cross-Section Points: Locate within 0.1 foot, horizontally and vertically.
5. Vertical Control Surveys: Close within 0.05 foot times the square root of the circuit length in miles.

3.06 FIELD RECORDS

A. Record field notes, computations, and other surveying data on electronic data collection devices or in fieldbooks. Field records shall be complete and accurate record of survey.

B. Record survey data in accordance with recognized professional surveying standards.

1. Notes or data not in accordance with standard formats will be rejected.
2. Illegible notes or data or erasures on any page of a fieldbook will be sufficient cause for rejection of part or all of fieldbook.
3. Corrections by ruling or lining out errors will be permitted.
4. Copied notes or data will not be permitted.
5. Rejection of part or all of a fieldbook may necessitate resurveying.

C. Data and notes may be collected on electronic data collection devices with prior approval of the COR.

1. Electronic files of notes: In approved format.
2. Include electronic files and paper copies of notes in submittals.

END OF SECTION

SECTION 01 74 00
CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work except as specified.
2. Cost of environmental site assessments are the Contractor's responsibility.

1.02 DEFINITIONS

A. Hazardous waste: Defined as hazardous by 40 CFR 261.3; or by other Federal, State, or local laws or regulations.

1.03 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

B. Code of Federal Regulations (CFR)

1.	40 CFR 261.3	Definition of Hazardous Waste
2.	49 CFR 171-179	Transportation - Hazardous Waste Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 74 00-1, Waste Production and Disposal Plan:

1. For each type of waste, list estimated quantity and planned disposal location.

C. RSN 01 74 00-2, Waste Production and Disposal Records.

1. For each type of waste, list quantity and disposal location.
2. Include certifications that waste was properly disposed.
3. Hazardous wastes manifests.

D. RSN 01 74 00-3, Environmental Consultant Resume:

1. Describe experience on similar project.

E. RSN 01 74 00-4, Environmental Site Assessment.

1.05 QUALIFICATIONS

A. Environmental consultant: Minimum 2 years' experience in conducting environmental site assessments for similar construction.

1.06 REGULATORY REQUIREMENTS

A. Comply with Federal, State, Navajo Nation and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

D. Comply with local regulations for presuppression, suppression, and prevention of fires when burning wastes.

1.07 PROJECT CONDITIONS

A. Report waste materials discovered at jobsite to COR.

1. Cease work in areas where waste may be hazardous until waste materials are investigated by the Government.
2. If waste is hazardous, the CO may order delays in time of performance or changes in work, or both.
3. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROGRESS CLEANING

A. Keep work and storage areas free from accumulations of waste materials and rubbish.

3.02 FINAL CLEANUP

A. Remove temporary plant facilities, buildings, concrete footings and slabs, rubbish, unused materials, concrete forms, and other similar materials which are not part of permanent work.

3.03 DISPOSAL

A. Nonhazardous waste materials:

1. Recycle at least 25 percent of waste materials. Submit documentation to COR in approved form.
2. Dispose of nonhazardous waste materials that are not reused or recycled at appropriately permitted disposal facilities.
3. Combustible waste materials: Dispose by removal from jobsite and Section 31 11 00 - Clearing and Grubbing.
4. Dispose by removal from jobsite.
5. Do not burn waste materials.
6. Do not bury waste materials.

B. Hazardous Waste Disposal:

1. Dispose by removal from jobsite.
2. Recycle hazardous waste whenever possible.
3. Dispose of hazardous waste materials that are not recycled at appropriately permitted treatment or disposal facilities.
4. Transport hazardous waste in accordance with 49 CFR 171-179.

C. Certification: Certify that wastes are disposed of in accordance with Federal, State, and local regulations.

3.04 SITE ASSESSMENT

A. Upon completion of work, perform site assessment at following areas for work done under these specifications:

1. Hazardous waste accumulation areas.
2. Petroleum dispensing and storage areas.
3. Hazardous material storage areas.

B. Employ qualified environmental consultant to perform assessments.

C. Demonstrate and document by appropriate analytical sampling that site contamination is less than regulator action cleanup levels. Submit written report with sampling locations, findings, manifests, photos and other pertinent information.

3.05 RECORDS

A. Keep records of types and amounts of waste materials produced.

B. Keep records of waste material disposal.

END OF SECTION

SECTION 01 78 30
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the Price Schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 78 30-1, Progress As-built Drawings:

1. As-built drawings for a particular structure or work.
2. Copies of As-built drawings maintained on site. Colored copies are not required.

C. RSN 01 78 30-2, Final As-built Drawings:

1. Certified marked sets.

1.03 RECORD DRAWINGS

A. Maintain 1 sets of full-size prints of contract drawings marked to show accurate and complete records of as-built conditions. Keep drawings at the jobsite and mark as work progresses.

1. Mark and dimension to show variations between actual construction and that indicated or specified in contract documents. Include:
   a. Buried or concealed construction and utilities.
   b. Existing items, topographic features, and utility lines revealed during construction which differ from those shown on contract drawings.
2. Mark to define construction actually provided where choice of materials or methods is permitted in specifications, or where variations in scope or character of work from that of the original contract are authorized.

B. Use standard drafting practice to represent changes and include supplementary notes, legends, and details necessary to clearly portray as-built construction.

C. Mark as-built drawings in the following colors:

1. Red - Additions to original drawings.
2. Green - Deletions to original drawings.

3. Blue - Notations necessary for explanation of as-built markings.

D. Allow the Government to review the drawings at all times.

E. Upon completion of work, sign marked prints as certified correct.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 03 11 10
CONCRETE FORMING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include thrust block forming in the price in Price Schedule for Line Pipe.

B. Cost:

1. Include in the price in Price Schedule for Air Chamber No. 1.

C. Cost:

1. Include in the price in Price Schedule for Air Chamber No. 2.

D. Cost:

1. Include in the price in Price Schedule for Regulating Tank No. 1.

E. Cost:

1. Include in the price in Price Schedule for Regulating Tank No. 2.

1.02 REFERENCE STANDARDS

A. American Concrete Institute

1.	ACI 318-11	Building Code Requirements for Structural Concrete and Commentary

B. APA - The Engineered Wood Association (APA)

1.	APA PS 1-09	Structural Plywood

C. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

D. Western Wood Products Association (WWPA)

1.	WWPA WLGR-11	Western Lumber Grading Rules

PART 2 PRODUCTS

2.01 THRUST BLOCKS

A. See Section 33 11 10 - Line Pipe.

2.02 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.03 REGULATING TANK NO. 1 AND NO. 2

A. See Section 33 16 50 - Steel Tanks.

PART 3 EXECUTION

3.01 FORM MATERIALS

A. Sheathing or Lining: Conform to Table 03 11 10A - Form Sheathing or Lining Materials, or provide other materials which will produce equivalent results.

Table 03 11 10A - Form Sheathing or Lining Materials

Finish	Wood sheathing or lining	Steel sheathing or lining
F1	Any grade common board or plywood	Steel sheathing permitted Steel lining permitted
F2	No. 2 common or better, shiplap, or plywood	Steel sheathing permitted Steel lining permitted if approved
F3	Plywood	Steel sheathing permitted Steel lining not permitted

B. Steel sheathing is steel sheets not supported by wood backing. Steel lining is thin sheets supported by wood backing.

C. Wood Sheathing or Lining: Softwood or plywood of such kind and quality and treated or coated so that deterioration or discoloration of formed concrete surfaces due to chemical action, contamination, or uneven absorption of water from concrete is prevented.

D. Plywood: APA PS1, Exterior, Grade B-B Concrete Form, Class I, mill oiled and edge sealed.

E. Softwood Lumber:

1. Meet requirements of WWPA WLGR for dressed lumber or worked lumber of specified grade.

2. Use common boards surfaced on both edges (S2E) in accordance with WWPA WLGR.

3. Use 6 or 8 inch wide lumber for shiplap forms.

4. Use same lumber width in forms for F2 finishes.

F. F3 Finish Forms: Use material with basic modular size of 4 by 8 feet.

3.02 INSTALLATION

A. Construct forms to confine and shape concrete to required lines so that completed work meets specified structural deviations, surface tolerances, and finish requirements.

B. Construct forms with sufficient strength to withstand pressure from placing and vibrating concrete. Maintain in proper position.

C. Adjust formwork design and concrete placing rate to compensate for hydraulic pressures exerted on forms by concrete with high fluidity.

D. Where form vibrators are to be used, construct forms with sufficient rigidity to effectively transmit energy from form vibrators to concrete without damaging formwork or altering form position.

E. Seal surfaces and joints of forms to prevent absorption of water into forms or loss of mortar from concrete.

F. Place chamfer strips in corners of forms and at tops of wall placements to bevel edges of permanently exposed concrete surfaces. Do not bevel interior angles of intersecting concrete surfaces and edges of construction joints except as indicated on drawings.

G. Install sufficient plumb and string lines to monitor formwork positions before concrete placement. Monitor plumb and string lines during concrete placement and correct deficiencies in formwork.

H. F2 Finish:

1. Use 1 type of form sheathing or lining material for exposed F2 surfaces.

2. Construct forms to produce a uniform and consistent texture and pattern on face of concrete. Metal patches on forms are not permitted.

3. Place form sheathing or lining so that horizontal form marks are continuous across entire surface.

4. For forms constructed of plywood form lining or shiplap panels, make vertical form marks continuous for entire height of surface.

5. For forms constructed of shiplap which is not paneled, cut boards square, stagger vertical joints in boards, and place vertical joints at studs.

I. F3:

1. Use 1 type of form sheathing or lining material for F3 surfaces. Fabricate filler panels for corners, soffits, and similar offsets from same material as used for forms.
2. Construct forms to produce a uniform and consistent texture and pattern on face of concrete. Metal patches on forms are not permitted.
3. Align sheathing or lining horizontally and vertically and place to minimize joint marks on surfaces.
4. Place form sheathing or lining so that horizontal form marks are continuous across entire surface.
5. Make vertical form marks continuous for entire height of surface.
6. Fill and smooth finish voids at joints in plywood form lining or sheathing.
7. Do not construct forms continuously from lift to lift. Remove forms after concrete in a lift has hardened and reset forms for next lift.
8. Reset forms to overlap hardened concrete in previous lift by 1 inch, maximum.
9. Tighten forms snugly against hardened concrete so that forms will not spread and cause offsets or loss of mortar at construction joints when concrete placement is resumed. Provide additional bolts or form ties required to hold reset forms tight against hardened concrete.

J. Form Ties and Anchors:

1. Embed ties for holding forms.
2. Terminate ties not less than 2 diameters or twice minimum dimension of tie, whichever is greater, from formed surface of concrete, except where F1 finish is permitted.
3. Install ties so ends or end fasteners can be removed without causing spalling at face of concrete.
4. Provide form anchors as required to ensure that concrete surfaces will meet specified tolerances. Replace form anchors embedded in concrete which are loosened before placement of adjoining concrete with other supports firmly embedded in hardened concrete.

K. Cleaning and Oiling Forms:

1. Clean form surfaces of encrustations of mortar, grout, or other foreign material.
2. Coat form surfaces with a form oil which will prevent sticking and will not soften or stain concrete surfaces or cause concrete surface to become chalky or dust producing.

3.03 REMOVAL

A. Remove forms within 24 hours after concrete has gained sufficient strength to prevent damage by form removal.

1. Nonsupporting forms such as sides of beams, walls, columns, and similar items: Remove after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement when:

    a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.

    b. Curing protection is maintained.

B. Do not remove forms until concrete strength is such that form removal will not result in perceptible cracking, spalling, or breaking of edges or surfaces, or other damage to concrete.

C. Remove forms in a manner which prevents damage to concrete.

D. Repair damaged concrete in accordance with Section 03 30 00 - Cast-in-Place Concrete.

E. Begin required repair and curing immediately after form removal.

END OF SECTION

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SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include thrust block reinforcing in the price in the Price Schedule for Line Pipe.

B. Cost:

1. Include valve box reinforcing in the price in the Price Schedule for NAPI Turnout.

C. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 1.

D. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 2.

E. Cost:

1. Include in the price in the Price Schedule for Regulating Tank No. 1.

F. Cost:

1. Include in the price in the Price Schedule for Regulating Tank No. 2.

G. Cost:

1. Include valve box reinforcing in the price in the Price Schedule for Valves and Equipment.

1.02 PAYMENT PROCEDURES

A. Includes splices located as shown on drawings or relocated splices approved by COR. Does not include splices allowed for Contractor convenience.

B. Does not include weight of accessories.

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 315-99	Details and Detailing of Concrete Reinforcement (Part of SP-66-04 ACI Detailing Manual)

B. ASTM International (ASTM)

1.	ASTM A615/A615M-14	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
2.	ASTM A996/A996M-14	Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 03 20 00-1, Reinforcement Diagrams and Lists:

1. Bar-placing diagrams, bar lists, and bar-bending diagrams required for reinforcement fabrication and placement.

a. Prepare bar-placing diagrams, bar lists, and bar-bending diagrams in accordance with ACI 315 and drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting.

B. Protect from contaminants such as grease, oil, and dirt.

C. Provide for identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.01 LINE PIPE

A. See Section 33 11 10 - Line Pipe.

2.02 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.03 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.04 REGULATING TANK NO. 1 AND NO. 2.

A. See Section 33 16 50 - Steel Tanks.

2.05 VALVES AND EQUIPMENT

A. See Section 35 22 15 - Valves and Equipment.

2.06 STEEL REINFORCING

A. Reinforcing Bars:

1. ASTM A615, Grade 60; or ASTM A996, Type A, Grade 60.
2. Deformed steel bar.

2.07 ACCESSORIES

A. Chairs, hangers, spacers, and other supports:

1. Material: Concrete, metal or other approved material.
    a. Compressive strength of precast concrete blocks: Equal to or greater than surrounding concrete.

PART 3 EXECUTION

3.01 INSTALLATION

A. Clean reinforcement surfaces of heavy, flaky rust; loose mill scale; dirt; grease; and other foreign substances before placement.

B. Field bending not allowed unless approved by COR.

1. Do not use heat to bend.

C. Do not use torch to cut.

D. Accurately place reinforcement:

1. Place reinforcement as shown on standard drawing 40-D-6263, unless otherwise shown on reinforcement design drawings.
2. Unless otherwise prescribed, placement dimensions shall be to the centerline of the bars.
3. Place reinforcement with a clear distance of 1 inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on drawings.

E. Splices:

1. Locate where shown on drawings, unless otherwise approved by COR.
2. Reinforcement may be spliced at additional locations for the convenience of the Contractor, subject to approval of COR.

F. Do not weld or tack weld reinforcing bars.

G. Secure reinforcement in place so that it will not be displaced during concrete placement.

H. Do not disturb reinforcement in concrete that has been placed.

I. Tolerances:

1. Maintain concrete cover over reinforcement within 1/2 inch of specified cover where specified cover is greater than 2-1/2 inches.
2. Maintain concrete cover over reinforcement within 1/4 inch of specified cover where specified cover is 2-1/2 inches or less.
3. Maintain spacing of reinforcing bars within 1 inch of required spacing.

J. Embedded Dowels:

1. Place dowels at locations shown on drawings.
2. Position dowels parallel to each other and to concrete surface as shown on drawings.
3. Maintain dowels accurately in position during concrete placement.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include concrete for thrust blocks in the price in the Price Schedule for Line Pipe.

B. Cost:

1. Include concrete for valve box in the price in the Price Schedule for NAPI Turnout.

C. Cost:

1. Include in price in the Price Schedule for Air Chamber No. 1.

D. Cost:

1. Include in price in the Price Schedule for Air Chamber No. 2.

E. Cost:

1. Include in price in the Price Schedule for Regulating Tank No. 1.

F. Cost:

1. Include in price in the Price Schedule for Regulating Tank No. 2.

G. Cost:

1. Include encasements and blocking in the Price Schedule for Steel Pipe.

H. Cost:

1. Include concrete for valve box in the Price Schedule for Valves and Equipment.

1.02 ACRONYMS

A. NRMCA: National Ready Mixed Concrete Association.

1.03 DEFINITIONS

A. Supplementary Cementitious Materials (SCM): Cementitious materials other than portland cement.

1.04 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 201.2R-08	Guide to Durable Concrete
2.	ACI 301-10	Structural Concrete
3.	ACI 304R-00(2009)	Guide for Measuring, Mixing, Transporting, and Placing Concrete
4.	ACI 305.1-14	Hot Weather Concreting
5.	ACI 306.1-90(2002)	Cold Weather Concreting

B. ASTM International (ASTM)

1.	ASTM C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
2.	ASTM C33/C33M-13	Concrete Aggregates
3.	ASTM C39/C39M-15a	Compressive Strength of Cylindrical Concrete Specimens
4.	ASTM C42/C42M-13	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5.	ASTM C94/C94M-15	Ready-Mixed Concrete
6.	ASTM C114-17	Chemical Analysis of Hydraulic Cement
7.	ASTM C117-13	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
8.	ASTM C136-14	Sieve Analysis of Fine and Coarse Aggregates
9.	ASTM C138/C138M-14	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
10.	ASTM C143/C143M-12	Slump of Hydraulic-Cement Concrete
11.	ASTM C150/C150M-12	Portland Cement
12.	ASTM C171-07	Sheet Materials for Curing Concrete
13.	ASTM C231/C231M-14	Air Content of Freshly Mixed Concrete by the Pressure Method
14.	ASTM C260/C260M-10a	Air-Entraining Admixtures for Concrete
15.	ASTM C295/C295M-12	Petrographic Examination of Aggregates for Concrete
16.	ASTM C309-11	Liquid Membrane-Forming Compounds for Curing Concrete

17.	ASTM C494/C494M-13	Chemical Admixtures for Concrete
18.	ASTM C566-13	Total Evaporable Moisture Content of Aggregate by Drying
19.	ASTM C595/C595M-14	Blended Hydraulic Cements
20.	ASTM C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
21.	ASTM C920-14a	Elastomeric Joint Sealants
22.	ASTM C989/C989M-14	Slag Cement for Use in Concrete and Mortars
23.	ASTM C1017/C1017M-13	Chemical Admixtures for Use in Producing Flowing Concrete
24.	ASTM C1064/C1064M-12	Temperature of Freshly Mixed Hydraulic-Cement Concrete
25.	ASTM C1260-14	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
26.	ASTM C1293-08b	Determination of Length of Change of Concrete Due to Alkali-Silica Reaction
27.	ASTM C1315-11	Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
28.	ASTM C1567-13	Determining the Potential Alkali-Silica Reactivity of Combination of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
29.	ASTM C1602/C1602M-12	Mixing Water Used in the Production of Hydraulic Cement Concrete
30.	ASTM D1752-04a(2013)	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

C. Bureau of Reclamation (USBR)

1.	USBR M-47	Repair of Concrete, August 1996 (Appendix A of “Guide to Concrete Repair” available at http://www.usbr.gov/tsc/techreferences/mands/mands-pdfs/guide.pdf
2.	USBR Concrete Manual	Concrete Manual, Eighth Edition, Revised Reprint, 1981

D. U.S. Army Corps of Engineers (COE)

1.	COE CRD-C662-10	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

E. International Concrete Repair Institute (ICRI)

1.	ICRI 310.2-13	Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays (formerly No. 03732)

F. National Sanitation Foundation (NSF)

1.	NSF 61-14a	Drinking Water System Components - Health Effects

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 03 30 00-1, Approval Data:

1. Mix Design: For each concrete mix.
    a. Mixture proportions.
    b. Material sources.
        1) Name and manufacturer of each cementitious material.
        2) Name of aggregate source(s).
        3) Product name and manufacturer of admixtures to be used in mix. Certify that admixtures:
            a) Contain no purposefully added chlorides.
            b) Chloride ion limits in accordance with ACI 201.2R.
        4) Government reserves the right to require submission of samples of concrete materials for testing before or during use in concrete.
    c. Physical properties:
        1) Compressive strength:
            a) Test data: ACI 301, paragraph 4.2.3.4.
            b) Field test data: Performed within past 24 months for compressive strength.
            c) Laboratory trial mixtures:

i. Incorporate admixtures that will be used in production mixes into trial mixes.

ii. Results from trial batches made within past 6 months.

iii. Trial mix test results, 3 six inch diameter cylinders each at 7 and 28 days.

iv. Average compressive strength of trial batch cylinders at specified design age.

d. Resubmit mix design for change in material source or type.

2. Name and manufacturer of curing compounds, and joint filler.

a. Include application instructions for curing compound.

3. Certifications and test reports:

a. Sealed by Professional Engineer.

b. Less than 12 months old for aggregates.

c. Certifications and test reports:

1) Cementitious materials manufacturer.

2) Aggregate producer for:

a) ASTM C33 physical properties.

b) ASR testing reports for each aggregate source.

3) Mixing water: ASTM C1602.

d. Submittal of certifications and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirements.

C. RSN 03 30 00-2, Certifications:

1. NRMCA Certification of Production Facilities. NRMCA certification shall include automatic digital recording of cementitious materials, aggregate, water, and chemical admixtures.

2. ACI Aggregate Testing Technician certification(s).

3. ACI Concrete Field Testing Technician certification(s).

4. ACI Concrete Strength Testing Technician certification(s).

D. RSN 03 30 00-3, Cementitious Materials Certification and Test Reports.

1. Less than 3 months old.

2. Certify materials were tested during production or transfer in accordance with specified reference standards.

E. RSN 03 30 00-4, Test Reports.

1. Aggregate test results as required by Table 03 30 00B - Contractor Batch Plant Quality Testing.

2. Concrete test reports as required by Table 03 30 00E- Contractor Field Quality Testing.

1.06 QUALIFICATIONS

A. Ready mix plant:

1. Certified by NRMCA.

a. NRMCA certification shall include automatic digital recording of cementitious materials, aggregate, water, and chemical admixtures.

B. Aggregate Testing Technician: Currently certified ACI Aggregate Testing Technician - Level 1.

C. Flatwork foreman with at least 5 years of experience with similar type placements.

D. Concrete Field Testing Technician: Currently certified ACI Concrete Field Testing Technician - Grade I.

E. Strength Testing Technician: Currently certified ACI Strength Testing Technician.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Furnish legible and digitized batch ticket with each batch of concrete in accordance with ASTM C94. Deliver ticket to COR at jobsite during batch delivery.

B. Sponge rubber joint filler storage:

1. Store in protected area at temperature of 70 degrees F (21 degrees C) or less.

2. Do not expose to direct sun.

1.08 PRE-PLACING MEETING

A. At least 14 days before first concrete placement, meet with COR for pre-placement meeting.

B. Coordinate time and place of meeting with COR at least 14 days before meeting.

C. Contractor attendees shall be at least the following:

1. Contractor onsite supervisor.

2. Concrete forming, placing, and finishing onsite supervisor(s); Contractor or subcontractor(s) employee as applicable.

3. Technical specialist from ready-mix supplier.
4. Concrete pump subcontractor onsite supervisor, if applicable.
5. Testing agency onsite supervisor(s).

PART 2 PRODUCTS

2.01 LINE PIPE

A. See Section 33 11 10 - Line Pipe.

2.02 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.03 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.04 REGULATING TANK NO. 1 AND NO. 2

A. See Section 33 16 50 - Steel Tanks.

2.05 STEEL PIPE

A. See Section 35 21 95 - Steel Pipe.

2.06 VALVES AND EQUIPMENT

A. See Section 35 22 15 - Valves and Equipment.

2.07 CEMENTITIOUS MATERIALS

A. Portland cement:
   1. ASTM C150, Type V.
      a. Meet equivalent alkalies requirements of ASTM C150 - Table 2.
         1) Low-alkali limitation for portland cement may be waived when tests of concrete aggregate source show that low-alkali cement is not required for ASR mitigation. See Concrete Aggregate Materials article (2.03).
      b. Meet false-set requirements of ASTM C150 - Table 4.

B. Blended hydraulic cement:
   1. ASTM C595, Type HS.

2. Meet equivalent alkalies requirement of ASTM C595, Table 2, Option G. or Table 3.

C. SCM:

1. Pozzolan:

a. ASTM C618, Class F:

1) Except:

a) Sulfur trioxide, maximum: 4.0 percent.

b) Loss on ignition, maximum: 2.5 percent.

2) In addition:

a) Meets Effectiveness in Controlling Alkali-Silica Reaction in Table 3 Supplementary Optional Physical Requirements of ASTM C618.

b) Calcium oxide, maximum: 8.0 percent.

c) Pozzolan "R" factor less than 2.5. Pozzolan with this "R" factor shall not decrease sulfate resistance of concrete.

i. R: (C-5)/F.

ii. C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.

iii. F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

2. Slag Cement: ASTM C989, Grade 120.

2.08 WATER

A. ASTM C1602, including optional requirements of Table 2.

2.09 AGGREGATE MATERIALS

A. Fine aggregate: ASTM C33.

1. Percent material passing No. 200 sieve: Less than 3 percent.

B. Coarse aggregate: ASTM C33, Class 4S, Size No. specified in Table 03 30 00A - Concrete Mixes.

C. Alkali Silica Reaction (ASR):

1. Test fine and coarse aggregates in accordance with ASTM C1260 for potential deleterious ASR.

a. For ASTM C1260, and other tests when required, continue readings for 28 days after the zero readings.

b. Acceptance criteria specified below are based on 14 day readings after the zero readings.

c. Expansion is no greater than 0.10 percent: Aggregates are acceptable.

d. Expansion is greater than 0.10 percent:

1) Test aggregates according to ASTM C1567 using components (e.g. coarse aggregate, fine aggregate, cementitious materials, and ASR inhibiting admixtures) in proportions proposed for mixture design.

a) For mixes using lithium admixtures use test procedure COE CRD-C 662.

b) Expansion of proposed mixture design test specimens, tested in accordance with ASTM C1567 does not exceed 0.10 percent:

i. Aggregates are acceptable.

c) Expansion of proposed mixture design test specimens is greater than 0.10 percent:

i. Aggregates are not acceptable unless adjustments to mixture design can reduce expansion to less than 0.10 percent, or testing by ASTM C1293 indicates aggregates will not experience deleterious expansion.

2) Use tested materials. Materials may be rejected if they do not match tested materials.

2. ASTM C1293 test results may be substituted for ASTM C1260 test results.

a. Average ASTM C1293 concrete prism expansion less than 0.04 percent at one year: Aggregates acceptable.

D. Appropriate for use in accordance with ASTM C295.

2.10 ADMIXTURES

A. Air-entraining admixture: ASTM C260.

B. Chemical admixtures:

1. Do not use chemical admixtures which contain more than 0.1 percent chloride, by weight.

2. Admixtures shall be compatible with each other.

3. Allowable chemical admixtures:

a. ASTM C494, Type A, D, F, G, or S.

b. ASTM C1017, Type I or II.

c. ASTM C494, Type C and E, provided they do not contain chlorides.

C. Specialized chemical admixtures:

1. When batch plant has not previously used a specialized chemical admixture, admixture manufacturer shall provide on-site representative to assist with mix design and to trial batch plant personnel in dispensing and mixing operations.

2. Do not use specialized chemical admixtures which contain more than 0.1 percent chloride, by weight.

3. Alkali Silica Reaction (ASR) Inhibiting Admixture:

a. Lithium Nitrate Admixture for ASR mitigation of reactive aggregates having the following characteristics:

1) Meets NSF 61.

2) Nominal 30 percent aqueous solution of Lithium Nitrate.

a) Density: 10 pounds per gallon or 1.2 kilograms per liter.

b) Approximate chemical constituents (percent by mass):

i. LiNo3 (Lithium Nitrate): 30 plus or minus 0.5.

ii. SO4-2 (Sulfate Ion), maximum: 0.1.

iii. Cl- (Chloride Ion), maximum: 0.2.

iv. NA+ (Sodium Ion), maximum: 0.1.

v. K+ (Potassium Ion), maximum: 0.1.

b. Coordinate with manufacturer regarding Lithium Nitrate dosage.

c. Do not use Lithium Nitrate Admixture for concrete in continuous or nearly continuous contact with water.

4. Extended set control admixture:

a. Delvo Stabilizer manufactured by BASF Construction Chemicals, Inc. www.basf-admixtures.com; or equal, with the following essential characteristics:

1) Meets ASTM C494, Type B.

2) Retards setting.

3) Does not reduce concrete strength.

b. Use within manufacturer’s time limits.

c. Include admixture on batch ticket.

d. Admixture quantity required to stabilize concrete shall be pre-determined using jobsite materials. Initial concrete setting time shall be monitored and adjusted during project by qualified concrete technician.

2.11 CURING MATERIALS

A. Water: ASTM C1602, including optional requirements of Table 2.

B. Curing compound: ASTM C309.

1. Capable of meeting moisture retention at manufacturer's application rate.
2. Meet Federal, state, and local regulations for VOCs.

C. Sheet materials:

1. Polyethylene film: ASTM C171, clear.
2. White burlap-polyethylene sheeting: ASTM C171.

2.12 ACCESSORIES

A. Sponge rubber joint filler:

1. ASTM D1752, Type I, except:
    a. Test specimen compression load: 50 to 150 pounds per square inch.
2. Joint filler adhesive: Nonbituminous adhesive recommended by filler manufacturer.

B. Elastomeric sealant: ASTM C920, polyurethane, Use M, Grade NS, Class 25.

C. Evaporation control:

1. MasterKure ER 50 manufactured by BASF Construction Chemicals, Inc., www.basf-admixtures.com; or equal having the following essential characteristics:
    a. Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
    b. For application after finishing and prior to applying curing compound.
    c. For use when the evaporation rate is high.
2. Do not use as finishing aid.

D. Plastic vapor retarder:

1. Preformed flexible membrane meeting ASTM E1745.
    a. Thickness: 10 mils, minimum.
2. Sealing materials for laps and protrusions: Recommended by manufacturer.

2.13 MIX

A. Design and adjust concrete mix.

1. The Government reserves the right to adjust mix proportions when need for adjustment is indicated by results of materials testing.

    a. When required, adjustment of mix proportions by the Government will be in accordance with USBR Concrete Manual.

B. Cementitious materials options:

1. Specified portland cement plus specified pozzolan by percent weight specified in Table 03 030 00A - Concrete Mixes.

2. Specified portland cement plus specified slag cement by percent weight specified in Table 03 03 00A - Concrete Mixes.

3. Blended Hydraulic: ASTM C595 provided, specified portland cement with percent of specified pozzolan or specified slag cement specified in Table 03 03 00A - Concrete Mixes.

C. Design concrete mixes in accordance with Table 03 30 00A - Concrete Mixes. General concrete mix shall be used for concrete unless otherwise specified.

1. Net water-cementitious materials ratio (w/c) is maximum, by weight. Cementitious material weight is cement plus SCM.

2. Slump at point of placement: In accordance with ASTM C143.

3. Air Entrainment: Percent air by volume of concrete as discharged at point of placement, in accordance with ASTM C231.

Table 03 30 00A - Concrete Mixes

Mix No	Feature	f'c (pounds per square inch)	Max w/c*	NMSA**	Percent SCM*** A: Class F Pozzolan B: Slag Cement C: Silica Fume	Slump (in)	Air Content (percent)	Notes
1	General Concrete	4500 at 28 days	0.45	No. 57, or 67	A or B: 20 plus or minus 5	2 to 4	4.5 to 7.5	1, 2
2	Air Chamber Foundations and Pre-manufactured Pump Station Foundations, Regulating Tank Foundations	4500 at 28 days	0.45	No. 57, or 67	A or B: 20 plus or minus 5	2 to 4	4.5 to 7.5	1, 2

Table 03 30 00A - Concrete Mixes

Mix No	Feature	f'c (pounds per square inch)	Max w/c*	NMSA**	Percent SCM*** A: Class F Pozzolan B: Slag Cement C: Silica Fume	Slump (in)	Air Content (percent)	Notes
3	Pipe Encasements and Thrust Restraint	4500 at 28 days	0.45	No. 57, or 67	A or B: 20 plus or minus 5	3 to 5	4.5 to 7.5	1, 2

*Maximum water/cementitious materials ratio.
**Nominal Maximum Size Aggregate.
*** SCM as percent of total cementitious material, by weight.
NOTES:

1. Ternary blended cementitious materials which meet the specifications may be submitted for approval.
2. Concrete with ASTM C1017, Type I or II plasticizing admixtures, ASTM C494 Type F high-range water-reducing admixtures, or Type G high-range water-reducing and retarding admixtures:
   i. Admixture shall be incorporated into trial batch or historical data.
   ii. Use slump appropriate for placing conditions.

D. Submit design mixes for each type and strength of concrete substantiated by either laboratory trial batch or field performance methods as specified in ACI 301. For trial batch method, mix shall be proportioned and stamped by a professional engineer.

E. Concrete trial mixes:

1. Average compressive strength of trial batch cylinders at design age: Design strength plus 1,200 psi for concrete between 3,000 and 5,000 psi.
2. Admixtures to be used in mix shall be incorporated into mix design submitted for approval.
3. Air content: Within 1 percent of top of specified range.
4. Slump: Within 1 inch of top of specified range.

2.14 BATCHING, MIXING, AND TRANSPORTING

A. Batch plant: NRMCA certified with automatic digital recording of cementitious materials, aggregate, water, and chemical admixtures.

B. Manufacture and deliver in accordance with ASTM C94 and ACI C304R.

1. Prepare batch ticket in accordance with ASTM C94 for every batch of concrete.

C. Cold weather: When air temperature has fallen to or is expected to fall below 40 degrees F, prepare ingredients and mix in accordance with ACI 306.1.

1. Do not use frozen materials or materials containing ice or snow.

2. Uniformly heat water and aggregates before mixing to obtain concrete mixture temperature of not less than 50 degrees F.

D. Hot Weather: When precautions are necessary, prepare ingredients and mix in accordance with ACI 305.1.

1. Cool ingredients before mixing to maintain specified maximum concrete temperature at time of placement.

2. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Ice replacing batch water shall be melted prior to discharge.

3. Using liquid nitrogen to cool concrete is Contractor's option.

E. Prevent appreciable segregation of ingredients.

F. Place concrete within 90 minutes from introduction of cement to water or aggregates.

1. For placing times exceeding 90 minutes, extended set control admixtures may be used when approved by COR.

2.15 CONCRETE TEMPERATURE

A. Concrete temperature at placing:

1. 50 to 85 degrees F (10 to 29 degrees C).

2.16 CONTRACTOR QUALITY TESTING

A. Perform sampling, testing, and reporting as required in Table 03 30 00B - Batch Plant Testing.

1. Independent testing agency in accordance with Section 01 46 20 - Testing Agency Services.

2. Personnel conducting tests: Qualified as ACI Aggregate Testing Technician, Level 1; or equal.

B. Perform tests at least as often as frequencies specified in Table 03 30 00B - Batch Plant Testing.

C. Notify COR immediately of test results showing failure of materials to meet specifications. Provide passing test to COR within 24 hours. Submit reports of test results as specified.

2.17 GOVERNMENT CONTRACT QUALITY ASSURANCE - SOURCE

A. The Government will perform, as a minimum, tests listed in Table 03 30 00B - Batch Plant Testing. This testing is in addition to the Contractor's Quality Control program and does not relieve the Contractor of performing adequate Quality Control testing. The list of tests is provided to alert the Contractor to potential impacts to work scheduling.

B. Government testing frequency is at the discretion of the COR. Greater frequency testing is normally performed at start of placing a mix design, when changing a mix design, when inconsistencies of materials is noticed, or when significant changes are made at batch plant. Testing frequency listed in Table 03 30 00B - Batch Plant Testing is provided only as approximation of Government testing.

C. In addition to specified Contractor Quality Testing, the Government may also perform the tests listed in Table 03 30 00B - Batch Plant Testing.

2.18 BATCH PLANT TESTING

Table 03 30 00B- Batch Plant Testing

TESTS OF	TEST STANDARD	STANDARD TITLE	REQUIREMENT	TESTING FREQUENCY
Aggregate Gradation	ASTM C136	Sieve Analysis of Fine and Coarse Aggregates	Fine and Coarse Aggregate meets sizing requirements per ASTM C33.	At beginning of placing each mix. At change in mix design. At least every 500 yd3 of placing a mix.
Aggregate Fines content	ASTM C117	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing	Fine aggregate meet specified allowable fines content (material passing No. 200 sieve)	At beginning of placing each mix. At change in mix design. At least every 500 yd3 of placing a mix.
Aggregate moisture content	ASTM C566	Total Evaporable Moisture Content of Aggregate by Drying	Verify that moisture meter at batch plant is accurate with the material batched.	At beginning of placing each mix. At change in mix design. At least every 500 yd3 of placing a mix.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove standing water, mud, and debris from foundation surfaces to be covered by concrete.

B. Prepare rock surfaces free from oil, objectionable coatings, and loose, semidetached, and unsound fragments. Immediately before placement of concrete, wash rock surfaces with air-water jet and dry to uniform surface-dry condition.

C. Prepare earth foundations free from frost or ice.

D. Thoroughly moisten surfaces of absorptive foundations to be covered with concrete so that moisture will not be drawn from fresh concrete. Keep subgrade moisture uniform without puddles or dry areas.

E. Clean, roughen, and surface dry surfaces of construction joints to be covered with fresh concrete.

1. Remove laitance, loose or defective concrete, coatings, sand, curing compound, and other foreign material.
2. Sandblast, steel shotblast, or high-pressure water jet surfaces, or use other method approved by COR to create a surface equivalent to or larger than CSP 5 in accordance with ICRI 310.2.
3. Wash surface thoroughly, and surface dry immediately before placement of adjoining concrete.

3.02 PLACING

A. Notify COR at least 24 hours before placing concrete.

B. Provide placement checkout cards in a watertight container. COR will approve placement card format.

1. Sign each line item indicating work is completed in accordance with specifications.
2. Obtain COR signature after each line item.
3. Do not place concrete without required signatures.
4. Use of placement checkout cards shall be required by COR.

C. Do not place concrete without approval of the COR.

D. Place concrete in presence of COR.

E. Perform concrete placing under the direct supervision of a qualified flatwork foreman for placements. Allow at least 7 days between adjacent placements, or as approved by COR.

F. Do not use aluminum pipes and chutes for placing or pumping concrete.

G. Adding water to concrete batch at site will be allowed only once and only when approved by the COR.

1. Add additional water before concrete is discharged.

2. Do not exceed specified water to cement ratio.

3. After water is added, mix concrete for at least 30 revolutions of mixer drum at mixing speed.

4. Record added water on the batch ticket to nearest gallon.

H. Adding air entraining admixtures to concrete batch at site will be allowed only once when approved by the COR.

1. After air entraining admixture is added, concrete shall be mixed for minimum of 30 revolutions of mixer drum at mixing speed.

2. Take slump and air content after air-entraining admixture addition and additional revolutions.

3. Record added air entraining admixture on batch ticket to nearest ounce.

I. Do not use concrete which has become so stiff that concrete cannot be properly placed.

J. Place formed concrete in continuous, approximately horizontal layers. Do not exceed 20 inches in depth of layers.

K. Vibrate concrete until concrete has been consolidated to maximum practical density, is free from pockets of coarse aggregate, and closes snugly against surfaces of forms and embedded materials.

L. Hot Weather:

1. Place concrete in accordance with ACI 305.1.

2. Protect reinforcing steel so that steel temperature does not exceed ambient air temperature immediately before placing concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

M. Cold weather:

1. Place concrete in accordance with ACI 306.1.

2. Do not place concrete on frozen subgrade or subgrade containing frozen materials.

3.03 FINISHING

A. Notify COR before finishing concrete.

B. Finish concrete in presence of Government inspector unless inspection is waived in each specific case.

C. Perform placement finishing under the direct supervision of a qualified flatwork foreman.

D. Finish surfaces as specified in Table 03 30 00F - Formed Surfaces and Table 03 30 00G - Unformed Surfaces.

E. Where finishes are not specified or shown on drawings for a particular surface, finish concrete as specified for similar work.

F. Formed surfaces:

1. Finish class is designated by symbols F1, F2, and F3.

2. Finish F1:

a. Applies to formed surfaces to be covered by fill material, grout, or concrete, and construction joint surfaces as specified in Table 03 30 00F - Formed Surfaces.

b. Protect form tie rod ends on surfaces in contact with fill material from moisture where they will be below water table or waterline.

1) Recess tie rod ends and fill recess with dry pack or other material approved by COR.

c. Cut off flush with formed surface form tie rod ends on surfaces in contact with concrete or fill material and above maximum water table or waterline elevation.

3. Finish F2:

a. Applies to exposed formed surfaces not permanently concealed by fill material, grout, or concrete, and not required to receive finish F3 or F4, and to contraction joint surfaces and expansion joint surfaces as specified in Table 03 30 00F - Formed Surfaces.

1) Recess tie rod ends and fill recess with dry pack or other material approved by COR.

4. Finish F3:

a. Applies to formed surfaces with special appearance requirements, such as surfaces exposed to view, and not required to receive finish F4, as specified in Table 03 30 00F - Formed Surfaces.

b. After required patching and correction of imperfections has been completed, sack rub surface as follows:

1) Thoroughly wet surface and sack rub while surface is still damp.

2) Use mortar consisting of 1 part cement; 2 parts, by volume, of sand passing No. 16 screen; and enough water so that mortar has consistency of thick cream. Blend standard cement with white cement as necessary to obtain color which will match surrounding concrete surface.

3) Thoroughly rub mortar over area with clean burlap or sponge rubber float to fill pits, bugholes, and other defects.

4) While mortar in pits is still plastic, rub surface with dry mix of above proportions and material to remove excess plastic material and place enough dry material in pits to stiffen and solidify mortar so that filling will be flush with surface. Remove material remaining on surface except material within pits.

5) Continue curing surface as specified.

G. Unformed surfaces:

1. Do not use dry portland cement or additional water during finishing.
2. Do not use “jitterbugs” or other tools to force coarse aggregate away from surface.
3. Finish class is designated by symbols U1, U2, or U3.
4. Finish U1 (Screeded Finish):
   a. Applies to unformed surfaces to be covered by fill material, grout, or concrete as specified in Table 03 30 00G - Unformed Surfaces.
   b. Use as first stage of finish U2 and U3.
   c. After concrete is placed and consolidated, strike off and level concrete to produce even uniform surface.
5. Finish U2 (Floated Finish):
   a. Applies to unformed surfaces not permanently concealed by fill material, grout, or concrete, and not required to receive finish U3, as specified in Table 03 30 00G - Unformed Surfaces.
   b. Begin floating as soon as screeded surface has sufficiently stiffened and bleed water sheen has disappeared.
   c. Use hand- or power-driven equipment.
   d. Finish surface with minimum floating necessary to produce surface that is free of screed marks and is uniform in texture.
   e. Use as second stage of finish U3. Floating shall bring small amount of mortar without excess water to surface, so as to permit effective troweling.
6. Finish U3 (troweled finish):
   a. Applies to unformed surfaces where appearance and porosity is considered by Government to be of special importance as specified in Table 03 30 00G - Unformed Surfaces.
   b. Begin steel troweling after bleed water has disappeared and floated surface has sufficiently hardened to prevent excess of fine material from being drawn to surface.

c. Trowel with firm pressure to flatten sandy texture of floated surface.

d. Trowel to a dense uniform surface free from blemishes and trowel marks. Do not excessively trowel surface.

7. Slope interior surfaces for drainage where shown on drawings or as directed by COR. Slope surfaces exposed to weather for drainage as directed by COR.

8. Slope narrow surfaces, such as tops of walls and curbs, approximately 3/8 inch per foot of width, unless use of other slopes or level surface is indicated on drawings or is directed by the COR.

9. Slope broader surfaces; such as walks, platform, and decks; approximately 1/4 inch per foot unless use of other slopes or level surfaces is indicated on drawings or is directed by the COR.

3.04 JOINTS AND EDGES

A. Construction joints (CJ):

1. Construction joints are joints which are purposely placed in concrete to facilitate construction, reduce initial shrinkage stresses and cracks, allow time for installation of embedded metalwork, or allow for subsequent placing of other concrete.

2. Bond is required at construction joints regardless of whether or not reinforcement is continuous across joint.

3. Locate construction joints where shown on drawings. Relocation, addition, or elimination of construction joints will be subject to approval by the COR.

4. Clean, roughen, and surface dry surfaces of construction joints to be covered with fresh concrete. See Preparation article.

5. Do not use a mortar layer on construction joints.

B. Expansion joints (EJ):

1. Cut sponge rubber joint filler to size and shape of joint surface to receive filler.

2. Adhere filler to concrete in accordance with adhesive manufacturer's recommendations.

3. Butt sections of filler with tight-fitting butt joints to prevent mortar from seeping through joint.

C. Edges:

1. Permanently exposed concrete, except slabs and top edges of curbs: Chamfer edges with 45 degree bevel 3/4 inch by 3/4 inch; unless otherwise shown on drawings.

2. Exposed edges of slabs and top edges of curbs: Tool to radius of 1/4 inch.

D. Preformed joints consisting of plastic or metal strips not allowed.

3.05 STRUCTURAL DEVIATIONS AND SURFACE TOLERANCES

A. Structural deviations are defined as allowable variations from specified lines, grades, and dimensions.

B. Surface tolerances are defined as maximum allowable magnitude of surface irregularities.

C. Specified structural deviations and surface tolerances are consistent with modern construction practice and governed by effects that permissible variations may have upon a structure. COR reserves the right to diminish specified structural deviations and surface tolerances where such variations impair structural action, operational function, or architectural appearance of a structure or portion of structure.

D. Construct concrete within stated variations even though more than one may be specified.

1. Specified variation for one element of a structure will not apply when it will permit another element of same structure to exceed its allowable variation.

2. Where variations are not specified or shown on drawings for a particular structure, variations shall be those specified for similar work. As an exception to clause at FAR 52.236-21 “Specifications and Drawings for Construction”, specific tolerances shown on drawings in connection with dimension shall govern.

E. Structural deviations:

1. Check variations from specified lines, grades, and dimensions in hardened concrete to determine that structures are within tolerances specified in Table 03 30 00C - Deviations from Specified Lines, Grades, and Dimensions.

2. Variation is distance between actual position of structure or element of structure and specified position in plan for structure or particular element.

   a. Plus or minus variations indicate a permitted actual position up or down and in or out from specified position in plan.

   b. Variations not designated as plus or minus indicate maximum deviation permitted between designated successive points on completed element of construction.

3. Specified position in plan is defined as lines, grades, and dimensions described in this section, shown on drawings, or prescribed by COR.

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

AIR CHAMBER, PRE-MANUFACTURED PUMP STATIONS, REGULATING TANKS AND OTHER BUILDINGS			
1.	Footings:		
	(a)	Variation in length and width dimensions from those specified	minus1/2 inch plus 2 inches
	(b)	Horizontal misplacement or eccentricity:	2 percent of footing width in direction of misplacement, but not more than 2 inches
	(c)	Reduction in thickness	5 percent of specified thickness
2.	Variation of horizontal dimensions at all floor and roof levels from specified position in plan:		
	(a)	Overall building dimensions	plus or minus 1/2 inch per 100 foot length with maximum for entire length of plus or minus 1 inch
	(b)	Overall bay dimensions limited by (c)below, but not to exceed	plus or minus 3/8 inch
	(c)	Intermediate dimensions for column, wall, and partition locations:	
		For dimensions less than 10 feet	plus or minus 1/4 inch
		For dimensions equal to or greater than 10 feet but less than 20 feet	plus or minus 3/8 inch
		For dimensions 20 feet or more	plus or minus 1/2 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

3.	Variation of vertical dimensions from specified position in plan:		
	(a)	Overall building dimensions	plus or minus 1/2 inch
	(b)	Overall story height limited by (c)below, but not to exceed	plus or minus 3/8 inch
	(c)	Intermediate dimensions:	
		Less than 10 feet	plus or minus 1/4 inch
		10 to 20 feet, inclusive	plus or minus 3/8 inch
		20 feet or more	plus or minus 1/2 inch
4.	Variation from plumb or specified batter for lines and surfaces of columns, piers, walls, and for arrises:		
	(a)	When overall height of line or surface is:	
		Less than 10 feet	plus or minus 1/4 inch
		10 to 20 feet, inclusive	plus or minus 3/8 inch
		More than 20 feet, but less than 40 feet	plus or minus 1/2 inch
		40 feet or more	plus or minus 1 inch
	(b)	For any two successive intermediate points on the line or surface separated by:	
		10 to 20 feet, inclusive	1/4 inch
		More than 20 feet	3/8 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

5.	Variation from plumb for lines and surfaces of corner columns, control joint grooves, and other conspicuous lines:		
	(a)	When overall height of line or surface is:	
		Less than 10 feet	plus or minus 1/4 inch
		10 to 20 feet, inclusive	plus or minus 3/8 inch
		More than 20 feet	plus or minus 1/2 inch
	(b)	For any two successive intermediate points on the line or surface separated by:	
		10 to 20 feet, inclusive	1/4 inch
		More than 20 feet	3/8 inch
6.	Variation from level or established grades for floors, roof decks, ceilings, beam soffits, and arrises:		
	(a)	When overall length of line or surface is:	
		Less than 10 feet	plus or minus 1/4 inch
		10 to 20 feet, inclusive	plus or minus 3/8 inch
		More than 20 feet, but less than 40 feet	plus or minus 1/2 inch
		40 feet or more	plus or minus 3/4 inch
	(b)	For any two successive intermediate points on the line or surface separated by:	
		10 to 20 feet, inclusive	1/4 inch
		More than 20 feet	3/8 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

7.	Variation from level or specified grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:	
	(a) When overall length of line or surface is:	
	Less than 10 feet	plus or minus 1/4 inch
	10 to 20 feet, inclusive	plus or minus 3/8 inch
	More than 20 feet	plus or minus 1/2 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	3/8 inch
8.	Variation in location from specified position in plan of sleeves and wall openings	plus or minus 1/2 inch
9.	Variation in sizes from those specified for sleeves, floor openings, and wall openings, except wall openings for swinging doors and louvers without tubular frames	plus or minus 1/4 inch
10.	Variation in sizes from those specified for wall openings for swinging doors and louvers without tubular frames	minus 0 inch plus 1/4 inch
11.	Variation in cross-sectional dimensions from those specified for columns and beams and in thicknesses from those specified for slabs and walls	minus 1/4 inch plus 1/2 inch
12.	Variation in rise and tread of steps from that specified:	
	(a) Flight of stairs:	
	Rise	plus or minus 1/8 inch
	Tread	plus or minus 1/4 inch
	(b) Consecutive steps:	
	Rise	1/16 inch
	Tread	1/8 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

PIPELINE STRUCTURES			
1.	Footings:		
	(a)	Variation of length and width dimensions from those specified	minus 1/2 inch plus 2 inches
	(b)	Misplacement or eccentricity:	2 percent of footing width in direction of misplacement, but not more than 2 inches
	(c)	Reduction in thickness from that specified	5 percent of specified thickness not to exceed 1 inch
2.	Monolithic siphons and culverts:		
	(a)	Departure from established alignment	plus or minus 2 inches
	(b)	Departure from established profile grade	plus or minus 2 inches
	(c)	Variation from specified thickness	minus 2.5 percent of specified thickness or minus 1/4 inch, whichever is greater; or plus 5 percent of specified thickness or plus 1/2 inch, whichever is greater
	(d)	Variation from specified inside dimensions	plus or minus 0.5 percent of inside dimensions

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

3.	Checks, overchutes, drops, turnouts, inlets, chutes, and similar structures:		
	(a)	Departure from established alignment	plus or minus 1 inch
	(b)	Departure from established grade	plus or minus 1 inch
	(c)	Variation from plumb or specified batter for lines and surfaces of columns, piers, walls, and for arrises:	
		(1) When overall length of line or surface is:	
		Less than 10 feet	Exposed: plus or minus 3/8 inch Buried: plus or minus 3/4 inch
		10 feet or more	Exposed: plus or minus 1/2 inch Buried: plus or minus 1 inch
		(2) For any two successive intermediate points	
		10 to 20 feet, inclusive	Exposed: 3/8 inch Buried: 3/4 inch
		More than 20 feet	Exposed: 1/2 inch Buried: 1 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

4.	Variations from level or specified grades for slabs, beams, and horizontal grooves:	
	(a) When overall length of line or surface is:	
	Less than 10 feet	Exposed: plus or minus 3/8 inch Buried: plus or minus 3/4 inch
	10 feet or more	Exposed: plus or minus 1/2 inch Buried: plus or minus 1 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	Exposed: 3/8 inch Buried: 3/4 inch
	More than 20 feet	Exposed: 1/2 inch Buried: 1 inch
5.	Variation in cross-sectional dimensions of columns, piers, slabs, walls, beams, and similar parts of structure(s) in 3. above from those specified	minus 1/4 inch plus 1/2 inch
6.	Variation in sizes and locations from those specified for slab and wall openings	plus or minus 1/2 inch
7.	**Variation from plumb or level for sills and sidewalls for radial gates and similar watertight joints _____	Not greater than a rate of 1/8 inch in 10 feet
**	Dimensions between sidewalls for radial gates: No more than shown on drawings at sills and not less than shown on drawings at top of walls.	
8.	Variation from plumb of pipe erected vertically in any length of 10 feet	plus or minus 1/2 inch

Table 03 30 00C - Deviations from Specified Lines, Grades, And Dimensions

4.	Variation from level or specified grades for slabs, other than bridge deck; beams; horizontal grooves; railing offsets; and diaphragms:	
	(a) Exposed construction:	
	(1) When overall length of line or surface is:	
	Less than 10 feet	plus or minus 3/8 inch
	10 feet or more	plus or minus 1/2 inch
	(2) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	3/8 inch
	More than 20 feet	1/2 inch
	(b) Buried construction:	
	(1) When overall length of line or surface is:	
	Less than 10 feet	plus or minus 3/4 inch
	10 feet or more	plus or minus 1 inch
	(2) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	3/4 inch
	More than 20 feet	1 inch
5.	Departure of bridge deck and rails from specified grades	plus or minus 1/4 inch
6.	Variation in cross-sectional dimensions from those specified for piers; slabs, other than bridge deck; walls; beams; and similar parts of bridge structures	minus 1/4 inch plus 1/2 inch
7.	Variation from that specified in thickness of bridge slabs	minus 1/8 inch plus 1/2 inch

F. Surface irregularities:

1. Bulges, depressions, and offsets are defined as surface irregularities or roughness.
2. Surface irregularities are classified as “abrupt” or “gradual” and allowable tolerances are specified in Table 03 30 00D - Surface Tolerances.

a. A surface tolerance is designated by a capital “T” followed by a number 1 through 5.

b. Surface tolerance designations are separate from surface finishes and structural deviations.

3. Abrupt surface irregularities:

a. Abrupt surface irregularities are defined as offsets such as those caused by misplaced or loose forms in which maximum dimension of irregularity perpendicular to surface is greater than maximum dimension of irregularity in plane of surface.

b. Abrupt surface irregularities include isolated surface irregularities which exceed specified gradual irregularities.

4. Gradual surface irregularities:

a. Gradual surface irregularities are defined as bulges and depressions resulting in gradual changes on surface.

b. Gradual surface irregularities are further defined as isolated undulations on surface. Maximum dimension of undulation perpendicular to surface is small relative to maximum dimension of undulation in plane of surface.

5. Check magnitude of surface irregularities of formwork and finished surfaces to ensure that surfaces are within specified tolerances.

G. Surface tolerances:

Table 03 30 00D - Surface Tolerances

Concrete surface	Maximum allowable surface irregularity tolerance	
	Abrupt	Gradual
T1	1 inch	1/4 inch/inch
T2	1/2 inch	1/8 inch/inch
T3	1/4 inch	1/16 inch/inch
T4	1/8 inch	1/32 inch/inch
T5	1/32 inch	1/120 inch/inch

H. Repair of hardened concrete not within specified tolerances:

1. Repair hardened concrete which is not within specified tolerances to bring it within those tolerances.

2. Perform repair after consultation with Government inspector regarding method of repair. Notify COR as to time when repair will be performed.

3. Repair concrete which will be exposed to view in manner which will result in concrete surface with uniform appearance.

a. When grinding surfaces exposed to view, limit depth of grinding such that no aggregate particles are exposed more than 1/16 inch in cross section at finished surface.

b. Where grinding has caused or will cause exposure of aggregate particles greater than 1/16 inch in cross section at finished surface, repair concrete by excavating and replacing concrete.

I. Field verification of surface tolerances:

1. Determine compliance of surface with specified surface tolerances.

2. Evaluate surface roughness.

a. Measure roughness height or depth and check for compliance with values specified in Table 03 30 00D - Surface Tolerances and Table 03 30 00C - Deviations from Specified Lines, Grades, and Dimensions.

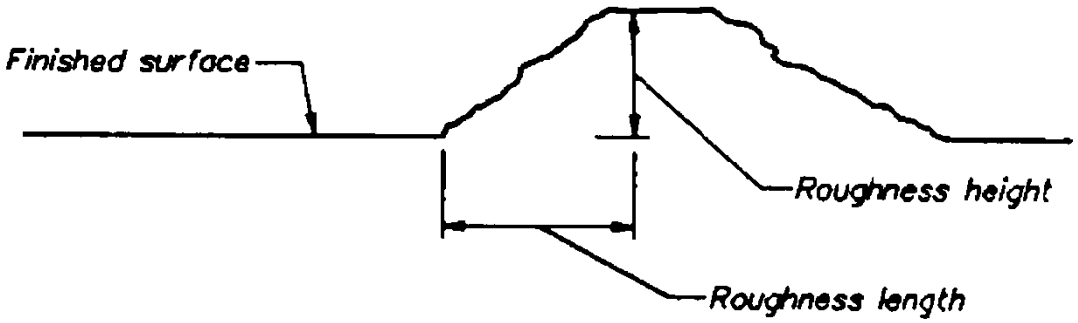
b. When measured height or depth of roughness is less than value in abrupt tolerance specification and height or depth of roughness does not cause structure to exceed applicable value specified in Table 03 30 00C - Deviations from Specified Lines, Grades, and Dimensions, surface roughness is acceptable.

c. When roughness height or depth exceeds abrupt tolerance specification, determine roughness slope for comparison to gradual tolerance specification.

1) Measure roughness length and determine roughness slope by dividing roughness height or depth by roughness length (see Figure 1).

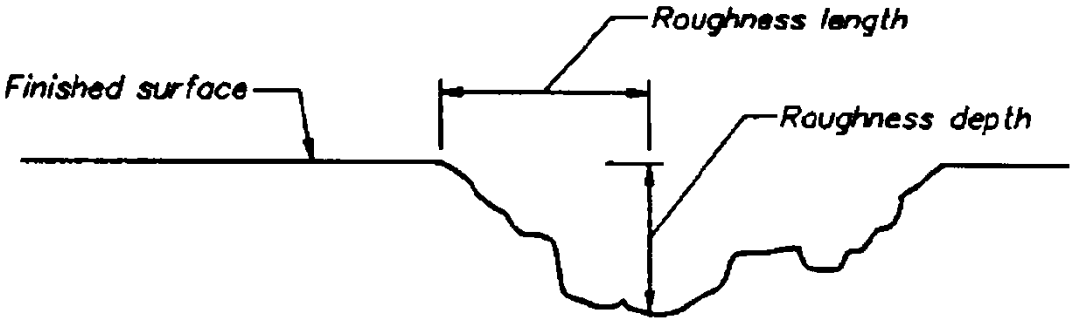
2) When roughness slope is greater than slope specified by gradual tolerance specification, surface roughness is unacceptable.

3) When roughness slope is less than gradual slope specified and gradual roughness does not cause structure to exceed allowable structural deviations, surface roughness is acceptable.



$$\text{Roughness slope ratio} = \frac{\text{Roughness height}}{\text{Roughness length}}$$

CASE 1 = Offset on the Surface



$$\text{Roughness slope ratio} = \frac{\text{Roughness depth}}{\text{Roughness length}}$$

CASE 2 = Offset into the Surface

FIGURE 1

J. Measuring surface roughness:

1. Examples below illustrate how to make necessary surface measurements for typical roughness.

2. Case 1 - Roughness Protruding above Surface:

   a. Measure roughness protruding above surface with straightedge that is at least 20 times longer than roughness height being measured.

   b. Position straightedge with one end resting on top of roughness, as shown in Figure 2 (case 1).

   c. Determine roughness height by measuring maximum gap that occurs normal to straight edge.

   d. Note position on the straightedge from which normal distance is measured.

   e. To determine roughness length, measure distance along straightedge from point where the height was measured to point of contact between straightedge and top of roughness.

   f. Roughness slope is defined as ratio of roughness height to roughness length.

   g. As roughness is seldom symmetric, moving position of straightedge about roughness may be necessary to locate point where maximum height and slope exists.

3. Case 2 - Roughness Extending below the Surface:

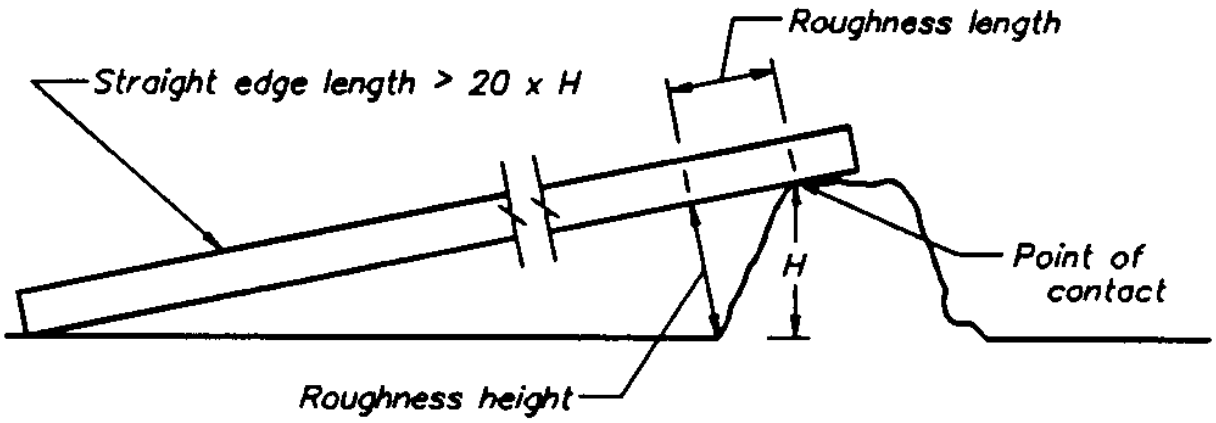
   a. A roughness occurring as an indentation to surface is measured by placing straightedge across indentation, as shown in Figure 2 (case 2).

   b. Measure maximum gap between straightedge and surface and note location of measurement on straightedge.

   c. From point of depth measurement, measure along straightedge in both directions to point of contact with surface.

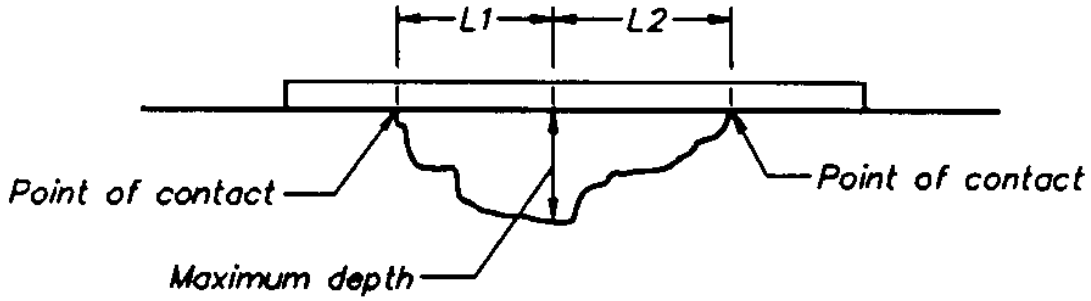
   d. Use shortest length measured as roughness length.

   e. Divide roughness depth by roughness length to determine roughness slope.



CASE 1

$$\text{Roughness slope} = \frac{\text{Roughness depth}}{\text{The shortest distance L1 or L2}}$$



CASE 2

FIGURE 2

K. Prevention of repeated failure to meet tolerances:

1. When concrete placements result in hardened concrete which does not meet specified tolerances, submit to COR an outline of preventive actions such as modifications to forms, modified procedure for setting screeds, and different finishing techniques to be implemented to avoid repeated failures. Submit when requested by COR.

2. Government reserves the right to delay concrete placements until preventive actions which have been approved by COR are implemented.

3.06 CURING

A. Water curing:

1. Keep concrete surface wet for 14 days, minimum, from time concrete has attained sufficient set to prevent detrimental effects to surface.

2. Cure methods:

a. Water-saturated material.

b. System of perforated pipes, mechanical sprinklers, or porous hose.

c. Other methods which will keep surfaces wet.

d. Subject to approval by COR.

B. Curing with curing compound:

1. Apply to concrete surface to provide water-retaining film. Reapply as necessary to maintain continuous, water-retaining film on surface for 28 days.

2. Thoroughly mix compound and spray apply in one coat to provide continuous, uniform film over surface.

3. Do not exceed coverage rate recommended by curing compound manufacturer. Decrease coverage rate on rough surfaces as necessary to obtain required continuous film.

4. Ensure ample coverage on edges, corners, and rough surfaces.

5. Use spray equipment recommended by curing compound manufacturer.

C. Sheet material curing:

1. Includes curing with {polyethylene film.

2. Thoroughly moisten concrete surface by lightly spraying with water as soon as concrete has hardened sufficiently to prevent damage.

3. Completely cover concrete surface with sheet material to provide airtight, water-retaining film over entire surface.

4. Lap edges of sheet material to seal adjacent sheets.

5. Place tightly against concrete surface at extreme edge of curing area.

6. Secure sheet material to withstand wind and prevent circulation of air inside sheet material.

7. Keep surface covered for 14 days, minimum.

3.07 CONTRACTOR FIELD QUALITY TESTING

A. Contractor shall perform sampling, testing, and reporting as required in Table 03 30 00E - Field Testing.

1. Independent testing agency shall meet requirements specified in Section 01 46 20 - Testing Agency Services.

2. Personnel conducting plastic concrete field tests: Qualified as ACI Concrete Field Testing Technician, Grade 1; or equal.

3. Personnel conducting concrete specimen tests: Qualified as ACI Concrete Strength Testing Technician; or equal.

B. Perform tests at least as often as frequencies specified in Table 03 30 00E - Field Testing.

C. Notify COR immediately of test results showing failure of materials to meet specifications. Notify COR within 2 hours of test results showing materials meet specifications. Submit reports of test results as specified.

3.08 GOVERNMENT CONTRACT QUALITY ASSURANCE - FIELD

A. The Government will perform, as a minimum, tests listed in Table 03 30 00E - Field Testing. This testing is in addition to the Contractors Quality Assurance/Quality Control (QA/QC) program and does not relieve the Contractor of performing adequate QA/QC testing. The list of tests is provided only to alert the Contractor to potential impacts to work scheduling.

B. Government testing frequency is at discretion of the COR. Greater frequency testing is normally performed at beginning of new work, new crew, or new equipment. Testing frequency listed in Table 03 30 00E - Field Testing is provided only as approximation of Government testing.

C. In addition to specified Contractor Quality Field Testing, the Government may also perform tests listed in Table 03 30 00E - Field Testing.

3.09 FIELD TESTING

Table 03 30 00E - Field Testing

TESTS OF	TEST STANDARD	STANDARD TITLE	TESTING FREQUENCY
Fresh Concrete Properties - tests performed at site	ASTM C143	Slump of Hydraulic-Cement Concrete	1 set of tests per load for first two loads. When tested concrete meets specifications, 1 set of tests each day of placement for each mixture for first 50 or less cubic yards, and 1 set of tests for each additional 100 cubic yards of concrete. Minimum of 1 set of tests per hour during placements. When concrete does not meet specifications, test each load until 2 consecutive loads meet specifications, then resume testing frequency specified above.
	ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method (alternative to ASTM C138 gravimetric method)	
	ASTM C1064	Temperature of Freshly Mixed Hydraulic-Cement Concrete	
	ASTM C138	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete	
Compressive Strength,	ASTM C31 ASTM C39	Making and Curing Concrete Test Specimens in the Field Compressive Strength of Cylindrical Concrete Specimens	1 set of samples (6 inch by 12 inch) for each day of placement for each mixture for the first 50 or less cubic yards, and 1 set of samples for each additional 100 cubic yards of concrete. A minimum of 5 samples for strength testing shall be made each time strength samples are collected. 2 additional field cured test cylinders during placement in adverse (hot or cold) weather. Cure these samples on jobsite under same conditions as concrete the cylinders represent for minimum of 7 days, then transfer to testing laboratory until testing at strength design days. Test 2 cylinders each at 7 days age and 2 cylinders at strength design age. Maintain last cylinder for testing in event that the strength design age test results fall below the required strength.

Table 03 30 00E - Field Testing

TESTS OF	TEST STANDARD	STANDARD TITLE	TESTING FREQUENCY
Concrete Cores	ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete	At discretion of the Government when cylinder strengths fail to meet minimum requirements. The Contractor shall obtain core specimens in accordance with ASTM C42 at locations directed by COR, at no additional cost to the Government. The Contractor shall repair the core holes in accordance with USBR M-47 as directed by COR

A. Acceptance criteria:

1. Cylinder compressive strength:

a. In accordance with ASTM C94, except as follows:

1) 90 Percent of test cylinders exceed specified compressive strength at design age.

2) Average compressive strength of six consecutive test cylinders exceeds specified compressive strength at design age.

3) No individual strength test falls below specified compressive strength by more than 500 pounds per square inch.

2. Drilled concrete cores:

a. Concrete in placement represented by core tests will be considered structurally adequate when average compressive strength of three cores is equal to at least 85 percent of specified compressive strength and no single core has a compressive strength of less than 75 percent of specified compressive strength.

3.10 PROTECTION

A. Protect concrete from damage until final acceptance by Government.

1. Do not load, remove forms or shoring, or backfill against concrete until concrete has gained sufficient strength to safely support its weight and imposed loads.

2. Protect fresh concrete against erosion from rain, hail, sleet, or snow; contamination from foreign materials; and damage from foot traffic until the concrete has hardened.

3. Protect concrete from heavy foot traffic and other construction activities by covering with plywood or other suitable material. Remove and dispose of temporary covering when no longer required.

B. Protect concrete when freezing temperatures are imminent:

1. Maintain concrete at a temperature of 50 degrees F (10 degrees C) or greater for 72 hours, minimum, after placement. Vent heater and prevent concrete from drying where artificial heat is employed.
2. Protect concrete from freezing during water curing. After discontinuance of water curing, maintain at a temperature of 50 degrees F (10 degrees C) or greater for next 72 hours.
3. Discontinue protection against cold weather such that the drop in temperature of the concrete will be gradual and will not exceed 5 degrees F per hour and 40 degrees F in 24 hours.

3.11 REPAIR

A. Repair concrete in accordance with USBR M-47.

B. Use repair or replacement method directed by COR.

3.12 FINISH, SURFACE TOLERANCES, AND CURING SCHEDULES

Table 03 30 00F - Formed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Surfaces upon or against which fill material will be placed	F1	T1	Water, White ASTM C309 Class A or B curing compound for horizontal surfaces, and White ASTM C309, Class B curing compound for vertical or sloped surfaces.
Surfaces not permanently concealed by fill material or concrete where appearance is not critical	F2	T2 and T3	Water, White ASTM C309 Class A or B curing compound for horizontal surfaces, and White ASTM C309, Class B curing compound for vertical or sloped surfaces.
Surfaces exposed prominently to view or where appearance is important	F3	T5	ASTM C1315 Class A Clear curing compounds, water-emulsified resin-base if outdoors
Interior walls and ceilings of vaults, sumps, pullboxes, and entry boxes	F2	T4	White ASTM C309, Class B curing compound

Table 03 30 00F - Formed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Indoor and outdoor curbs	F2	T5	Polyethylene film or White Burlap-polyethylene, ASTM C309 Class A or B curing compound
Pedestals and equipment foundations	F2	T5	ASTM C1315 Class A Clear curing compounds, water-emulsified resin-base if outdoors, Polyethylene film
Construction joints and surfaces to be covered by grout	F1	T	Water White, ASTM C309 Class A curing compound
Expansion joints	F2	T	Water White ASTM C309 Class A or B curing compound for horizontal surfaces, and White ASTM C309, Class B curing compound for vertical or sloped surfaces

Table 03 30 00G - Unformed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Surfaces to be covered by fill material or concrete	U1	T1	White ASTM C309 Class A or B curing compound for horizontal surfaces, and White ASTM C309, Class B curing compound for vertical or sloped surfaces
Outdoor entrance slabs, and walks and stoops	U2	T3 T5	ASTM C1315 Class A Clear curing compounds, water-emulsified resin-base, Polyethylene film or White Burlap-polyethylene sheet

Table 03 30 00G - Unformed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Outdoor curbs and gutters	U2	T3 T5	White ASTM C309 Class A or B curing compound Polyethylene film or White Burlap-polyethylene sheet
Outdoor equipment slabs and foundations	U2	T3 T5	White ASTM C309 Class A or B curing compound, Polyethylene film or White Burlap-polyethylene sheet
Floors of vaults, sumps, pullboxes, and entry boxes	U2	T5	White wax-base or white water-emulsified resin-base curing compound
Interior floors	U3	T5	Polyethylene film Water
Masonry substrate	U2	T5	Water Polyethylene film

END OF SECTION

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SECTION 03 48 00

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for NAPI Turnout.

B. Cost:

1. Include in the price offered in the Price Schedule for Class 150B Two Inch Diameter Air Valve Assemblies.

C. Cost:

1. Include in the price offered in the Price Schedule for Class 250B Two Inch Diameter Air Valve Assemblies.

D. Cost:

1. Include in the price offered in the Price Schedule for Valves and Equipment.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO SSHB-02	Standard Specifications for Highway Bridges, 17th Edition

B. ASTM International (ASTM)

1.	ASTM C33/C33M-13	Concrete Aggregates
2.	ASTM C478-15a	Precast Reinforced Concrete Manhole Sections
3.	ASTM C923-08(2013)	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

C. Code of Federal Regulations

1.	29 CFR 1910.27	Fixed Ladders

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 03 48 00-1, Product Approval Drawings and Data:

1. Shop drawings and product data for precast concrete structures including block outs, sections, joints and joint sealant.
2. Manufacturer's certification of compliance.
3. Manufacturer’s installation instructions.

C. RSN 03 48 00-2, Mix Design:

1. Data for mix design.

D. RSN 03 48 00-3, Curing, Handling And Storage Requirements:

1. Methods and materials used for curing concrete.
2. Handling and measures used to protect precast concrete from damage during manufacturing and storage.

PART 2 PRODUCTS

2.01 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.02 CLASS 150B AND 250B TWO INCH DIAMETER AIR VALVE ASSEMBLIES

A. See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

2.03 VALVES AND EQUIPMENT

A. See Section 35 22 15 - Valves and Equipment.

2.04 MANHOLE

A. Furnish riser sections and slab top as shown on drawings.

1. Concrete manhole conforming to ASTM C478.
   a. Bell and spigot joints.
   b. No elliptical reinforcement allowed.
   c. Rubber gasket not required.
2. Joint Sealant: As recommended by manufacturer.

B. Ladder Rungs:

1. In accordance with 29 CFR 1910.27.
2. Polypropylene coated steel.

C. Size: As indicated on drawings.

D. Furnish equivalent size prefabricated lids as shown on drawings.

2.05 COARSE AGGREGATE BASE

A. ASTM C33, coarse aggregate, Size No. 57.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place coarse aggregate base below flowmeter vault and vaults for air valves as shown on drawings and in accordance with Section 31 23 02 - Compacting Earth Materials.

B. Erect precast concrete structures per manufacturer's recommendations and as located on drawings.

C. Clean pipe ends with wire brush prior to ends being joined. Place bell end down.

D. Place lids and grout openings as shown on the drawings or as directed by COR.

END OF SECTION

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SECTION 03 63 00
EPOXY GROUT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Pre-manufactured Pump Station No. 1.

B. Cost:

1. Include in the price in the Price Schedule for Pre-manufactured Pump Station No. 2.

C. Cost:

1. Include in the price in the Price Schedule for Complete Electrical System.

D. Cost:

1. Include in price in the Price Schedule for Regulating Tank No. 1.

E. Cost:

1. Include in price in the Price Schedule for Regulating Tank No. 2.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C579-01(2012)	Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
2.	ASTM C580-02(2012)	Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
3.	ASTM D638-14	Tensile Properties of Plastics
4.	ASTM D696-08	Coefficient of Linear Thermal Expansion of Plastic Between -30 degree C and 30 degree C with a Vitreous Silica Dilatometer

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 03 63 00-1, Approval Data:

1. Grout manufacturer's product data.

2. Grout manufacturer's environmental, product storage, preparation, mixing, installation and curing instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver epoxy materials to jobsite in manufacturer's original unopened packaging with labels and seals intact.

B. Store epoxy materials in protected area in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 PRE-MANUFACTURED PUMP STATION NO. 1 AND NO. 2

A. See Section 22 11 35 - Pre-manufactured Pump Station.

2.02 COMPLETE ELECTRICAL SYSTEM

A. See Section 26 05 02 - Basic Electrical Materials and Methods.

2.03 REGULATING TANK NO. 1 AND NO. 2

A. In accordance with Section 33 16 50 - Steel Tanks.

2.04 EPOXY GROUT

A. Three part flowable epoxy grout; resin, hardener, and aggregate filler.

1. CHOCKFAST RED manufactured by ITW Polymer Technologies, 130 Commerce Drive, Montgomery PA; or equal, having following essential characteristics:

a. ASTM C579 Compressive Strength: Minimum of 15,000 psi.

b. ASTM C579 Compressive Modulus: 2,000,000 psi.

c. ASTM D696 Coefficient of Linear Thermal Expansion: 11.2×10^{-6} degrees F.

d. ASTM C580 Flexural Strength: Minimum 4,000 psi.

e. ASTM D638 Tensile Strength: Minimum 1,800 psi.

f. Service temperature: Up to 140 degrees F.

g. Pot life: Approximately 3 hours at 70 degrees F.

h. Shelf life: 2 years in dry storage.

B. Aggregate filler as recommended by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mix and install grout in accordance with manufacturer's instructions to fill space to be grouted.

1. Concrete shall be a minimum of 28 days old.
2. Clean and roughen concrete surfaces.
3. Remove dirt, dust, oil, grease, debris, paint, curing compounds, sealers, and unsound concrete.
4. Mechanically prepare concrete surfaces in accordance with manufacturer's instructions to give surface profile of a minimum of 1/8 inch and expose coarse aggregate of concrete.
5. Concrete shall have an open surface texture.

B. Placement:

1. Place grout at air temperature recommended by manufacturer.
2. Bring materials to be epoxied as close to 70 degrees F as possible.
3. Do not place grout over frozen concrete.
4. Hold grout in place with forms. Prepare forms to prevent sticking of grout.
5. Minimum 3/4 inch by 3/4 inch, 45 degree chamfer.
6. Mix grout components in accordance with manufacturer's instructions and technical data sheet.
7. Place grout in accordance with manufacturer's instructions.
8. Finish surface of grout in accordance with manufacturer's instructions.
9. Smooth sharp edges.

C. Protection:

1. Protect placed grout from damage during construction.
2. Maintain grout at 50 degrees F or greater for 72 hours, minimum, after placement unless otherwise recommended by manufacturer.
    a. After protection period, discontinue protection against cold weather such that the drop in temperature of the grout will be gradual and will not exceed 5 degree F per hour and 40 degree F in 24 hours.
3. The more stringent of grout manufacturer's recommendation or section shall apply.
4. Initial Loading:
    a. Do not apply loads epoxy grout sooner than 72 hours after placement.

1) Apply load after epoxy grout has attained a compressive strength of 3000 psi, minimum.

b. Time required for epoxy grout used to attain this strength will be determined by COR.

c. Take care when applying loads on hardened epoxy grout.

d. Contractor shall be responsible for damage resulting from impact loads when positioning equipment or metalwork.

D. Protect from movement until grout has fully cured.

END OF SECTION

SECTION 04 22 10

REINFORCED CONCRETE UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A615/A615M-14	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
2.	ASTM C90-14	Loadbearing Concrete Masonry Units
3.	ASTM C140/C140M-14B	Sampling and Testing Concrete Masonry Units and Related Units
4.	ASTM C144-11	Aggregate for Masonry Mortar
5.	ASTM C150/C150M-12	Portland Cement
6.	ASTM C207-06(2011)	Hydrated Lime for Masonry Purposes
7.	ASTM C270-14a	Mortar for Unit Masonry
8.	ASTM C404-11	Aggregates for Masonry Grout
9.	ASTM C426-10	Linear Drying Shrinkage of Concrete Masonry Units
10.	ASTM C476-10	Grout for Masonry

B. International Code Council (ICC)

1.	IBC-15	International Building Code

C. Masonry Industry Council (MIC)

1.	MIC Manual-99	Hot and Cold Weather Masonry Construction Manual

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 04 22 10-1, Approval Data:

1. Manufacturer's product data for each masonry unit and accessory material.
2. Include the independent testing agency test results which show minimum compressive strength and maximum water absorption for masonry units.

C. RSN 04 22 10-2, Sample Kit:

1. Manufacturer’s color sample kit for color selection of masonry unit and precast wall cap.

D. RSN 04 22 10-3, Certifications:

1. Manufacturer's certification that masonry units meet specified requirements. Attach results from specified source sampling and testing to each certification.
2. Manufacturer's certification that portland cement and lime meet specified requirements.

E. RSN 04 22 10-4, Mix Design:

1. Mortar mix design indicating type and proportions of ingredients in compliance with the proportion specifications of ASTM C270.
2. Grout mix design indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C476.

F. RSN 04 22 10-5, Instructions:

1. Manufacturer's instructions for cleaning masonry units.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials off ground and under cover to prevent contact with moisture.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. In accordance with Section 33 16 14 - Air Chambers.

2.02 MASONRY UNITS

A. ASTM C90, lightweight, hollow and solid units.

B. Finish:

1. Split face; rough exposed aggregate, uneven natural split texture.
2. One-sided.

C. Nominal size:

1. 16 inches long by 8 inches high (15-5/8 inches long by 7-5/8 inches actual); thickness as shown on the drawings.

2. Furnish necessary shapes and sizes, bond-beam units, lintel units, and corner units as required to satisfy conditions indicated on the drawings. Include half-size units where required.

D. Color: Selected by Government from manufacturers standard chart.

2.03 MORTAR MATERIALS

A. Portland cement: ASTM C150; Type I, II, or III; standard gray color.

B. Hydrated lime: ASTM C207, Type S.

C. Aggregate: ASTM C144.

D. Water: Clean water free of detrimental amounts of silt, organic matter, alkali, salts, and other impurities.

E. Color: Selected by Government from manufacturers standard chart.

2.04 GROUT MATERIALS

A. Portland cement: ASTM C150; Type I, II, or III.

B. Aggregate: ASTM C404.

C. Water: Clean water free of detrimental amounts of silt, organic matter, alkali, salts, and other impurities.

2.05 REINFORCEMENTS

A. Reinforcing bars: ASTM A615, Grade 60, deformed steel bar, uncoated.

2.06 MORTAR MIX

A. Type: ASTM C270, Type S, proportion specification using specified materials.

B. Do not add calcium chloride or anti-freeze compounds.

C. Retemper mortar in accordance with ASTM C270 except use and place mortar within 1-1/2 hours after mixing.

2.07 GROUT MIX

A. Coarse Grout: ASTM C476, proportion specification using specified materials.

2.08 CONTRACTOR SOURCE QUALITY TESTING

A. Independent testing agency shall sample and test masonry units in accordance with ASTM C140 and ASTM C426 before shipment to jobsite.

B. Independent testing agency in accordance with Section 01 46 20 - Testing Laboratory Services.

2.09 ACCESSORIES

A. Precast Wall Cap:

1. Furnish necessary peaked wall cap shapes and sizes as required to satisfy conditions indicated on the drawings.

2. Color: Selected by Government from manufacturers standard chart.

PART 3 EXECUTION

3.01 PREPARATION

A. Comply with recommended practices of MIC Manual for hot and cold weather masonry.

B. Clean and roughen concrete substrate surfaces to be in contact with mortar or grout. Remove curing compounds, laitance, efflorescence, loose or defective concrete, sand, dirt, and foreign material.

C. Clean top of unfinished masonry of loose mortar and foreign material before resuming work.

D. Lay concrete masonry units dry. Do not prewet.

E. Clean excess concrete and loose rust from dowel bars to be embedded in masonry.

F. Clean loose rust and coatings from reinforcing bars, joint reinforcements, and metal items to be embedded in masonry.

3.02 COURSING

A. Place masonry plumb, level, and true to required lines.

B. Maintain masonry courses to uniform width.

C. Make vertical and horizontal joints equal and of uniform thickness.

D. Lay units in running bond except as indicated on drawings. Course one unit and one mortar joint to equal nominal unit dimension.

E. Form concave mortar joints.

3.03 PLACING AND BONDING

A. Lay masonry with completely filled mortar joints. Buttering corners of joints and deep or excessive furrowing of mortar joints are not permitted.

B. Do not shift or tap units after mortar has taken initial set. Remove and replace with fresh mortar where adjustment must be made.

C. Keep concrete foundation surfaces to be in contact with grout free of mortar.

D. Keep cells to be grouted free of mortar.

E. Keep wall cavities free of mortar.

F. Remove excess mortar.

G. Saw cut to form straight unchipped edges where jobsite cutting is required. Cut units dry.

3.04 TOLERANCES

A. Variation from unit to adjacent unit: 1/32 inch, maximum.

B. Variation from plane of wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

C. Variation from plumb: 1/4 inch per story noncumulative, 1/2 inch in two stories or more.

D. Variation from level coursing: 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch, maximum.

E. Variation of joint thickness: 1/8 inch in 3 feet.

F. Maximum variation from cross sectional thickness of walls: Plus or minus 1/4 inch.

3.05 REINFORCEMENT INSTALLATION

A. Reinforcing bars:

1. Place reinforcing bars supported and secured against displacement.
2. Maintain position within 1/2 inch of true dimension.
3. Lap bar splices: As indicated on the drawings.

3.06 GROUTING

A. Place and consolidate grout fill without disturbing reinforcements.

B. Maintain grout thickness of 1/2 inch, minimum, between bar and masonry units.

C. Place grout in lifts of 4 feet, maximum, as wall is built.

D. Stop grout 1-1/2 inches below top of masonry when grouting is stopped for 1 hour or more.

E. Agitate to consolidate grout and fill space.

F. Grout all reinforced and unreinforced masonry cells.

3.07 BUILT-IN WORK

A. Build in steel doorframes and other built-in items.

B. Build in items plumb and level.

C. Bed doorframe anchors in mortar joints.

D. Fill doorframes solid with mortar.

E. Rake joint between doorframes and masonry to 1/4 inch depth for sealant installation.

3.08 CUTTING AND FITTING

A. Cut and fit for pipes, conduits, sleeves, and similar items. Provide correct size, shape, and location.

3.09 POINTING AND CLEANING

A. Cut out and replace defective mortar. Match adjacent work.

B. Remove excess mortar and mortar and grout smears.

C. Clean soiled surfaces.

D. Clean masonry in accordance with manufacturer's instructions. Do not mottle, discolor, stain, damage, or acid burn masonry.

E. Obtain approval of each cleaning method from COR at jobsite before using method on work.

3.10 PROTECTION

A. Provide temporary bracing during erection to support finished work and withstand wind loads. Maintain bracing until structure provides permanent support.

B. At workday's end, cover unfinished work with secure waterproof covers to prevent moisture infiltration. Keep unfinished work covered during work shutdown.

3.11 FIELD QUALITY ASSURANCE

A. Facilitate access and materials necessary for the Government's Quality Assurance inspection.

B. Special Inspection: Government will complete a Level 1 special inspection of the construction of the masonry walls that is in compliance with the IBC, Sections 1704 through 1708.

C. Mortar Mix: Government will verify that the actual mortar mix used in the construction of the masonry walls agrees with the approved mix design and that it is in compliance with ASTM C270.

D. Grout Mix: Government will verify that the actual grout used in the construction of the masonry walls agrees with the approved mix design and that it is in compliance with ASTM C476.

E. Concrete Masonry Units: Government will verify that the concrete masonry units used in the construction of the masonry walls are in compliance with ASTM C90. In addition, the Government will randomly select 3 concrete masonry units to determine their compressive strengths are in compliance with ASTM C90.

END OF SECTION

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SECTION 05 21 00
STEEL JOISTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)

1.	AISC 303-10	Steel Building and Bridges
2.	AISC 360-10	Structural Steel Buildings

B. ASTM International (ASTM)

1.	ASTM A123/A123M-14	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2.	ASTM A153/A153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3.	ASTM A307-14	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4.	ASTM A325-14	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5.	ASTM A563-15	Carbon and Alloy Steel Nuts
6.	ASTM F436-11	Hardened Steel Washers

C. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel
2.	AWS D1.3/D1.3M-08	Structural Welding Code - Sheet Steel

D. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC SP6/NACE 3-07	Commercial Blast Cleaning
2.	SSPC SP7/NACE 4-06	Brush-Off Blast Cleaning

E. Steel Joist Institute (SJI)

1. Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 43rd Edition

2. Standard Specifications for Open Web Steel Joists, K-Series

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 21 00-1, Approval Drawings, Data, and Certification:

1. Detailed shop and erection drawings.

a. Show layout of joist units, anchorage details, splice and connection details, bracing, bridging, accessories, and attachments to other work. Include mark, number, type, location and spacing of joists and bridging.

1) Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.

2) Indicate locations and details of metal roof frames to be attached to joists.

2. Manufacturer's product data for each distinct type of joist accessories, and product specified.

a. Include pertinent product data for metal roof frame, and identify roof frame acceptability for anticipated hatch loads and installation procedures.

3. Manufacturer's certification that joists comply with SJI "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders".

C. RSN 05 21 00-2, Welder Qualifications:

1. Welders to be employed in work comply with the requirements specified in Quality article.

2. Welding procedure specification (WPS) document per AWS Code requirements.

D. RSN 05 21 00-3, Inspection Reports.

1.04 QUALIFICATIONS

A. Manufacturer: Be a member of the Steel Joist Institute.

B. SJI Design Standard: Comply with recommendations of SJI's "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders," applicable to types of joists indicated.

C. Welder:

1. Certified in accordance with AWS D1.1 and D1.3 within the last 12 months.

2. Maintain permanent records of pertinent information.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work. Inspect the joists for damage before unloading and note any permanent bend or deformation or broken welds on the receiving documents.

B. Store materials to permit easy access for inspection and identification. Keep joist members off ground using pallets, skids, platforms or other supports.

C. Protect steel members from corrosion and damage.

D. Store packaged materials in original unbroken package or container.

E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures.

F. Replace damaged shapes or members as required.

PART 2 PRODUCTS

2.01 AIR CHAMBER BUILDINGS NO. 1 AND NO. 2

A. In accordance with Section 33 16 14 - Air Chambers.

2.02 MATERIALS

A. Steel:

1. Comply with requirements of:

a. Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders".

b. "Standard Specifications for Open Web Steel Joists, K-Series".

B. Welding Electrodes: Comply with AWS D1.1 and AWS D1.3.

2.03 FABRICATION

A. Manufacture steel joists of type indicated in accordance with SJI specification. Material shall be clean and straight.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" with steel-angle or steel-channel members.

C. Comply with AWS D1.1 and AWS D1.3 requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Bridging: Provide horizontal or diagonal type bridging as required by "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders" or as indicated on Drawings for type of joist, chord size, spacing and span.

E. Top Chord Extensions:

1. Provide top chord extensions on joists as indicated on the drawings.
2. The extensions shall be capable of withstanding the full uniform load of the joist.
3. Attach extensions to the embedded anchor plates as indicated on the Drawings.

F. End Anchorage: Use embedded anchor plates to secure joist seats to supports as indicated on the drawings.

2.04 ACCESSORIES

A. Bridging:

1. Schematically indicated.
2. Detail and fabricate according to SJI Specifications.
3. Furnish additional erection bridging if required for stability.

B. Provide accessories, including splice plates, reinforcing angles and bolts as required to complete the joist installation while complying with SJI Specifications and Drawings.

C. Threaded Fasteners: ASTM A307, Grade A, Galvanized.

D. High-Strength Bolts: ASTM A325, Galvanized.

E. Nuts: ASTM A563, Galvanized.

F. Washers: ASTM F436, Galvanized.

G. Metal Roof Frame:

1. Schematically indicated.
2. Coated steel.
3. Comply with the requirements of AISC 303 and AISC 360.
4. Acceptable for attachment to steel joists and designed to transfer roof loads to joists.

2.05 GALVANIZING

A. Cleaning:

1. After shopwork completion, clean materials of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.
2. Clean surfaces of metalwork in contact with or embedded in concrete or grouting mortar in accordance with SSPC SP6/NACE 3 and SSPC SP7/NACE 4.

B. Steel Joists:

1. Galvanize steel joists as designated on the drawings for galvanizing.
2. After cleaning, zinc coat materials in accordance with ASTM A123.
3. Where member lengths prevent dipping in one operation, exercise care to prevent warping.
4. Provide finished compression members with lateral variations not greater than 1/1000 the axial length between the points which are to be supported laterally.
5. After galvanizing, remove excess spelter from holes.

C. Hardware:

1. Galvanize threaded fasteners, high-strength bolts, nuts, and washers in accordance with ASTM A153.
    a. Remove excess spelter by centrifugal spinning.

D. Fabricator's Galvanizing Repair:

1. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.
2. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.
3. Where local repair is authorized:
    a. Repair damage to galvanizing, including damage due to drifting, repair operations, in accordance with Section 09 96 20 - Coatings.

2.06 CONTRACTOR SOURCE QUALITY TESTING

A. Inspect in accordance with the SJI Standard Specifications.

B. Notify COR 7 days prior to testing.

2.07 CONTRACTOR SOURCE QUALITY ASSURANCE

A. Materials, fabrication, and welds may be visually inspected by the Government in the manufacturer's factory. The Government may perform additional inspections and non-destructive tests on work that is questionable or suspect.

B. Bear the cost for the Government's inspection and tests, if such inspections and tests reveal failure of portions of the work to comply with requirements indicated in this section. Bear costs made necessary by such failures including those of repeated testing and inspections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Welding shall comply with applicable provisions of AWS D1.1 and AWS D1.3.

B. Prior to installation of steel joists and accessories.

1. Examine supporting substrates, embedded bearing plates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of joists.
    a. Verify elevation locations and dimensions of surfaces to receive steel joist.
    b. Furnish plates, angles and other accessories as required to secure joists.
    c. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Verify opening dimensions and orientation of metal roof frame prior to installation of materials.

3.02 ERECTION

A. Place and secure steel joists in accordance with SJI Specifications, approved shop drawings.

B. Placing joists: Do not place steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

C. Bridging:

1. Install bridging simultaneously with joist erection, before construction loads are applied.
2. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

3. Comply with OSHA requirements for bolted bridging to be in place before slackening lines on joist longer than 40 feet.

D. Fastening joists: Field weld joists to embedded anchor plates in accordance with SJI Specifications for type of joists used.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds and methods used in correcting welding work.

2. Coordinate welding sequence and procedure with placement of joists.

3. The lengths of welds applied to the top and bottom chords of joist shall not exceed half the width of the member.

E. Install metal roof frame in accordance with manufacturer's recommendations.

F. Repair damaged galvanized coatings on exposed surfaces in accordance with Section 09 96 20 - Coatings.

3.03 REPAIRS

A. Repair damage as directed by COR.

END OF SECTION

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SECTION 05 30 00
METAL ROOF DECK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A653/A653M-15	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
2.	ASTM A924/A924M-14	General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
3.	ASTM A1008/A1008M-15	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

B. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel
2.	AWS D1.3/D1.3M-08	Structural Welding Code - Sheet Steel

C. Steel Deck Institute (SDI)

1.	SDI RDDM-13	Roof Deck Design Manual
2.	SDI MOC2-06	Manual of Construction with Steel Deck

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 30 00-1, Approval Drawings and Data:

1. Metal deck manufacturer's product data.
    a. Include complete descriptions of, specifications and installation instructions for the roof metal deck, and accessories. Include material type, grade, metal thickness, and finish.
2. Detailed shop and erection drawings.
    a. Show deck section layout and attachment to the steel roof joists and structural steel, including unit dimensions and sections.
    b. Show type and number of deck units and the type, location and method of attachment.
3. Show accessories and details required for proper installation of metal roof decks as specified on drawings.

C. RSN 05 30 00-2, Welder Qualifications.

1.04 PERFORMANCE REQUIREMENTS

A. Design the attachment of metal roof deck to open web steel joists and embedded anchor plates according to SDI RDDM as required and per manufacturer's recommendations.

B. Structural Performance:
1. Design the metal roof deck attachment to withstand specified design loads within and under conditions required.
2. Design loads: As specified on drawings.

1.05 QUALIFICATIONS

A. Manufacturer: Member of Steel Deck Institute.

B. Welder: Qualify in accordance with AWS D1.1 and AWS D1.3. Maintain permanent records of pertinent information.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle metal roof deck in a manner to protect it from corrosion, deformation, and other types of damage.

B. Do not bend metal roof decking. Exercise care not to damage the material or overload the decking during the construction period.

C. Maximum uniform distributed storage load shall not exceed the design live load.

D. Stack decking on platforms or pallets and cover with watertight ventilated covering. Elevate one end during storage to provide for drainage. Maintain deck finish to prevent the formation of rust.

E. Replace damaged material.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. In accordance with Section 33 16 14 - Air Chambers.

2.02 METAL ROOF DECK

A. 1.5B22 Metal deck manufactured by Vulcraft, 1875 West Highway 13 South, Brigham City, UT 84302, Telephone: 435-734-9433; or equal, having the following essential characteristics:

1. Conform to SDI RRDM.
2. Nominal depth: 1.5 inches.
3. Thickness before coating: 22 gage nominal, 0.0295 inches, minimum.
4. Section modulus: 0.186 in^3 per foot, minimum.
5. Moment of inertia: 0.155 in^4 per foot, minimum.
6. ASTM A1008, Grades C and D, or ASTM A653, Structural Quality.
    a. Yield Strength: 33,000 pounds per square inch, minimum.
7. Steel Materials Content:
    a. If manufactured in an Electric Arc Furnace:
        1) Minimum post-consumer content: 67 percent.
        2) Minimum total recovered materials: 100 percent.
8. Metal deck shall be galvanized.
    a. Galvanizing shall conform to ASTM A924 with a minimum coating class of G30 as defined in ASTM A653.
9. Panel Length: To span from end support to end support.

2.03 ACCESSORIES

A. Provide accessories required for fastening and a finished installation of metal deck in accordance with SDI RRDM and SDI MOC2.

B. Accessories shall be galvanized.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Visually inspect puddle welds.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to installation of decking units and accessories, examine worksite to verify that structure will permit installation of decking system without modification and supporting members are in correct layout and alignment.

3.02 PREPARATION

A. Check surfaces to receive the decking and assure they are free of debris.

3.03 INSTALLATION

A. Install steel deck units and accessories in accordance with approved shop drawings, SDI MOC2, and manufacturer's recommendations.

B. Place units on structural supports, properly adjusted, leveled, aligned side laps, and aligned at right angles to supports.

C. Align steel deck units before permanently anchoring. Locate deck ends over supports only.

D. Bearing Length: 2-1/2 inches, minimum.

E. Attachment: Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten metal deck units to structural supports and to adjacent deck units as shown on shop drawings.

1. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding.
2. Attachment of adjacent deck units by button-punching is prohibited.
3. Location, size, and spacing of fastening shall be as indicated on the approved shop drawings.

F. Welding: Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturer of the base metal alloys being used.

1. Ensure only operators previously qualified by tests prescribed in AWS D1.1 and AWS D1.3 perform welds.
2. Immediately clean welds by chipping and wire brushing.

3. Heavily coat welds, cut edges and damaged portions of coated finish in accordance with Section 09 96 20 - Coatings.

G. Cutting and Fitting: Cut and fit deck units and accessories around projections through roof with neat, square, and trim cuts. Do not use cutting torches where a neat appearance is required.

3.04 REPAIRS

A. Repair damaged galvanized coatings on exposed surfaces in accordance with Section 09 96 20 - Coatings.

B. Repair damage as directed by COR.

END OF SECTION

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include barrier posts in the price in the Price Schedule for Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems System.

B. Cost:

1. Include barrier posts in the price offered in the Price Schedule for NAPI Turnout.

C. Cost:

1. Include barrier posts in the price in the Price Schedule for 150B Four Inch Diameter Blowoffs.

D. Cost:

1. Include barrier posts in the price in the Price Schedule for 250B Four Inch Diameter Blowoffs.

E. Cost:

1. Include air valve equipment supports in the price in the Price Schedule for 150B Two Inch Diameter Air Valve Assemblies.

F. Cost:

1. Include air valve equipment supports in the price in the Price Schedule for 250B Two Inch Diameter Air Valve Assemblies.

G. Cost:

1. Include anchor plates in the price in the Price Schedule for Air Chamber No. 1.

H. Cost:

1. Include anchor plates in the price in the Price Schedule for Air Chamber No. 2.

1.02 DEFINITIONS

A. Miscellaneous metalwork: Where either shown on the drawings or specified elsewhere in this Section or these specifications, “miscellaneous metalwork” means metal fabrications as used in this Section.

1.03 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)

1.	AISC 325-11	Steel Construction Manual, 14th Edition

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3.	ASTM A108-13	Steel Bar, Carbon and Alloy, Cold-Finished
4.	ASTM A123/A123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5.	ASTM A307-14	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
6.	ASTM A385/A385M-15	Providing High-Quality Zinc Coatings (Hot-Dip)
7.	ASTM A615/A615M-15a	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
8.	ASTM F844-07a-13	Washers, Steel, Plain (Flat), Unhardened for General Use

C. American Welding Society, Inc. (AWS)

1.	AWS D 1.1/D1.1M-15	Structural Welding Code - Steel

D. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

1.04 QUALIFICATIONS

A. Welders: In accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect from corrosion, deformation, and other types of damage.

B. Store items in an enclosed area free from contact with soil and weather.

C. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.01 BURIED GALVANIC ANODE CATHODIC PROTECTION AND CORROSION MONITORING SYSTEMS

A. See Section 26 42 10 - Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems.

2.02 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.03 TWO INCH DIAMETER AIR VALVE ASSEMBLIES AND FOUR INCH DIAMETER BLOWOFFS

A. See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

2.04 AIR CHAMBER BUILDINGS NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.05 MATERIALS

A. Arc-Welding Electrodes:

1. Use filler metal and shielding gases suitable for base materials, positions, and other conditions.
2. Filler metal and required shielding gases or fluxes: AWS D1.1.
3. Use filler metal with a minimum tensile strength of 70,000 pounds per square inch for steel.

B. Steel Pipe: ASTM A53, type E or S, grade B.

1. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
2. Government inspection at the mill and hydrostatic tests will not be required.

C. Structural Steel:

1. Bars and Plates: ASTM A36.

2.06 BARRIER POSTS AND GUARD POSTS

A. Steel Pipe: ASTM A53, type E or S, grade B.

1. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
2. Government inspection at the mill and hydrostatic tests will not be required.

B. Concrete:

1. In accordance with the applicable requirements of Section 03 30 00 - Cast-in-Place Concrete.
2. 3/4 inch maximum size aggregate.
3. Minimum compressive strength of 2,500 pounds per square inch at 28 days.

C. Reinforcing Bars:

1. ASTM A615, Grade 60.
2. Deformed steel bar.

D. Coating: In accordance with Section 09 96 20 - Coatings.

2.07 AIR VALVE EQUIPMENT SUPPORTS

A. Channels: Unistrut P1000; or equal, having the following essential characteristics:

1. No. 12 gauge steel.
2. Channel: 1-5/8 inch wide by 1-5/8 inch deep with 7/8 inch opening.
3. Galvanized.

B. Bolts, nuts, and washers:

1. Bolts: ASTM A307.
2. Nuts: Spring nuts, suitable for channel attachment.
3. Washers: ASTM F844.
4. With electro-galvanized finish.

C. Expansion Anchors:

1. CID A-A-1923A, Type 4, galvanized steel.
2. Bolt length: Provide bolt length with 3-1/2 inch minimum embedment.

D. Fittings: ASTM A36 steel, galvanized.

2.08 ANCHOR PLATES

A. Fabricated Plates: ASTM A36 steel, galvanized.

B. Headed Concrete Anchors (HCA): H4L headed concrete anchor as manufactured by Nelson Stud Welding, Incorporated, 9008 S. Thomas Avenue, Bridgeview, IL 60455; or equal, having the following essential characteristics:

1. ASTM A108.

2. Flux-filled ends suitable for end welding to steel with automatically timed stud-welding equipment.

2.09 FABRICATION

A. Fabricate metalwork in accordance with AISC 325 and this section.

1. Perform welding and related work in accordance with AWS D1.1.

B. If straightening is necessary, use methods that will not injure the metal.

C. After shop work completion and before galvanizing, clean material of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.

D. Galvanizing:

1. Galvanize items of metalwork as specified or shown on drawings. Use hot-dip galvanizing, where required after fabrication, in accordance with ASTM A123 and ASTM A385.

2. Fabricator's Galvanizing Repair:

a. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.

b. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.

c. Where local repair is authorized:

1) Repair damage to galvanizing in accordance with Section 09 96 20 - Coatings.

PART 3 EXECUTION

3.01 PREPARATION

A. Where locations and dimensions of miscellaneous metalwork shown on drawings are dependent upon existing equipment and/or equipment furnished, confirm locations and dimensions prior to fabrication of miscellaneous metalwork.

3.02 INSTALLATION

A. Holes in Metalwork: Drill, or drill and tap as required, holes in metalwork required for installation.

B. Anchors:

1. Drill holes for anchors straight and true and of diameter recommended by anchor manufacturer.

2. Install anchors in accordance with manufacturer's recommendations.

3. Follow manufacturer’s recommendations when embedded steel or reinforcement is encountered during drilling for anchors.

4. When drilling water is used, clean surfaces of concrete to remain exposed immediately to prevent discoloration.

5. Following drilling, clean holes with water to remove cuttings, followed by air to ensure holes are dry.

C. Barrier Posts:

1. Install posts plumb in concrete footings and as shown on drawings.

2. Fill posts with concrete and trowel top of post round for water drainage. Posts may be capped in lieu of filling posts with concrete.

D. Installer’s Galvanizing Repair:

1. Repair damage to galvanizing in accordance with Section 09 96 20 - Coatings.

E. Painting:

1. Paint surfaces of miscellaneous metalwork exposed after installation, except galvanized steel in accordance with Section 09 96 02 - Coatings.

END OF SECTION

SECTION 07 41 13
PREINSULATED METAL ROOF PANELS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. American Architectural Manufacturers Association (AAMA)

1.	AAMA 501.2-15	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

B. ASTM International (ASTM)

1.	ASTM A653/A653M-15	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
2.	ASTM A755/A755M-15	Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
3.	ASTM A792/A792M-10(2015)	Steel Sheet, 55% Aluminum-Zinc Ally-Coated by the Hot-Dip Process
4.	ASTM C518-10	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
5.	ASTM C591-15	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
6.	ASTM E72-15	Conducting Strength Tests of Panels for Building Construction

7.	ASTM E90-09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
8.	ASTM E283-04(2012)	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
9.	ASTM E331-00(2009)	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
10.	ASTM E413-10	Classification for Rating Sound Insulation

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 07 41 13-1, Sample and Color Sample Kit:

C. RSN 07 41 13-2, Product Data and Shop Drawings:

1. Metal panels, edges, joints, profiles, corners, anchorages, attachments, trim, flashings, closures and accessories approval data:
   a. Certification of specified recovered material content.
2. Shop drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
3. Product test reports.

D. RSN 07 41 13-3, Closeout Maintenance Data.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind loads: As shown on drawings.
2. Other design loads: As shown on drawings.
3. Deflection limits: For wind loads, no greater than L/180 of the span.

1.05 QUALIFICATIONS

A. Installer Qualifications: Worked on 3 projects of similar scope.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 GENERAL

A. Minimum R-value of 30 in accordance with ASTM C518.

B. Water Penetration: No uncontrolled water penetration through the panel joints at a pressure differential of 20 psf in accordance with ASTM E331.

C. Air Infiltration: Not to exceed 0.001 cfm per sf at 20 psf air pressure differential in accordance with ASTM E283.

D. Sound Transmission Coefficient (STC): Minimum of 22 in accordance with ASTM E90 and ASTM E413.

E. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free.

1. Minimum recovered materials content: 9 percent.

F. Steel Materials Content:

1. If manufactured in a Basic Oxygen Furnace:
    a. Minimum post consumer content: 16 percent.
    b. Minimum total recovered materials: 25 to 30 percent.
2. If manufactured in an Electric Arc Furnace:
    a. Minimum post consumer content: 67 percent.
    b. Minimum total recovered materials: 100 percent.

G. Coatings: In accordance with manufacturer’s recommendation.

2.03 ROOF PANELS

A. 900 High Rib Panel, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: www.kingspanpanel.com or equal with the following essential characteristics:

1. Factory-formed insulated metal panels.
2. Designed and manufactured to prevent through metal-to-metal contact between exterior and interior faces of installed system.
3. Total panel thickness: 4 inches.

4. ASTM A755.
5. Coatings: Refer to Section 09 96 20 - Coatings.
6. Exterior face:
   a. Gauge: 24.
   b. Overlapping rib 1-1/2 inch to 2 inch high at panel joint.
   c. Color: To be determined by Government from submitted color samples.
   d. Finish and texture: Standard Manufacturer's.
7. Interior Face:
   a. Gauge: 26.
   b. Finish and Texture: Standard Manufacturer's.
   c. Color: Imperial White.

B. Fasteners:
1. Structural fasteners shall be hex-head type, cadmium plated steel with neoprene washer, or as recommended by manufacturer.
2. Saddle clip for panel attachment shall be 16 gauge with integral self-sealing gasket supplied by the manufacturer.
3. Stitch fasteners for roof panel sidelaps and endlaps shall be vibration resistant type (anti-backout thread), self-drilling low profile screws with sealing washers, designed to resist back out by increasing thread friction as screw loosens.
4. Size and spacing: As recommended by manufacturer.

C. Perimeter Trim and Penetration Treatments:
1. Fabricated perimeter trim, penetration treatments and fascia, and metal flashing: Same gauge, material and coating color as exterior face of insulated metal roof panel.

D. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.
1. Butyl Tape: As recommended by manufacturer.

2.04 ACCESSORIES

A. Gutters and Downspouts:
1. Material: ASTM A653, Coating Designation G90, or ASTM A792, Coating Designation AZ55, coated steel sheet.
2. Thickness: 24 gauge, minimum, core steel.
3. Gutter finish: Pre-finished, color to match building roof panels.
4. Downspout finish: Pre-finished, color to match building wall panels.

B. Splash Blocks: As shown on the drawings.

C. Gutter Supports:

1. Material: Zinc coated steel.
2. Concealed support of type and size recommended by building manufacturer.

D. Downspout Anchors:

1. Same material, thickness, finish, and color as downspouts.
2. Type, size, and quantity recommended by building manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Examination:

1. Provide field measurements to panel manufacturer.

B. Panel Installation:

1. In accordance with manufacturer's installation guidelines and recommendations.
2. Install panels plumb, level, and true-to-line to dimensions and layout indicated on shop drawings.
3. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions.
4. Butyl weather barrier sealant:
    a. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
    b. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
    c. Do not use non-skinning butyl tube sealant to bridge gaps.
5. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the shop drawings.

C. Trim Installation:

1. Place fascia, trim and trim fasteners as indicated on the shop drawings.
2. Field drill weep holes where appropriate in horizontal trim; minimum 1/4 inch diameter at 24 inches on center.
3. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper weather seal.

D. Sealant Installation For Exposed Joints:

1. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.

2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

3. Direct contact between butyl and silicone sealants shall not be permitted.

3.02 CONTRACTOR QUALITY CONTROL

A. Field Water Test: After completing portion of metal roof panel assembly including accessories and trim, test a 2-bay area for each structure selected by the COR for water penetration in accordance with AAMA 501.2.

B. Cleaning And Protection:

1. Remove protective film immediately after installation.

2. Touch-up, repair or replace metal panels and trim that have been damaged as approved by COR.

3. After metal roof panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07 42 13
PREINSULATED METAL WALL PANELS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. American Architectural Manufacturers Association (AAMA)

1.	AAMA 501.2-09	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

B. ASTM International (ASTM)

1.	ASTM A755/A755M-15	Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
2.	ASTM C518-15	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
3.	ASTM C591-15	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
4.	ASTM E72-15	Conducting Strength Tests of Panels for Building Construction
5.	ASTM E90-09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
6.	ASTM E283-04(2012)	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen

7.	ASTM E331-00(2009)	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
8.	ASTM E413-10	Classification for Rating Sound Insulation
9.	ASTM E1592-05(2012)	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 07 42 13-1, Sample and Color Sample Kit:

C. RSN 07 42 13-2, Product Data and Shop Drawings:

1. Metal panels, edges, joints, profiles, corners, anchorages, attachments, trim, flashings, closures and accessories approval data:

   a. Certification of specified recovered material content.

2. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

3. Product test reports.

D. RSN 07 42 13-3, Closeout Maintenance Data.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind loads: As shown on drawings.

2. Other design loads: As shown on drawings.

3. Deflection limits: For wind loads, no greater than L/180 of the span.

1.05 QUALIFICATIONS

A. Installer: Worked on 3 projects of similar scope.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 GENERAL

A. Minimum R-value of 7.5 per inch in accordance with ASTM C518.

B. Water Penetration: No uncontrolled water penetration through the panel joints at a pressure differential of 20 psf in accordance with ASTM E331.

C. Air Infiltration: Not to exceed 0.001 cfm/sf at 20 psf air pressure differential in accordance with ASTM E283.

D. Sound Transmission Coefficient (STC): Minimum of 22 in accordance with ASTM E90 and ASTM E413.

E. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free.

1. Minimum recovered materials content: 9 percent.

F. Coatings:

1. In accordance with the manufacturer's recommendations.

2. Factory applied.

2.03 INTERIOR WALL PANELS

A. 300 Minor Rib Panel, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: (www.kingspanpanels.us) with the following essential characteristics:

1. Factory-formed insulated metal panels.

2. Total panel thickness: 2-inches.

3. Exterior and interior faces:

a. ASTM A755.

b. Exterior and interior Gauge: 24.

c. Profile: Minor Rib.

d. Texture None.

e. Color: Imperial White (both faces).

4. Interior face coating: Arbosol, as manufactured by P and R Industries, Inc., www.arbonite.com or equal with the following essential conditions:

a. Factory applied.

b. Corrosion resistant.

2.04 ACCESSORIES

A. Fasteners:

1. Self-drilling fasteners shall be cadmium plated steel with neoprene washer, as recommended by manufacturer.
2. Material: Hex-head type with steel and neoprene washer and 12 gauge stainless steel clip supplied by the manufacturer.
3. Size: As recommended by manufacturer.

B. Perimeter Trim:

1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal wall panel.
2. Extruded perimeter trim: Extruded aluminum 6063-T5 alloy with spray applied PVF coating in same color as exterior face of insulated metal wall panel.

C. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

D. Butyl Tape: As recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Provide field measurements to panel manufacturer.

B. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects.

3.02 INSTALLATION

A. Panel Installation:

1. In accordance with manufacturer's installation guidelines and recommendations.
2. Install panels plumb, level, and true-to-line to dimensions and layout indicated on shop drawings.
3. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions.
4. Butyl weather barrier sealant:
    a. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
    b. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.

c. Do not use non-skinning butyl tube sealant to bridge gaps.

5. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the shop drawings.

B. Trim Installation :

1. Place trim and trim fasteners as indicated on the shop drawings.

2. Field drill weep holes where appropriate in horizontal trim; minimum 1/4 inch diameter at 24 inches on center.

3. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper weather seal.

C. Sealant Installation For Exposed Joints:

1. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.

2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

3. Direct contact between butyl and silicone sealants shall not be permitted.

3.03 CONTRACTOR QUALITY CONTROL

A. Cleaning and Protection:

1. Remove protective film immediately after installation.

2. Touch-up, repair or replace metal panels and trim that have been damaged as approved by COR.

3. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

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SECTION 07 72 30
ROOF HATCHES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Aluminum Association (AA)

1.	AA ADM-15	Aluminum Design Manual

B. ASTM International (ASTM)

1.	ASTM D1056-14	Flexible Cellular Materials - Sponge or Expanded Rubber

C. American Welding Society, Inc. (AWS)

1.	AWS D1.2/D1.2M-14	Structural Welding Code - Aluminum

1.03 DELIVERY, STORAGE, AND PROTECTION

A. Protect from corrosion, deformation, and other types of damage.

B. Store items in an enclosed area free from contact with soil and weather.

C. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 DOUBLE LEAF ROOF HATCHES

A. Roof Hatches:

1. Aluminum access hatches of sizes shown on drawings.

2. Roof hatches: Type "D" as manufactured by the Bilco Company, P.O. Box 1203, New Haven, CT 06505; B-RH Series as manufactured by Babcock-Davis Hatchways, Incorporated, 50 Lowell Street, Arlington MA 02174; or equal, having the following essential characteristics:

   a. Double leaf.

   b. Twelve inch high curb with 3-1/2 inch wide flange with holes for securing to the roof (hatch), 3/16 inch aluminum with welded watertight corners.

   c. Curb insulation:

      1) 1 inch rigid fiberboard.

      2) Enclose curb insulation with metal of same material and gauge as curb.

   d. Covers: 3/16 inch aluminum.

   e. Cover insulation:

      1) One inch thick glass fiber.

      2) Fully enclose with metal cover of 11 gauge aluminum.

   f. Aluminum hardware.

   g. Heavy duty hinges.

   h. Spring operators to ease operation when opening hatch.

   i. Automatic hold-open device.

   j. Turn handles on inside.

   k. Weathertight and watertight.

2.03 MATERIALS

A. Gaskets:

1. Dense sheet neoprene gaskets: ASTM D1056, Grade 2A1.

2. Bond gasket to metal with manufacturer's standard adhesive.

2.04 FABRICATION

A. Fabricate metalwork in accordance with AA ADM and this section.

B. Perform welding and related work in accordance with AWS D1.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install roof hatches as shown on drawings.

B. Install roof hatches in accordance with manufacturer's instruction to be weathertight and watertight.

C. Coating: Coat aluminum in contact with steel with 1 coat of industrial bituminous paint.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Spray hatches with water. Repair leakage as approved by COR.

B. Inspect hatches for light infiltration. Repair as approved by COR.

END OF SECTION

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SECTION 08 34 53
SECURITY DOORS AND FRAMES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors), 21 August 2001

B. International Code Council (ICC)

1.	ICC IECC-12	International Energy Conservation Code

C. Steel Door Institute (SDI)

1.	SDI A250.6-03(2009)	Hardware Reinforcing on Standard Steel Doors and Frames
2.	SDI A250.8-14	Standard Steel Doors and Frames
3.	SDI A250.11-12	Erection Instructions for Steel Frames

D. Underwriters Laboratories (UL)

1.	UL 752-05	Bullet-Resisting Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 08 34 53-1, Approval Drawings and Data:

1. Manufacturer’s shop drawings:

a. Show dimensions, material gauges, framing members, reinforcements, hardware preparation and locations, anchorage details, and other fabrication and installation details.

b. Identify doors and frames by Government designations on drawings.

2. Manufacturer's product data for doors, frames, and accessory materials.

a. Include complete descriptions and specifications for materials, construction, and finish.

b. Identify doors and frames by Government designations on drawings.

3. Manufacturer's product data for grout to be used to fill frames.

C. RSN 08 34 53-2, Instructions:

1. Manufacturer's storage, handling, and installation instructions.

1.04 QUALITY ASSURANCE

A. Manufacturers Qualifications: Obtain bullet resistant door and frame assemblies through one source from a single manufacturer with a minimum 5 years of documented experience producing bullet resistant door and frame type work similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Bullet resistant door and frame assemblies to be certified by an independent laboratory to applicable UL standards.

1. Provide bullet resistant assemblies with minimum UL 752, Level 4 rating.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store and handle materials at jobsite in accordance with manufacturer's instructions and SDI A250.8.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for bullet resistant hollow metal frames.

B. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors.

C. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 BULLET RESISTANT HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of type and design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with SDI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard bullet resistant door core construction designed and tested for the specified UL752 standard Level rating.
3. Insulation: Manufacturer’s standard insulation meeting the requirements of Climate Zone 5 in accordance with IBC IECC.
4. Level/Model: Level 3 and Physical Performance Level A, Model 2, hot-dipped zinc coated steel, 14 gauge.
5. Vertical Edges:
    a. Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door.
    b. Welds are to be ground, filled and dressed smooth.
    c. Beveled Edge, 1/8 inch.
6. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 12 gage, extending the full width of the door and welded to the face sheet. Finish top and bottom to provide a smooth flush condition.
7. Surface Applied Hardware Reinforcements: Fabricate according to SDI A250.6 with reinforcing plates from same material as door face sheets.
8. End closure: Flush end closure at top.

2.03 BULLET RESISTANT HOLLOW METAL FRAMES

A. General: Provide frames of the type and profile indicated, not less than thickness indicated; to comply with SDI A250.8.

1. Hot-dipped zinc coated steel.
2. Fabricate frames with mitered corners.

3. Fabricate frames with "closed and tight" mitered, full depth continuously welded seams, finished smooth with no visible seam unless otherwise indicated. Knock down type frames are not permitted.

4. Minimum 14 gage thick steel sheet.

B. Surface Applied Hardware Reinforcements: Fabricate according to SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.04 DOOR ACCESSORIES

A. Steel Astragals:

1. Continuous steel astragal.

2. Thickness: 1/8 inch.

3. Width: 1-1/2 inches.

2.05 FRAME ACCESSORIES

A. Frame Anchors: SDI A250.8.

B. Mortar Guard Boxes: 22 gauge, minimum, sheet steel.

C. Floor Anchors: SDI A250.8.

D. Expansion Anchors for Floor Anchors: CID A-A-1923A, Type 4.

2.06 FABRICATION

A. Fabricate bullet resistant hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate bullet resistant hollow metal work to tolerances indicated in SDI A250.8.

C. Bullet Resistant Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.

2. Astragals: Provide overlapping astragals on one leaf of pairs of doors where required for bullet resistance level standard. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

3. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Section 08 71 10 - Door Hardware.

D. Bullet Resistant Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Full depth continuously weld frame seams; grind, fill, dress, and make smooth and flush.

a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

2. High Frequency Hinge Reinforcement: Provide 12 gage angle reinforcements for butt type hinges on every door and frame assembly.

3. Continuous Hinge Reinforcement: Provide welded continuous 12 gage straps for continuous hinges specified in hardware sets in Section 08 71 10 - Door Hardware.

E. Surface Hardware Preparation: Factory prepare bullet resistant hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08 71 10 - Door Hardware.

1. Locate hardware as indicated, or if not indicated, according to SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface-mounted door hardware.

3. Comply with applicable requirements in SDI A250.6 for preparation of bullet resistant hollow metal work for hardware.

F. Weld astragal to door leaf before finishing.

G. Repair damage to zinc-coated materials with commercial zinc-rich priming paint.

2.07 FINISH

A. Prime finish in accordance with SDI A250.8.

B. Use lead- and chromate-free priming paint compatible with finish paint to be field applied.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded bullet resistant hollow metal frames for squareness, alignment, twist, and plumbness.

C. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

A. General: Install bullet resistant hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Bullet Resistant Hollow Metal Frames: Install bullet resistant hollow metal frames of size and profile indicated. Comply with SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

    a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with appropriate mortar.

4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame.

C. Bullet Resistant Hollow Metal Doors: Fit bullet resistant hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

    c. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

D. Test and adjust door operation for proper operation.

3.03 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including bullet resistant hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from bullet resistant hollow metal work immediately after installation.

3.04 CONTRACTOR FIELD QUALITY TESTING

A. Spray doors with water. Repair leakage as approved by COR.

B. Inspect doors for light infiltration. Repair as approved by COR.

3.05 COATINGS

A. Coat installed doors and frames in accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Builders Hardware Manufacturers Association (BHMA)

1.	BHMA A156.1-13	Butts and Hinges
2.	BHMA A156.4-13	Door Controls - Closers
3.	BHMA A156.6-10	Architectural Door Trim
4.	BHMA A156.13012	Mortise Locks and Latches
5.	BHMA A156.16-13	Auxiliary Hardware
6.	BHMA A156.21-09	Thresholds
7.	BHMA A156.22-12	Door Gasketing and Edge Seal Systems

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 08 71 00-1, Approval Data:

1. Contractor’s hardware schedule.
    a. Include complete hardware group, door, handing, hardware, accessories, and finish identification.
    b. Use Government designations to identify doors and hardware groups.
2. Manufacturer’s product data.

C. RSN 08 71 00-2, Instructions:

1. Manufacturer’s installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Label each hardware container with item number in approved hardware schedule.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 BASIC HARDWARE REQUIREMENTS

A. Single Source Requirement: Provide matching products from single manufacturer for each type of hardware.

B. Templates: Provide manufacturers' templates for door and frame preparation.

2.03 BUTT HINGES

A. Standard-Weight Steel Butt Hinges: BHMA A156.1, A8112, full-mortise template hinge with 5 knuckles, 2 ball bearings, non-rising pin, and flat button tips.

2.04 LOCKSETS AND LATCHES

A. Type, Series, and Grade: BHMA A156.13, Series 1000, Grade 1, mortise locksets and latches.

B. Front: Armored.

C. Case: Wrought steel with zinc dichromate corrosion protection.

D. Latch Bolt: 3/4 inch-throw, anti-friction, deadlocking stainless steel bolt.

E. Deadbolt: 1 inch-throw, solid stainless steel bolt with two enclosed hardened steel roller pins.

F. Trim Installation: Self-aligning installation secured with thru-bolts from inside trim.

G. Trim:

1. Round rose and lever handle on inside and outside.
2. Round lever handle with end return.
3. Base Material:
    a. BHMA 630 finish: Stainless steel.

2.05 DOOR CLOSERS

A. BHMA A156.4, Grade 1, Surface Closer - Modern Type with Cover, Option PT 4A, Option PT 4D, adjustable latching speed, multisize spring power adjustable from size 2 through 6, non-handed arm, and corrosion inhibiting prime coat or pretreatment.

2.06 FLUSH BOLTS

A. Lever Extension Flush Bolts:

1. Non-fire-rated Doors: BHMA A156.16, with flat front and 12 inch length rod.

2.07 DOOR PLATES

A. Kick Plates: BHMA A156.6, J102, stainless steel plate, 0.050 inch thick, with three beveled edges.

B. Mop Plates: BHMA A156.6, J103, stainless steel plate, 0.050 inch thick, with 3 beveled edges.

2.08 STOPS

A. Wall Stop: BHMA A156.16, Convex Type, concealed mounting, convex bumper, and backplate.

2.09 AUXILIARY HARDWARE

A. Kick Down Holder: BHMA A156.16, solid cast brass with duraflex bumper, 4-5/8 inch projection.

B. Silencers: BHMA A156.16, inserted-type rubber silencer.

2.10 GASKETING SYSTEMS

A. Door Shoe with Drip Cap:

1. BHMA A156.22.
2. One piece, channel-type, extruded aluminum housing with integral rain drip.
3. One piece, removable, fingered vinyl insert seal.
4. One half inch seal height.

B. Door Shoe without Drip Cap:

1. BHMA A156.22, R3D434.
2. One piece, channel-type, extruded aluminum housing.
3. One piece, removable, fingered vinyl insert seal.
4. One half inch seal height.

2.11 WEATHERSTRIPPING

A. Neoprene Gasket Weatherstripping: Closed-cell expanded neoprene gasket, 1/8 inch thick and 1/2 inch wide, with self-adhesive backing.

2.12 THRESHOLDS

A. Saddle Threshold: BHMA A156.21, extruded aluminum with 1/4 inch height and 5 inch width or as required.

2.13 DOOR SWEEPS

A. Door Bottom Sweep: 3/8 inch wide, 1-11/16 inch total height with insert, neoprene insert, clear anodized aluminum.

2.14 ACCESSORIES

A. Strikes and Accessories: Provide matching strikes and accessories required for installation or operation of hardware.

B. Fasteners: Matching fasteners suitable for application furnished by product manufacturer.

2.15 LOCK CYLINDERS AND KEYING

A. Furnish locks with 7 pin, interchangeable-core, lock cylinders.

1. Furnish lock cylinders with temporary construction core system which can be voided after contract completion.
2. Key locks alike.

B. Furnish permanent core system after contract completion. Furnish 2 keys per lock.

C. Stamp construction keys with "U.S. Property - Do Not Duplicate" and appropriate key numbers.

D. Furnish 6 construction keys to COR for Government’s use during construction.

E. Deliver construction keys to COR at jobsite after completion of work when directed by COR.

PART 3 EXECUTION

3.01 SEQUENCING

A. Do not install surface mounted hardware, gasketing systems, or weatherstripping on steel doors and frames until doors and frames have been painted.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount hardware in accordance with approved shop drawings for doors and frames.

C. Use manufacturer's templates for field mounting of hardware.

D. Adjust operation of door operators and closers as recommended by manufacturer for door size, weight, movement, and jobsite conditions.

E. Mount activation device for door operator with centerline of device at 36 inches above finished floor.

F. Thresholds:

1. Fit threshold to doorframe.
2. Attach to concrete with machine screws in expansion anchors.

G. Gasketing and Weatherstripping:

1. Install or apply in continuous lengths without joints.
2. Butt corners tight.
3. Provide effective door seal.

H. Test door operation and correct defects in operation.

3.03 HARDWARE SCHEDULE

Table 08 71 00A - Door Hardware Schedule

Hardware Group No.	Door Numbers	Required Hardware for Each Door
1	Air Chamber Building Nos. 1 and 2 100, 101	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair - BHMA 630 finish. F13 dormitory lockset - BHMA 630 finish. Closer with non-hold-open parallel arm, cush-n-stop type feature. BHMA 630 finish. Door shoe: Pemko 209 V. Threshold: Saddle Type Weatherstripping: Self-adhesive neoprene, Pemko S88.

END OF SECTION

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SECTION 09 65 10
RUBBER WALL BASE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. For the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. For the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM F1861-08(2012) Resilient Wall Base

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 09 65 10-1, Approval Data and Color Sample Kit:

1. Manufacturer’s product data for base and adhesive.
2. Manufacturer’s color sample kit for color selection.

C. RSN 09 65 10-2, Instructions:

1. Manufacturer’s surface preparation and installation instructions for base and adhesive.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 RUBBER WALL BASE

A. ASTM F1861, Type TV, Group 1, Style B - cove.

B. Thickness: 1/8 inch.

C. Height: 6 inches.

2.03 ACCESSORIES

A. Corners: Matching factory-made molded corners.

B. Adhesive: As recommended by base manufacturer for substrate surface.

PART 3 EXECUTION

3.01 PREPARATION

A. Install base before wall surface is painted.

B. Clean and dry wall surface in accordance with manufacturer's instructions.

C. Prime substrate as recommended by adhesive manufacturer.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in maximum possible lengths to minimize joints.

C. Butt joints tight without gaps or offset.

D. Accurately scribe to doorframes and intersecting surfaces.

E. Finish internal and external wall corners with molded corners.

END OF SECTION

SECTION 09 96 20

COATINGS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Pre-manufactured Pump Station No. 1.

B. Cost:

1. Include in the price in the Price Schedule for Pre-manufactured Pump Station No. 2.

C. Cost:

1. Include in the price in the Price Schedule for Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems.

D. Cost:

1. Include in the price in the Price Schedule for Submerged Galvanic Anode Cathodic Protection System For Welded Tanks.

E. Cost:

1. Include in the price in the Price Schedule for Bolted Tank Submerged Galvanic Anode Cathodic Protection System.

F. Cost:

1. Include in the price in the Price Schedule for Line Pipe.

G. Cost:

1. Include in the price in the Price Schedule for NAPI Turnout.

H. Cost:

1. Include in the price in the Price Schedule for Class 150B Two Inch Diameter Air Valve Assemblies.

I. Cost:

1. Include in the price in the Price Schedule for Class 250B Two Inch Diameter Air Valve Assemblies.

J. Cost:

1. Include in the price in the Price Schedule for Class 150B Four Inch Diameter Blowoffs.

K. Cost:

1. Include in the price in the Price Schedule for Class 250B Four Inch Diameter Blowoffs.

L. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 1.

M. Cost:

1. Include in the price in the Price Schedule for Air Chamber No. 2.

N. Cost:

1. Include in the price in the Price Schedule for Regulating Tank No. 1.

O. Cost:

1. Include in the price in the Price Schedule for Regulating Tank No. 2.

P. Cost:

1. Include in the price in the Price Schedule for Steel Piping.

Q. Cost:

1. Include in the price in the Price Schedule for Valves and Equipment.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A380-13	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
2.	ASTM A780/A780M-09(2015)	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
3.	ASTM C920-14a	Elastomeric Joint Sealants
4.	ASTM D870-09	Testing Water Resistance of Coatings Using Water Immersion
5.	ASTM D2244-15a	Calculation of Color Differences From Instrumentally Measured Color Coordinates
6.	ASTM D2794-93(2010)	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

7.	ASTM D4060-14	Abrasion Resistance of Organic Coatings by the Taber Abraser
8.	ASTM D4285-83(2012)	Indicating Oil or Water in Compressed Air
9.	ASTM D4541-09	Pull-Off Strength of Coatings Using Portable Adhesion Testers
10.	ASTM D4587-11	Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
11.	ASTM D5894-10	Cyclic Salt Fog/UV Exposure of painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
12.	ASTM D6677-07(2012)	Evaluating Adhesion by Knife
13.	ASTM G8-96(2010)	Cathodic Disbonding of Pipeline Coatings
14.	ASTM G154-12a	Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

B. American Water Works Associations (AWWA)

1.	AWWA C104-13	Cement-Mortar Lining and for Ductile-Iron Pipe and Fitting
2.	AWWA C205-12	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4In. (100mm) and Larger - Shop Applied
3.	AWWA C222-08	Polyurethane Coatings for the Interior and Exterior of Steel Pipe and Fittings
4.	AWWA C602-11	Cement Mortar Lining of Water Pipelines in Place - 4 In. (100mm) and Larger
5.	AWWA D103-09	Two-Layer Nylon-11-Based Polyamide Coating System for the Interior and Exterior of Steel Water Pipe, Connections, Fittings, and Special Connections

C. Bureau of Reclamation (USBR)

1.	USBR M47-15	Repair of Concrete

D. General Services Administration (GSA)

1.	FED-STD-595-15	Colors Used in Government Procurement

E. International Organization For Standardization (ISO)

1.	ISO 8502-3-92	Assessment of dust on Steel Surface Prepared for Painting (Pressure-Sensitive Tape Method)

F. Master Painters Institute (MPI)

1.	Approved Product List (APL)	www.paintinfo.com or www.mpi.net

G. National Association of Pipe Fabricators (NAPF)

1.	NAPF 500-03-04-06	Abrasive Blast Cleaning of Ductile Iron Pipe
2.	NAPF 500-03-05-06	Abrasive Blast Cleaning of Cast Ductile Iron Fittings

H. NSF International (NSF)

1.	NSF 61-14	Drinking Water System Components

I. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-AB1-15	Mineral and Slag Abrasives
2.	SSPC-AB2-15	Cleanliness of Recycled Ferrous Metallic Abrasives
3.	SSPC-AB3-04	Newly Manufactured or Re-Manufactured Steel Abrasives
4.	SSPC-Paint Manual-95	Good Painting Practices, Fourth Edition
5.	SSPC-PA2-15	Measurement of Dry Paint Thickness with Magnetic Gages
6.	SSPC-SP1-15	Solvent Cleaning
7.	SSPC-SP3-04	Power Tool Cleaning
8.	SSPC-SP5/NACE 1-07	White Metal Blast Cleaning
9.	SSPC-SP6/NACE 3-07	Commercial Blast Cleaning
10.	SSPC-SP10/NACE 2-07	Near-White Blast Cleaning
11.	SSPC-SP11-13	Power Tool Cleaning to Bare Metal
12.	SSPC-SP13/NACE6-03	Surface Preparation of Concrete
13.	SSPC-VIS1-02	Guide and Reference Photographs for Steel Surfaces Prepared by Abrasive Blast Cleaning
14.	SSPC-VIS3-04	Visual Standard for Power- and Hand-Tool Cleaned Steel

15.	NACE RP0287-02	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
16.	NACE SP0188-06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

1. Include the following information with each set of data or certification:

   a. Applicable tabulation number from Coating Tabulations.

   b. Identification of “Items to be coated” including sub-letter and sub-number listed in Coating Tabulations.

B. RSN 09 96 20-1, Approval Data:

1. For each coating material, manufacturer’s product data, application, and SDS sheets.

   a. Supplier’s name, address, and phone number.

   b. Manufacturer’s designated product name.

   c. Applicable tabulation number from Coating Tabulations.

   d. Identification of “Items to be coated” including sub-letter and sub-number listed in Coating Tabulations.

2. “Equal” Products:

   a. For coating materials proposed as “equal” products to specified brand name products in Coating Categories, submit following with specified approval data:

   b. List of projects (not less than 3) where material has been successfully used in applications similar to this project. Include:

      1) Project name and location.

      2) Type of structure.

      3) Owner’s name, address, and telephone number.

      4) Application dates.

   c. Manufacturer’s certification substitute coating material meets specified requirements. Include:

      1) Manufacturer’s name, address, and phone number.

      2) Batch number(s) for each material, except thinners.

3) Signature of manufacturer's technical representative and date of signature.

d. Certified test reports that demonstrates substitute material meets or exceeds specified coating category requirements for physical and performance characteristics from each of following:

1) Coating manufacturer.

2) Independent laboratory.

3. Paint Chip Samples:

a. Color chip samples approximately 4 by 6 inch.

b. Label each sample to include manufacturer's designated product name, color, and gloss.

C. RSN 09 96 20-2, Final Approval Data:

1. For each coating material:

a. Purchase orders.

1) Supplier's name, address, and phone number.

2) Purchase order number and date.

3) Manufacturer's designated product name.

4) Batch number(s) for each material, except thinners.

5) Quantities ordered for each material, except thinners.

b. Product Certifications:

1) Manufacturer's certification that materials certified by a Qualified Products List (QPL) meet specified requirements.

2) NSF 61 certification that materials meet specified requirements for coating systems in-contact with potable water.

D. RSN 09 96 20-3, Contractor Testing Data for "Shop or Field Applied" Coatings:

1. Note - Not required for an equipment manufacture's standard coating system.

2. Date of work.

3. Description of areas and work performed.

4. Surface preparation.

5. Surface cleanliness (visible contaminates).

6. Surface profile.

7. Substrate soluble salt concentration.

8. Ambient conditions.

9. Dry film thickness after each coat.

1.04 QUALIFICATIONS

A. Painting contractor:

1. References showing painting contractor has previous successful experience applying coating systems.
2. Include name, address, and telephone number of project owners.

B. Coating applicators qualifications: SSPC-certified Level 2 Coating Application Specialist.

C. Coating inspector: NACE certified Level 2 Coating Inspector or SSPC-certified Level 2 Protective Coatings Inspector.

1.05 DELIVERY, STORAGE, HANDLING

A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.

B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.

C. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 50 to 95 degrees F.

D. Do not expose to direct sunlight during storage.

E. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).

1.06 AMBIENT CONDITIONS

A. Do not apply coatings under following environmental conditions:

1. Substrate surface temperature less than 5 degrees F above dewpoint.
2. Temperatures of ambient air or receiving surface are less than 35 degrees F.
3. Temperature of receiving surface is higher than 125 degrees F.
4. Ambient air temperature, substrate surface temperature, or humidity are outside of manufacturer's recommended range.

B. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.

C. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heating or cooling, and dehumidification required to maintain temperature and humidity. Maintain environmental conditions in accordance with the recommendations of the coating material manufacturer. Complete curing before placing the coating systems into service.

PART 2 PRODUCTS

2.01 PRE-MANUFACTURED PUMP STATION NO. 1 AND NO. 2

A. See Section 22 11 35 - Pre-manufactured Pump Stations.

2.02 BURIED GALVANIC ANODE CATHODIC PROTECTION AND CORROSION MONITORING SYSTEMS

A. See 26 42 10 - Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems.

2.03 SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM FOR WELDED TANKS

A. See Section 26 42 11 - Submerged Galvanic Anode Cathodic Protection System for Welded Tanks.

2.04 BOLTED TANK SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM

A. See Section 26 42 12 - Bolted Tank Submerged Galvanic Anode Cathodic Protection System.

2.05 LINE PIPE

A. See 33 11 10 - Pipeline General Requirements.

2.06 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.07 CLASS 150B AND 250B TWO INCH DIAMETER AIR VALVE ASSEMBLIES AND CLASS 150B AND 250 B FOUR INCH DIAMETER BLOWOFFS

A. See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

2.08 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.09 REGULATING TANK NO. 1 AND NO. 2

A. See Section 33 16 50 - Steel Tanks.

2.10 STEEL PIPING

A. See Section 35 21 95 - Steel Piping.

2.11 VALVES AND EQUIPMENT

A. See Section 35 22 15 - Valves and Equipment.

2.12 MATERIALS

A. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1, type I (natural minerals) and type II (slags), class A, except flint minerals are not permitted.
2. SSPC-AB2 for recycled cleanliness.
    a. In addition to the SSPC-AB2, include:
        1) Screen and air wash abrasive recycled at the job site to remove dirt and fines.
        2) Add new abrasive so that the combined new and recycled abrasive mixture meets specified requirements.
        3) Do not recycle abrasive which has picked up toxic or hazardous materials.
3. SSPC-AB3 Class I (steel) or II (iron) for angular shaped grit.
4. Use commercially available processes to render the hazardous waste stream non-hazardous.
5. Do not exceed toxicity threshold limit for hazardous materials.

B. Coatings:

1. Specified in Coating Tabulations.
2. Apply 1 coating category per option in Coating Tabulations.
3. Volatile Organic Compounds (VOC):
    a. Do not exceed maximum permitted by Federal, State, and local air pollution control regulations.
    b. Do not exceed maximum content as supplied in container or by addition of coating thinner material.
    c. Factory color or tint. Do not color or tint at jobsite. Tint each coat progressively darker to enable confirmation of the number of coats.
    d. Use thinners recommended by manufacturer for each coating material.

e. Use of accelerator products is not permitted unless approved by COR.

C. Caulking and Fillers:

1. Fillers and Caulks Flexible gaps or crevices:

a. Coating manufacturer's standard or compatible flexible filler or caulk material.

b. Caulk material: Meet or exceed ASTM C920 type S or M, grade NS, class 25, suitable for water immersion service.

2. Nonflexible gaps or crevices: Coating manufacturer's standard filler or caulk material.

PART 3 EXECUTION

3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES

A. Protect items or surfaces not to be coated from contamination and damage during cleaning and coating operations.

1. Protect from abrasive blast particles and airborne coating particles.

2. Includes surfaces and equipment in physical contact and in the vicinity of cleaning and coating operations.

3. Examples include: Mating and machined surfaces, mechanical and electrical equipment (open or enclosed); instruction and similar plates; and wet and newly coated surfaces.

B. Do not move newly coated items until coating is thoroughly dry as determined by one of following:

1. Coating manufacturer's instructions for handling.

2. Coating film cannot be distorted or removed by exerting substantial, but less than maximum, pressure with thumb and turning thumb through 90 degrees in plane of film.

3.02 REPAIR OF CONTRACTOR DAMAGED SURFACES

A. Repair items, equipment, or surfaces which are damaged or contaminated by the contractor or as a result of transportation and insulation as determined by the COR.

1. Repair damaged items of restore manufacturer coated equipment to original condition and appearance.

2. Before coating any damaged coated surfaces, re-clean exposed surfaces and apply coating materials in accordance with the coatings manufacturer's instructions.

3.03 COATING OF METALWORK EMBEDDED IN CONCRETE

A. For metal pipe embedded in concrete extend primer coats 6 inches, minimum, into concrete embedment measured from face of concrete and along surface of embedded. Caulk or seal gaps between the steel and the concrete at the exposed faces. Follow manufacturer's instructions to apply caulking material with maximum thickness of 1/2 inch.

B. Coat ferrous surfaces in direct contact with concrete or grout overlapping concrete surfaces by 2 inches. Examples include: sill or anchor plates for impacted immersion

C. Extend primer coat continuously through solid concrete structure with burial or immersion service exposure on either side of concrete faces. Examples include: thrust or anchor blocks.

3.04 SURFACE PREPARATION FOR FERROUS SURFACES

A. Remove or repair surface irregularities before specified surface preparation.

1. Welds:

   a. Welds: Smooth and continuous.

   b. Weld spatter, buckshot, laminations, and slivers: Remove and grind smooth.

   c. Undercuts and pinholes: Fill with weld metal and grind smooth.

   d. Projections, sharp edges, high points, fillets and corners: Grind smooth to radius of at least 1/16 inch.

2. Pitting, gouges, scratches, porosity, and similar defects: Grind sharp edges smooth.

3. Slag burrs, and laminations: Remove and grind smooth.

B. Grind full length of free edges and corners to 1/16 inch chamfer before specified surface preparation.

C. Specific preparation method and profile:

1. See Coatings Tabulations.

2. Remove deposits of rust and scale from the edges of beam flanges, angles and plates, bearings, rivets, the heads of nuts and bolts, and similar surfaces that are marginally accessible and difficult to clean. Hand pound using a hammer, or power tool cleaning using a needle gun or de-scaler before abrasive blast cleaning work begins.

D. Surface profile:

1. Prepare in accordance with manufacturer's instructions for metallic or existing coating surfaces and service environment, unless specified in Coating Tabulations.
2. Where manufacturer's instruction do not specify a surface profile, prepare blasted surfaces to following profile:
    a. Atmospheric Service Environments: 1 mil or greater angular profile and less than specified millage of first applied coat.
    b. Burial and Immersion Service Environments: Angular profile between 2 to 3 mils minimum and less than specified millage of first applied coat.
3. Perform tests in accordance with surface profile inspection procedures specified.
4. Heat cast iron components to between 140 and 180 degrees F to evaporate moisture in crystalline matrix for 2 hours minimum.

3.05 SURFACE PREPARATION FOR CONCRETE AND MASONRY SURFACES

A. Specific surface preparation methods for concrete and masonry:

1. Before surface preparation and coatings application, cure cementitious materials for 28 days minimum.
2. Before coating application, repair cementitious defects greater than 3/4 inch in depth by one of the following:
    a. In accordance with USBR M47.
    b. In accordance with manufacture's product instructions.
3. Specific surface preparations:
    a. See coatings Tabulations.
    b. Surfaces shall be free of dirt, dust, grease, oil, laitance, efflorescence, from oil, and curing compounds.
    c. Perform moisture tests one per 1000 square feet, minimum.
    d. Perform moisture tests in accordance with moisture content inspection procedures specified and coatings manufacture allowable moisture content

3.06 APPLICATION EQUIPMENT

A. Air compressor and spray application equipment:

1. Provide appropriate type equipment, adequately sized, and in proper operating order.
2. Equip with pressure gauges and pressure regulators.

3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.

4. Perform tests in accordance with oil and moisture inspection procedures specified.

B. Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D4285. Remove oil or water before proceeding with work.

3.07 COATING APPLICATION

A. Apply number of coats and coating thickness specified in Coating Tabulations, and if not specified apply in accordance with manufacturer's instructions.

B. After surface preparation and cleaning, apply stripe coat and primer coat before rust bloom (flash rust) occurs or the same day, whichever is sooner. Re-clean surface areas not receiving stripe coats and primer coat within this period.

C. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.

D. Apply an even film of uniform thickness which tightly bonds to substrate or previous coats. Each coat shall be smooth, free from defects, such as skips, runs, sags, drips, pinholes, laps, brush marks, voids, or defects as defined in SSPC Paint Manual, Volume 1, Chapter 23. Each coat shall be free from pinholes, blisters and holidays, with no evidence of defects or blemishes with the defects repaired before applying the next coat. Coatings shall be sharply cut to lines.

E. Surfaces which become contaminated in the intervals between applications of coatings shall be re-cleaned prior to applying the next coat. For each coat, apply a stripe coat by brush, roller, or dauber to welds, corners, and behind angles, edges of beams etc. and areas not fully reachable by spray in order to obtain the specified coverage and thickness.

1. Fill crevices and cover other irregularities before coating.

2. Brush stripe welds, corners, seams, edges, nuts, threads, and bolts, a minimum of 2 inches around, prior to the application of first coat, as practicable.

F. Eliminate over spray or dry spray. Clean surface the over spray or dry spray prior to the application of succeeding coats.

G. Avoid contamination of painted surfaces between coats. Remove contamination before coating.

H. Stripe Coat:

1. Stripe Coat Application:

a. Apply stripe coats by brush, dauber, or roller.

b. Spraying of stripe coat is not permitted.

c. Apply to edges, corners, interior angles, pits, seams, and crevices, junctions of joining members, rivets, nuts, threads, bolts, washers, weld lines, and similar surface before applying primer, intermediate, and finish coats.

I. Primer Coats:

1. Apply immediately after surface preparation, cleaning, and stripe coat, if applicable. Apply before rust bloom occurs or the same day, whichever is less.
2. Cover peaks of surface profile by specified dry film thickness.
3. Apply number of coats and coating thickness specified in Coating Tabulations.
4. Apply within re-coat window at referenced humidity and temperature recommended by manufacturer.
5. Tint coats to differentiate between coats.

J. Intermediate and Topcoats:

1. Apply number of coats and coating thickness specified in Coating Tabulations.
2. Apply within re-coat window at referenced humidity and temperature recommended by manufacturer.
3. Tint intermediate coats to differentiate between coats.

3.08 FILLERS AND CAULK APPLICATION

A. Apply fillers and/or caulks in a uniform texture, neatness, and color matched appearance.

B. Apply fillers and/or caulks in accordance with manufacturer's instructions which tightly bonds to substrate or previous coats.

1. Fill crevices and other gaps where coatings cannot bridge.
2. Apply caulk after the coating has been applied.
3. Areas shall include crevices, steel plates butted together, bolts, rivets, seams, skip welds, and conduit through metal.

3.09 PROTECTION OF NEWLY COATED SURFACES

A. Do not walk on, subject to abrading action, or move items until coats are hardened sufficiently to resist damage.

3.10 CONTRACTOR QUALITY TESTING

A. Inspection Devices:

1. Provide inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint.

2. Use calibration plates and/or plastic shims to calibrate thickness gauge prior to every use.

B. Conduct tests.

C. Perform tests in presence of the COR. Tests performed in absence of the COR will not be accepted and subject coating shall be retested in the COR's presence.

D. Complete the following quality control tests, and prepare and submit reports of results:

1. Surface Profile: Inspect surface profile in accordance with NACE RP0287 for compliance with specified requirements.
   a. Use replica tape suitable for surface profile depth range.
2. Visual Comparison of Prepared Surfaces:
   a. Compare prepared steel surfaces to following visual reference photographs for allowable visible contaminants and stains:
      1) SSPC-VIS1 for abrasive blast cleaning.
      2) SSPC-VIS3 for power and hand tool cleaning.
3. Assessment of dust on newly prepared metal surfaces:
   a. Visually inspect and conduct pressure sensitive clear tape test method in accordance with ISO 8502-3 to verify surface cleanliness at a minimum of three random tests per each blasted section per shift.
   b. Clear tape test shall meet cleanliness with a No. 3 grade maximum contamination allowed.
4. Compressed air quality: ASTM D4285.
5. Post Cure Evaluation:
   a. Dry Film Thickness (DFT):
      1) After each coat, inspect hardened coating system for DFT compliance in accordance with SSPC-PA2.
      2) Acceptance Criteria: no single spot measurement less than specified minimum.
   b. Discontinuity (Holiday) Testing:
      1) Inspect in accordance with NACE SP0188.
         a) Use maximum test voltage for DFT as recommended by coating manufacturer to prevent coating damage.
         b) Use of detergent wetting solution is not permitted.
         c) Subtract thickness of zinc-rich primer from applied coating systems to determine test voltage.

c. Adhesion test:

1) Perform when and where directed by COR.

a) COR will direct performance of this test when inadequate procedures are suspected.

2) Test procedure: ASTM D6677.

E. Reports:

1. Prepare report for each shift performing coating work, including surface preparation. Complete report for coating work performed on the shift. Make reports available for ongoing review by Government personnel.

2. Report shall signed by Contractor qualified inspection personnel. Include:

a. Date of work.

b. Description of areas and work performed.

c. Surface preparation.

d. Surface cleanliness (visible contaminates).

e. Surface profile.

f. Substrate soluble salt concentration.

g. Ambient conditions.

h. Dry film thickness after each coat.

3.11 COATING TABULATIONS

Tabulation No. 01		
Items to be coated - shop or factory applied coating systems using a coating manufacturer's standard coating material: Air Chamber buildings metal wall and metal roof panels. Valve actuators and motors. Air valve assemblies. Flow meters. Overhead traveling crane, rail, hoist, and trolley.		
Coating materials	Number and thickness of coats	Surface preparation method
Factory or Shop applied permanent coating system: Factory or shop standard surface preparation and permanent coating system. Items subject to sunlight shall be topcoated with ultraviolet (UV) stable materials. Permanent coating system shall have 10-year corrosion-free protection without significant defects stored in atmospheric exposure. Color and gloss: Manufacturer's standard color unless a specific color is otherwise specified in the color schedule. Unless otherwise specified, unexposed surfaces that require coatings, such as interior of cabinets, enclosures, and equipment, shall be given the manufacturer's standard permanent coated finish.		
Field Repair: Repair damaged areas of coated surfaces with compatible materials to equal thickness and color match of undamaged areas, unless otherwise tabulated herein.		

Tab AE-05.DOC

Tabulation No. 02

Items to be coated:

Air chamber building doors and frames. Match to the exterior building roof panel color and gloss.
Barrier posts and guard posts.

Notes:

Shop applied coatings: Standard surface preparation and shop applied permanent coating system that meets the following:
Color and gloss to be manufacturer's standard unless specified below or in color schedule.
Unexposed interior surfaces of cabinets, enclosures, and equipment to be given the manufacturer's standard permanent coated finish.

Shop coating to meet one or more of following application alternatives:
Alternative 1 - Complete shop applied permanent 3-coat system that consists of 1-prime coat and 2-finish coats.
Alternative 2 - Baked-on, coil, extrusion, or fusion bonded that consists of 1 or more coats of UV stable system.
Alternative 3 - Shop applied primer and field finish coating system that consists of: 2-mil DFT primer, minimum, and 2-field finish coats compatible with shop applied primer as specified below in coating material options.

Repair damaged areas with same shop applied primer and finish coat materials or compatible materials.
Do not coat surfaces of crane rails or monorail crane beam that contacts trolley or end truck wheel treads

Remove stabilizing or storage treatments on galvanizing by one of following (a) SSPC-SP1 and sweep blasting or (b) manufacturer's compatible wash treatment.

Coating materials - Option 1 Alkyd/Silicone Alkyd	Number and thickness of coats	Surface preparation method
Prime or spot repair coats: Carboline: Carbocoat 115 VOC International Paint: Devguard 4160 Sherwin Williams: Kem Kromik Universal Primer Tnemec: Chem-Prime HS Series 37H	1 or more prime coats for uncoated or repair of damaged surfaces. Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	Undamaged coated surfaces to receive additional coats: SSPC-SP1 followed by: Uncoated surfaces: SSPC-SP6 Damaged coated surfaces: SSPC-SP6/NACE 3 and/or SSPC-SP11 where abrasive blasting is impractical

Tabulation No. 02		
Topcoat Carboline: Carbocoat 30R International Paint: Devshield 877 Sherwin Williams: Steel Master 9500 Tnemec: Versatone Series 82HS Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats. Apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 6 mil DFT, minimum 9 mil DFT, maximum	Follow manufacturer's surface preparation instructions and application instructions to apply subsequent coats.
Coating materials - Option 2 Water-borne acrylic	Number and thickness of coats	Surface preparation method
Prime or spot repair: Carboline: Carbocrylic 3358 International Paint: Devflex 4020PF DTM Sherwin Williams: DTM Waterborne Acrylic Primer series B66W1	1 or more prime coats for uncoated or repair of damaged surfaces. Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	Undamaged coated surfaces to receive additional coats: SSPC-SP1 followed by: Uncoated surfaces: SSPC-SP6/NACE 3 Damaged coated surfaces: SSPC-SP6/NACE 3 and/or SSPC-SP11 where abrasive blasting is impractical
Topcoat: Carboline: Carbocrylic 3359 International Paint: Devflex 4216HP Sherwin Williams: DTM Finish B66-100 or B66-200 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats. Apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 6 mil DFT, minimum 9 mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS: Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1 kg load:	250 mg loss or less
Direct impact, ASTM D2794	40 inch-pounds for alkyd/silicone alkyd 140 inch-pounds for waterborne acrylics

Tabulation No. 02	
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	250 psi or greater for alkyd/silicone alkyd 500 psi or greater for waterborne acrylics
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs.
QUV accelerated weathering test, ASTM D4587, ASTM G154:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D2244.

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Tabulation No. 03		
Items to coated: Exterior surfaces of exposed valves, fittings, and appurtenances located above ground. Exterior surfaces of exposed valves, fittings, and appurtenances located in concrete vaults. Valves may be coated with fusion bonded epoxy at no additional cost to the project. Exterior surfaces of exposed pipe, fittings, and appurtenances located in concrete vaults. Exterior surfaces of exposed pump manifolds and mounts. Exterior surfaces of exposed piping and fittings. Exterior of exposed pipe couplings. Exterior of exposed blow off piping, fittings, and valves. Coat associated fasteners to include nuts, bolts and washers.		
Notes: Do not coat stainless steel, bronze, or non-metallic surfaces. Do not coat mating surfaces, machine surfaces, seals, and surfaces that would be functionally impaired by the coating. Coat exposed machined surfaces after assembly.		
Coating materials - Option 1 Epoxy/ polyurethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Carboline: Carboguard 691 PPG: Amerlock 400 or Amerlock 2 Sherwin Williams: Duraplate 235 or Macropoxy 646 Tnemec: Epoxoline Series N69 or Epoxoline Series V69	2 or more prime coats. Apply at 6 to 8 mils DFT, per coat, plus stripe coats.	SSPC-SP1 followed by: For steel: SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4

Tabulation No. 03		
Finish coats: Carboline: Carbothane 134 HB, HG, or VOC PPG: Amercoat 450H or Amershield VOC Sherwin Williams: Hi solids polyurethane or Hi solids polyurethane 250 Tnemec: Endura-shield 175 Color and gloss: see color schedule	1 or more compatible manufacturer's finish coats, apply at 3 to 4 mils DFT, per coat. Total system, excluding stripe coats: 15-mil DFT, minimum 20-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Sherwin Williams: Corothane I Mio-zinc Wasser: MC-Miozinc 2.8 or 100	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	SSPC-SP1 followed by: For steel: SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4
Intermediate coat: Sherwin Williams: Corothane I Ironox B Wasser: MC Ferrox B 2.8 or 100	1 or more compatible manufacturer's finish coats, apply at 3 to 5 mils DFT, per coat.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Finish coats: Gloss Sherwin Williams: Corothane I Aliphatic Finish Coat Wasser: MC Shieldcoat 2.8 or 100 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats, apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 10-mil DFT, minimum 16-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
PERFORMANCE REQUIREMENTS:		

Tabulation No. 03

Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1-kg load:	Epoxy/polyurethane: 100 milligram loss or less MC urethanes: 100 milligram loss or less
Direct impact, ASTM D2794	Epoxy/polyurethane: 30 inch-pounds MC Urethanes: 100 inch-pounds
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	Epoxy polyurethane, and MC urethane: 800 psi or greater
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs
QUV accelerated weathering test, ASTM D4587:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D2244.

Tab AE-07.DOC

Tabulation No. 04		
Items to be coated: Exterior surfaces of immersed or buried valves. Valves may be coated with fusion bonded epoxy at no additional cost to the project. Exterior of bypass piping. Exterior of fill line piping. Exterior of buried or immersed piping (not encased in concrete and not in tanks). Coat fasteners to include nuts, bolts, washers, and exposed anchors.		
Notes: Do not coat stainless steel, bronze, or non-metallic surfaces. Do not coat mating surfaces, machine surfaces, seals, and surfaces that would be functionally impaired by the coating. Coat exposed machined surfaces after assembly.		
Coating materials - Option 1 Abrasion Resistant Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Carboline: Carboguard 690GF Carboline: Carboguard 890GF2 or 890LTGF International Paint (Devoe) Dev-Grip 238 Jotun: Marathon 500 PPG: Amerlock 2/400GF Color and gloss: manufacturer's standard light gray or other light color and gloss	3 or more base coats, apply at 8 to 10 mils DFT, per coat, plus stripe coats. Total base coat system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum	SSPC-SP1 followed by - For steel: SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2-4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 High Solids Abrasion Resistant Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 04		
For ferrous surfaces: Sherwin Williams: Duraplate UHS Primer and Duraplate UHS Intermediate and Topcoat Color and gloss: manufacturer's standard light gray or other light color and gloss	1 or more prime coats, apply at 4 to 8 mils DFT, per coat, plus stripe coats. 2 or more intermediate and topcoats, apply at 10 to 12 mils DFT, per coat. Total coat system, excluding stripe coats: 24-mil DFT, minimum 32-mil DFT, maximum	SSPC-SP1 followed by - For steel: SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2 - 4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 3 100% Solids Abrasion Resistant Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Carboline Plasite 4500 S KCC Coatings Techni-Plus AEP 18AR NSP Products: NSP 120 Color and gloss: manufacturer's standard light gray or other light color and gloss	2 or more base coats, apply at 10 to 16 mils DFT, per coat. Total coating system, excluding stripe coats: 20-mil DFT, minimum 32-mil DFT, maximum	SSPC-SP1 followed by - For steel: SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2 - 4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 4 100 percent Solids Abrasion Resistant Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 04

For ferrous surfaces: A.W. Chesterton ARC S2 Enviroline (International): Enviroline 225 or 376-30 or 376F-30LT International: Interzone 485 KCC Corrosion: Techni-plus EN 25.5 Color and gloss: manufacturer's standard light gray or other light color and gloss	1 or more base coats, apply at 30 to 60 mils DFT, per coat. Total coating system, excluding stripe coats: 30-mil DFT, minimum 60-mil DFT, maximum	SSPC-SP1 followed by - For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2 - 5 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Fresh/deionized water immersion test, ASTM D870:	Passes 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D870:	Passes 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1 kg load:	Epoxy: 100 milligram loss or less 100 percent Epoxy: 60 milligram or less
Direct impact, ASTM D2794	40 inch-pounds
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs.
Cathodic disbondment, ASTM G8:	No disbondment at 120 day test

Tab IE-02.DOC

Tabulation No. 05

Items to be coated:
For potable water service, NSF 61 approved coating:

Interior surfaces of exposed valves, fittings, and appurtenances located above ground.
Interior surfaces of exposed valves, fittings, and appurtenances located in concrete vaults.
Valves may be coated with fusion bonded epoxy at no additional cost to the project.
Interior and exterior surfaces of pump bowls. The pump bowls may be coated with fusion bonded epoxy at no additional cost to the project. Coating subject to direct sunlight will need a UV resistant topcoat.
Interior surfaces of exposed pipe, fittings, and appurtenances located in concrete vaults.
Interior surfaces of exposed pump manifolds and mounts.
Interior of pipe couplings.
Interior surfaces of immersed or buried valves. Valves may be coated with fusion bonded epoxy at no additional cost to the project.
Interior of bypass piping.
Interior of fill line piping.
Interior and exterior of cast iron or ductile iron pipe and fittings. May be coated with fusion bonded epoxy.
Interior and exterior of metal fittings for turnout PVC piping and may be coated with fusion bonded epoxy at no additional cost to the project.
Coat associated fasteners to include nuts, bolts and washers.

Notes:
Materials listed below require certified NSF 61 approval for contact with potable water.
Do not coat stainless steel, bronze, or non-metallic surfaces.
Do not coat mating surfaces, machine surfaces, seals, and surfaces where the coating could interfere with proper operation or fit.
Coat exposed machined surfaces after assembly.

Coating materials - Option 1 Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base Coats: Carboline: Carboguard 691(pw) PPG (Ameron): Amerlock 2(pw) Sherwin Williams: Duraplate 235 NSF(pw)	3 or more base coats, apply at 8 to 10 mils DFT, per coat, plus stripe coats. Total base coat system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum	SSPC-SP1 followed by - For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2-4 mil surface profile Follow manufacturer's

Tabulation No. 05		
Tnemec: Pota-Pox Series 20(pw) Color and gloss: manufacturer's standard color and gloss		surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 100 percent Solids Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: International (Enviroline) Enviroline 230(pw) Raven Lining Systems AquataPoxy A-6(pw) Color: manufacturer's standard color and gloss	1 or more base coats, apply at 30 to 50 mils DFT, per coat, plus stripe coats. Total coat system, excluding stripe coats: 30-mil DFT, minimum 50-mil DFT, maximum	SSPC-SP1 followed by - For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2-4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 3 100 percent Solids Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base Coats: Carboline Plasite 4500 S(pw) NSP Products: NSP 120(pw) Sherwin Williams Dura-Plate UHS(pw)	2 or more base coats, apply at 10 to 16 mils DFT, per coat. Total coating system, excluding stripe coats: 20-mil DFT, minimum 32-mil DFT, maximum	SSPC-SP1 followed by - For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For cast-iron: NAPF 500-03-05 Blast Clean No. 4 2-4 mil surface profile Material amine blushes, multiple coat systems need to be prepared in accordance

Tabulation No. 05

Color and gloss: manufacturer's standard color and gloss		with manufacturer's instructions to apply subsequent coats. Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Fresh/deionized water immersion test, ASTM D870:	Passes 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D870:	Passes 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1 kg load:	Epoxy: 100 milligram loss or less
Direct impact, ASTM D2794	30 inch-pounds
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs.
Cathodic disbondment, ASTM G8:	No disbondment at 120 day test

Tab IE-03.DOC

Tabulation No. 06		
Items to be coated: Buried interior and exterior surfaces of ferrous line pipe Buried interior and exterior surfaces of ferrous pipe field welded joints. Buried exterior surfaces of ferrous piping and fittings not tabulated herein.		
Notes: Do not paint aluminum-brass, bronze, and stainless steel metalwork. Do not coat seals, mating surfaces, and machined surfaces where paint could interfere with proper operation or fit. Coat exposed machined surfaces after installation. Pipe bedding and trench backfill will be installed so as to avoid abrasion or other damage to the coatings.		
Coating materials - Option 1(Interior only) - Cement-mortar lining		Surface preparation method
For ferrous surfaces: Apply in accordance with following standards: AWWA C104 or C 205, shop applied.		In accordance with AWWA C104 or AWWA C205
For girth welds and damaged areas: Apply in accordance with AWWA C602, in-place method.		In accordance with AWWA C602
Coating materials - Option 2 (Exterior and may also be used for interior lining) - Polyurethane	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Material: EC-120 or Corropipe II TX-15; as manufactured by: Madison Chemical Industries Inc., 490 McGeachie Drive, Milton, Ontario, Canada L9T 3Y5, 905-878-8863, www.madisonchemical.com Protec II; as manufactured by: ITW Futura Coatings, 130 Commerce Drive, Montgomeryville, PA 18936, www.futuracoatings.com Standard: Meets or exceeds requirements of		SSPC-SP1 followed by - For steel: SP10/NACE 2 For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 2-4 mil surface profile Follow manufacturer's

Tabulation No. 06	
AWWA C222 Thickness: 25-mil DFT, minimum Color: Manufacturer's standard color	surface preparation and application instructions to apply subsequent coats.
For repair of damaged and defective polyurethane areas: Material: Use coating manufactures recommended repair materials. Thickness: Achieve thickness equal to surrounding undamaged polyurethane.	For damaged coated surfaces: SSPC-SP-1 followed by SP-10 and/or SSPC-SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
For girth weld area option 1: Materials: Aqua-Shield AQW; as manufactured by: Canusa-CPS, 2408 Timberloch Place, Building C-8, The Woodlands TX 77380,281-367-8866, www.canusacps.com Application: Follow manufacturer's recommendations and instructions to apply heat shrink sleeve. Repair: Repair damage or defective sleeve areas per manufacturer's instructions. Replace sleeve for areas exceeding six square inches.	Follow manufacturer's surface preparation and application instructions to apply sleeve and any subsequent repairs.
For girth weld area option 2: Category: Liquid applied girth weld coating, compatible and approved by the polyurethane pipe coating manufacture. Application: Follow manufacturer's recommendations and instructions to apply girth weld coating. Repair: Repair damage or defective areas per manufacturer's instructions.	Follow manufacturer's surface preparation and application instructions to apply girth weld coating and any subsequent repairs.

Tabulation No. 07		
Items to be coated: Outdoor steel water storage tank coating options: Coating exterior of welded steel water storage tank option. Exterior of bolted steel water storage tank option. Coatings shall meet requirements of AWWA D103. Exterior surfaces of air chamber, piping and fittings. Exterior surfaces of the outdoor steel water piping, fitting, and valves. Exterior surfaces of the steel overflow piping and flap valve. Exterior surfaces of the steel wall manhole and hatch covers. Tank dome vent. Surfaces of accompanying metalwork to be coated and not left galvanized: Ladders, stairs, walkways, hatches, balconies, safety cages, handrail, safety railings, platforms, and catwalks. Coat fasteners to include nuts, bolts, washers, and anchors.		
NOTES: Do not paint aluminum-brass, bronze, and stainless steel metalwork. Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.		
Coating materials - Option 1 Zinc Rich Epoxy/Epoxy/Polyurethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Carboline: Carbozinc 859 or Carbozinc 859 VOC International Paint: Catha-coat 303H PPG: Amercoat 68HS or Amercoat 68HS VOC Sherwin Williams: Zinc Clad III HS or Zinc Clad III HS 100 Tnemec: Tneme-zinc 90-97	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10 For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical
Intermediate coat for ferrous surfaces: Carboline:	1 or more intermediate coats. Apply at 6 to 8 mils DFT,	Follow manufacturer's surface preparation and application instructions to

Tabulation No. 07		
Carboguard 691 PPG: Amerlock 400 or Amerlock 2 Sherwin Williams: Duraplate 235 or Macropoxy 646 Tnemec: Epoxoline Series N69 or Epoxoline Series V69	per coat, plus stripe coats.	apply subsequent coats.
Finish coats: Carboline: Carbothane 134 HB, HG, or VOC PPG: Amercoat 450H or Amershield VOC Sherwin Williams: Hi solids polyurethane or Hi solids polyurethane 250 Tnemec: Endura-shield 175 Color and gloss: see color schedule	1 or more compatible manufacturer's finish coats. Apply at 3 to 4 mils DFT, per coat. Total system, excluding stripe coats: 12 mil DFT, minimum 17 mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Sherwin Williams: Corothane I Mio-zinc Wasser: MC-Miozinc 2.8 or 100	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10 For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical

Tabulation No. 07		
Intermediate coat: Sherwin Williams: Corothane I Ironox B Wasser: MC Ferrox B 2.8 or 100	1 or more compatible manufacturer's finish coats. Apply at 3 to 5 mils DFT, per coat.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Finish coats: Gloss Sherwin Williams: Corothane I Aliphatic Finish Coat Wasser: MC Shieldcoat 2.8 or 100 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats, apply at 1 to 3 mils DFT, per coat. Total system, excluding stripe coats: 8 mil DFT, minimum 16 mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1 kg load:	Epoxy/polyurethane: 100 milligram loss or less MC urethanes: 100 milligram loss or less
Direct impact, ASTM D2794	Epoxy/polyurethane: 30 inch pounds MC Urethanes: 100 inch pounds
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	Epoxy polyurethane, and MC urethane: 800 psi or greater
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs.
QUV accelerated weathering test, ASTM D4587:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D2244.

Tabulation No. 08

Items to be coated: Outdoor steel water storage tank coating options:
Coating interior of welded steel water storage tank option.
Interior of bolted steel water storage tank option. Coatings meet the requirements of AWWA D103.
Interior and exterior ferrous surfaces of tank piping, and valves in-contact with potable water.
Interior of air chamber tank.
Interior and exterior ferrous surfaces of buried tank piping and valves.
Interior and exterior ferrous surfaces of the tank overflow piping and flap valve (not exposed to direct sunlight).
Interior and exterior ferrous surfaces of the tank wall manhole and hatch covers.
Pipe supports.
Fasteners to include nuts, bolts, washers, and anchors.

Note:
Materials listed below require certified NSF 61 approval for contact with potable water.
Do not paint aluminum-brass, bronze, and stainless steel metalwork.
Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.

Coating materials - Option 1 Epoxy - NSF 61	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Carboline: Carboguard 691(pw) PPG (Ameron): Amerlock 2(pw) Sherwin Williams: Duraplate 235 PW(pw) Tnemec: Pota-Pox Series 20(pw) Color: white and gloss	3 or more base coats. Apply at 8 to 10 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 24 mil DFT, minimum 30 mil DFT, maximum	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10 For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 08		
Coating materials - Option 2 100 percent Solids Epoxy - NSF 61	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Raven Lining Systems AquataPoxy A-6(pw) Color: manufacturer's standard white and gloss	1 or more base coats. Apply at 20 to 60 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20 mil DFT, minimum 60 mil DFT, maximum	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10, 2 to 3 mil profile For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 3 100 percent Solids Epoxy - NSF 61	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Carboline: Plasite 4500 S(pw) Color: manufacturer's standard gray and gloss.	1or more base coats. Apply at 20 to 60 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20 mil DFT, minimum 60 mil DFT, maximum	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10, 3 to 4 mil profile For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 4 100 percent Solids Epoxy - NSF 61	Number and thickness of coats	Surface preparation method

Tabulation No. 08		
For ferrous surfaces: Base coats: NSP Specialty Products NSP 120(pw) Color: manufacturer's standard gray and gloss.	2 or more base coats. Apply at 10 to 15 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20 mil DFT, minimum 30 mil DFT, maximum	Uncoated surfaces: SSPC-SP1 followed by SSPC-SP10, 3 to 4 mil profile For damaged coated surfaces: SSPC-SP1 followed by SSPC-SP10 and/or SSPC-SP11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Fresh/deionized water immersion test, ASTM D870:	Passes 2 years aerated water at ambient temperature no blisters on scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D870:	Passes 2 years aerated water at ambient temperature no blisters on either scribed or unscribed sides.
Abrasion resistance, ASTM D4060, CS-17 wheel, 1,000 cycles, 1 kg load:	100 milligram loss or less
Direct impact, ASTM D2794	30 inch pounds
Pulloff adhesion, ASTM D4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D5894:	1/4 inch or less undercutting at 3000 hrs.
Cathodic disbondment, ASTM G8:	No disbondment 120 day test

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Tabulation No. 9		
Items to be coated: Coat cathodic weld nuggets.		
Coating materials	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Carboline Bitumastic 50 or equal Color: Manufacturer's standard color	2 or more heavy base coats. Follow manufacturer's instructions for dry or wet film thickness per coat.	SSPC-SP3
Approved Materials: Materials from MPI APL		

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Tabulation No. 10		
Damaged galvanized items to be repaired: Hatch covers. Gratings. Ladders. Handrail and safety railings. Platforms. Steel joists Metal roof deck. Damaged galvanized surfaces not otherwise tabulated.		
Coating materials	Number and thickness of coats	Surface preparation method
Repair damaged galvanized surfaces in accordance with ASTM A780, except repair materials containing cadmium and lead are not permitted.		

Tab AE-11.DOC

Tabulation No. 11		
Damaged stainless steel items not to be coated and to receive a uniform passivation layer: Stainless steel clad surfaces not otherwise tabulated herein.		
Note: Do not coat stainless steel items listed above. New stainless steel surfaces to receive uniform passivation at point of manufacture. Clean and restored uniform passivation layer of damaged, contaminated, or depassivated stainless steel surfaces by methods listed below.		
Coating materials	Number and thickness of coats	Surface testing method
Do not coat unless specifically listed elsewhere in these tabulations.		ASTM A380
Repassivation Methods and Inspection Procedures of Contaminated Stainless Steel Surfaces		
Degree of surface contamination	ASTM A380* Surface preparation method**	ASTM A380* Surface preparation method**
Locally heavy surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates caused by field welding or cutting.	Method 5. - "Descaling", General Method 5.3 - "Mechanical Descaling" by grinding and/or Method 6.3 - "Cleaning of Welds and Weld-Joint Areas"	Method 7.2 - "Gross Inspection" Methods 7.2.5 - "Tests for Free Iron: Gross Indications"
General surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates.	Method 5. - "Descaling," General Method 5.2 - "Chemical Descaling" Method 5.2.2.(1) - "Chemical Descaling" by swab or spray wetting the surfaces and/or Method 5.3 - "Mechanical Descaling" by grinding	Method 7.2 - “Gross Inspection” Method 7.2.5 - Tests for Free Iron: Gross Indication

Tabulation No. 11		
General surface contaminated areas: Contaminated by grease, oil, residual chemical films, or other non-free iron related contaminates.	Method 6.2.10 - "Water Jetting" and/or Method 6.4 - "Final Cleaning, or Passivation, or Both", wiping with a clean, solvent-moistened cloth	Method 7.2 - "Gross Inspection" Method 7.2.2 - "Wipe Tests" Where films are not detectable under white light conditions, use Method 7.3 - "Precision Inspection" Method 7.3.2 - "Black Light Inspection"

* Other ASTM A380 methods may be used instead of above specified surface preparation methods and inspection procedures.

** Do not damage attached parts, adjacent parts, or materials by field cleaning and passivation methods of stainless steel.

Tab AE-14.DOC

3.12 COLOR SCHEDULE

A. Color and gloss to meet one or more of following:

1. Munsell Color.
2. FED-STD-595.
3. Manufacturer's standard color.

B. Gloss abbreviations:

1. G - Full Gloss.
2. SG - Semigloss.
3. F - Flat.

C. Table 09 96 20A: Color Schedule.

1. Numbers listed in the "Tabulation No." column correspond to "Items to be coated" listed in Coating Tabulations.

D. Color and gloss of finished coats to be selected and approved by the COR.

Table 09 96 20A - Color Schedule

Tabulation No.	Item Surface	Color	Color No.	Gloss
7	a. Exterior tank surfaces, piping, fittings, valves, and accompanying metal work.	Beige	Munsell 2.5Y8/4	G
	b. For lettering or stenciling of the tanks.	Blue	Munsell 7.5B7/8	G

END OF SECTION

SECTION 10 14 26
UTILITY MARKERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price in the Price Schedule for Line Pipe.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 10 14 26-1, Utility Marker Plan:

1. Show proposed locations of utility markers.

PART 2 PRODUCTS

2.01 LINE PIPE

A. See Section 33 11 10 - Line Pipe.

2.02 UTILITY MARKERS

A. CRM-06-66, Utility Marker, manufactured by Carsonite, www.carsonite.com; or equal, with the following essential characteristics:

1. Durable.
2. UV resistant.
3. T-cross section with support rubs along each edge.
4. Resistant to impact, ozone and hydrocarbons.
5. Service Temperature Range: Minus 40 degrees F to 140 degrees F.
6. Width: 3.75 inches, minimum.
7. Length: 66 inches minimum.
8. Anchor Barb.
9. Color: Blue (66).

2.03 UTILITY MARKER LABEL

A. Catalog No. LT-00427, Part No. SD-8683K, NTUA Decal, from Albuquerque Pipe and Pump Supply, 4300 Ellison NE, Albuquerque, NM 87109, (505) 344-4646 or equal with the following essential characteristics:

1. NTUA decal with label: ”WATERLINE WARNING”.

PART 3 EXECUTION

3.01 INSTALLATION

A. Use manual driving tool drive per manufacturer’s recommendations.

B. Install in locations approved by COR. At a minimum install every 2,000 feet and at:

1. Horizontal pipe bends.
2. High points in existing ground.
3. Each side of road crossing.
4. Each end of bore and jack locations which are not at road crossings.

END OF SECTION

SECTION 22 11 35

PRE-MANUFACTURED PUMP STATION

1.01 MEASUREMENT AND PAYMENT

A. Pre-manufactured Pump Station No. 1.

1. Payment: Lump sum cost offered in the Price Schedule.

a. Includes foundation drainage.

B. Pre-manufactured Pump Station No. 2.

1. Payment: Lump sum cost offered in the Price Schedule.

a. Includes foundation drainage.

1.02 DEFINITIONS

A. Pumping unit: Pump and motor.

B. NPSH: Net Positive Suction Head.

C. NPSHA: Net Positive Suction Head Available.

D. NPSHR: Net Positive Suction Head Required.

E. RTD: Resistance Temperature Detectors.

1.03 REFERENCE STANDARDS

A. American Architectural Manufacturers Association (AAMA)

1.	AAMA 501.2-15	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

B. American Bearing Manufacturers Association (ABMA)

1.	ABMA 9-15	Load Ratings and Fatigue for Ball Bearings
2.	ABMA 11-14	Load Ratings and Fatigue Life for Roller Bearings

C. Association of Edison Illuminating Companies (AEIC)

1.	AEIC CS8-13	Extruded Dielectric, Shielded Power Cables Rated 5 Through 46 kV

D. American Institute of Steel Construction (AISC)

1.	AISC 325-11	Steel Construction Manual, 14th Edition

2.	AISC 360-10	Structural Steel Buildings
3.	AISC RCSC-14	Structural Joints Using ASTM A325 or A490 Bolts

E. American Society of Civil Engineers (ASCE)

1.	ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

F. American Society of Mechanical Engineers (ASME)

1.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
2.	ASME B16.9-12	Factory-made Wrought Steel Buttwelding Fittings
3.	ASME B46.1-09	Surface Texture

G. ASTM International (ASTM)

1.	ASTM A29/A29M-12	Steel Bar, Carbon and Alloy, Hot-Wrought General Requirements
2.	ASTM A36/A36M-14	Carbon Structural Steel
3.	ASTM A48/A48M-03(2012)	Gray Iron Castings
4.	ASTM A105/A105M-14	Carbon Steel Forgings for Piping Applications
5.	ASTM A108-13	Steel Bar, Carbon and Alloy, Cold-Finished
6.	ASTM A536-84(2014)	Ductile Iron Castings
7.	ASTM A653/A653M-15	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
8.	ASTM A755/A755M-15	Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil Coating Process for Exterior Exposed Building Products
9.	ASTM B8-11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
10.	ASTM B148-14	Aluminum-Bronze Sand Castings
11.	ASTM B505/B505M-14	Copper Alloy Continuous Castings
12.	ASTM C90-15	Loadbearing Concrete Masonry Units
13.	ASTM C920	Miscellaneous Masonry Accessories
14.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry

15.	ASTM E709-15	Magnetic Particle Testing

H. American Welding Society, Inc. (AWS)

1.	AWS A2.4-12	Standard Symbols for Welding, Brazing, and Nondestructive Examination
2.	AWS D1.1/D1.1M-15	Structural Welding Code Steel
3.	AWS D1.3/D1.1M-08	Structural Welding Code - Sheet Steel

I. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 In (150 mm) and Larger
2.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
3.	AWWA C504-10	Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm)
4.	AWWA C507-15	Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm)
5.	AWWA C508-09	Swing-Check Valves for Waterworks Service 2-In Through 24-In (50-mm Through 600-mm) NPS

J. American National Standard/Hydraulic Institute (ANSI/HI)

1.	ANSI/HI 1.1-1.2-14	Centrifugal Nomenclature
2.	ANSI/HI 1.3-13	Rotodynamic (Centrifugal) Pumps for Design
3.	ANSI/HI 1.4-14	Centrifugal Installation, Operation, and Maintenance
4.	ANSI/HI 2.4-08	Rotodynamic (Vertical) Pumps for Manuals Describing Installation, Operation, and Maintenance
5.	ANSI/HI 9.1-9.5-00	Pumps-General Guidelines
6.	ANSI/HI 9.6.1-12	Rotodynamic Pumps Guideline of NPSH Margin
7.	ANSI/HI 9.6.2-15	Rotodynamic Pumps for Assessment of Applied Nozzle Loads
8.	ANSI/HI 9.6.4-09	Rotodynamic Pumps for Vibration Measurements and Allowable Values
9.	ANSI/HI 9.6.6-09	Rotodynamic Pumps for Pump Piping
10.	ANSI/HI 9.8-12	Intake Design for Rotodynamic Pumps

11.	ANSI/HI 14.6-11	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

K. Institute of Electrical And Electronics Engineers (IEEE)

1.	IEEE 81-12	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
2.	IEEE 112-04	Test Procedure for Polyphase Induction Motors and Generators
3.	IEEE C57.13-93	Instrument Transformers

L. International Code Council (ICC)

1.	ICC IBC-12	International Building Code

M. International Organization for Standardization (ISO)

1.	ISO 1940-1:03	Mechanical Vibration

N. Metal Building Manufacturer's Association (MBMA)

1.	MBMA MBSM-12	Metal Building Systems Manual

O. Military Specifications (MIL)

1.	MIL-PRF-907F	Anti-seize Thread Compound, High Temperature

P. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 V Maximum)
2.	NEMA CP 1-00(2008)	Shunt Capacitors
3.	NEMA ICS 3-05(2010)	Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC
4.	NEMA ICS 5-00(2010)	Industrial Control and Systems Control Circuit and Pilot Devices
5.	NEMA ICS 6-1993	Industrial Control and Systems Enclosures
6.	NEMA MG1-14	Motors and Generators
7.	NEMA WC74-12	5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
8.	NEMA WD6-02(2008)	Dimensions for Wiring Devices

Q. InterNational Electrical Testing Association (NETA)

1.	NETA ATS-13	Electrical Power Equipment and Systems.

R. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code

S. Steel Door Institute (SDI)

1.	SDI A250.8-14	Standard Steel Doors and Frames

T. The Society for Protective Coatings (SSPC)

1.	SSPC SP10/NACE 2-07	Near-White Metal Blast Cleaning

U. Underwriters Laboratory (UL)

1.	UL 10C-09	Positive Pressure Fire Tests of Door Assemblies
2.	UL 752-05	Bullet Resisting Equipment

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

1. Submittal review time is 28 days.
2. Final Drawings, Final Data, Manuals:
    a. Submit electronically until approved.
    b. Paper submittals prior to approved, final shall be rejected.

B. RSN 22 11 35-1, Pre-construction Data and Drawings:

1. Tab M1: Mechanical Systems Approval Drawings and Data:
    a. Fire Extinguisher Product data including label, capacity, and classification.
    b. HVAC System:
        1) Calculations demonstrating system sizing.
        2) Submit manufacturer’s product data indicating:
            a) Cooling and heating capacities.
            b) Dimensions.
            c) Weights.
            d) Electrical requirements with electrical characteristics and connection requirements.
            e) Controls.

f) Accessories.

g) Sound ratings.

c. Seal Water Filtration System, as applicable, based on pump and packing manufacturers' published seal water recommendations:

1) Commercial products data for piping, fittings, valves, instrumentation, pumps, strainers and other appurtenances for the complete seal water filtration and booster system. Include catalog illustrations, sizes, materials, pressure ratings and complete parts lists, as applicable.

2) Drawings showing complete seal water filtration and booster system including plan view, elevations and pipe details.

3) Booster pumps:

a) Pump description and operating criteria.

b) Outline and mounting detail drawings including equipment weights.

c) Performance characteristics curves.

d) Assembly drawings including parts and material lists.

e) Motor nameplate data.

4) Filtration System:

a) System description and operating criteria.

b) Outline and mounting detail drawings including equipment weights.

c) Performance characteristics curves including pressure drop.

d) Assembly drawings including parts and material lists.

e) Necessary calculations to support design and selection of system.

f) Motor nameplate data.

g) List of special tools required for assembly and disassembly.

2. Tab M2, Resumes and Qualifications:

a. Pump and Motor Manufacturer's Installation Representatives.

b. Millwright: 3 years minimum of pumping unit installation and alignment experience.

c. Raw Water PumpingPlant Manufacturer:

1) Three references including name, company and telephone number verifying installation and operation of similar type pumping plant.

3. Tab M3, Pump Approval Data and Drawings:

   a. Commercial products data, including complete identifying data giving manufacturer's name, type, model, size, scale range, electrical rating, calibration curves and dimensions, as applicable.

      1) Pumps.

      2) Electrical terminal blocks.

      3) Pump bearing temperature relays.

      4) RTDs.

      5) Pump and motor shaft coupling.

   b. Drawings and data:

      1) Pumping unit outline drawings.

      2) Base frame details, which include the following:

         a) Base frame drawings showing leveling bolt locations, if applicable.

         b) Anchor bolt drawing, if applicable.

         c) Manufacturer's recommended tightening torques for the base frame anchor bolts and pump and motor mounting bolts.

         d) Base frame dimension, finishes, and tolerances.

      3) Sectional assembly drawings showing components and part numbers, materials descriptions for components that reference material standards, and component weights.

      4) Typical pump performance curves that show:

         a) Efficiency.

         b) Horsepower.

         c) Total dynamic head.

         d) NPSHR with reference to capacity and operating speed.

      5) Pumping unit (pump and motor) flywheel effect (WR^2):

         a) Pump unwatered.

         b) Pump watered.

         c) Motor.

      6) Net weight and dimensions:

         a) Complete pumping unit (pump and motor) and individual pump and motor weights.

         b) Pumping unit base frame.

7) Packing Seal Water Design.

a) Rate of water flows to each lantern ring and supply pressure required.

b) Packing seal water quality minimums published by pump and packing manufacturers.

c. Lifting beam drawings for pumping units, if applicable.

d. Test set-up drawing showing pumping unit assembly (pump and motor) and instrumentation set-up for pumping unit performance shop performance test.

e. Pumping unit installation, operation, and maintenance instructions, including:

1) Detailed procedures for leveling and grouting base frame and for torqueing of bolts.

2) Detailed pump and motor field alignment procedures.

3) Pump operational field testing procedures.

4) Pumping unit short term and long term storage/maintenance requirements.

f. Base frame deflection analysis.

1) Calculations and supporting data.

g. Pump net positive suction head analysis.

1) NPSH margin calculations and commercial product reference data for pumping units including head losses from Forebay Tank No. 1 to each pump in Pumping Plan No. 1 and from Regulating Tank No. 1 to each pump in Pumping Plant No. 2 for the lowest NPSH margin operating conditions.

h. Pumping Plant losses:

1) Calculations and commercial product reference data for piping and equipment head losses in the submitted Pumping Plant from inlet flange to outlet flange of Pumping Plant.

2) Include calculations for 1 and 4 pumps operating under normal conditions.

i. Hydraulic grade lines from Pumping Plant forebay tanks to pump suction flanges:

1) Plot of the hydraulic grade line from Forebay Tank No. 1 to the suction flange of each pump in Pumping Plant No. 1 for the condition of Forebay Tank No. 1 at low tank emergency off.

2) Plot of the hydraulic grade line from Regulating Tank No. 1 to the suction flange of each pump in Pumping Plant No. 2 for the condition of Regulating Tank No. 1 at low tank emergency off.

3) For each Pumping Plant, plot the centerline of piping on same plots and indicate piping diameter.

4) Verify the hydraulic grade line is at least 1.5 pipe diameters above the centerline of whichever is higher, the suction manifold or the pump suction piping.

j. System analysis:

1) Calculations and commercial product reference data for piping and equipment head losses used to determine the total head for the systems and conditions listed in the Table 22 11 35A. Complete blank cells of Table 22 11 35A based on analysis.

a) Calculations based on materials furnished.

4. Tab M4, Motor Equipment Approval Data:

a. Catalog data, including complete identifying data giving manufacturer's name, type, model, size and dimensions for:

1) Induction motors.

2) Protective devices.

3) Accessories.

5. Tab M5, Motor Approval Data and Drawings:

a. Assembly and sectional drawings with parts and materials lists, and component weights.

b. Motor outline drawings including thrust bearings and dimensioned location of terminal boxes.

c. Schematic and wiring diagrams:

1) Schematic diagrams:

a) Armature winding connection.

b) Indicating and Protective devices.

c) Space heaters.

2) Wiring diagrams: Medium-voltage terminal box.

d. Standard drawing 40-D-6032 completed for each size motor.

e. Allowable number of starts and time between starts.

f. Nameplate data.

g. Motor locked rotor current rating.

6. Tab M6, Steel Pipe Shop Drawings.
    a. Checked, detailed shop drawings showing dimensions and tolerances, material data, joint details, valve placement, welding requirements; and coating, lining, and coating requirements.
7. Tab M7, Steel Pipe Commercial.
    a. Elastomeric Connectors.
    b. Pipe couplings.
    c. Suction Diffusers.
8. Tab M8, Valves, Commercial Product Data.
    a. Butterfly valves:
        1) Products data for butterfly valves including hydrostatic pressure testing certification. Include pressures used in testing valves.
        2) For exposed service with manual actuators.
    b. Pressure Sustaining Valves.
        1) Product data.
            a) Index.
            b) Parts identification lists.
            c) Lists of special tools and accessories.
            d) Schematics showing pilot-operated connections and manufacturer recommended componentry:
                i. Pilot control system.
                    i) Instructions for installing, operating, lubricating, and maintaining equipment.
                    ii) Certification of hydrostatic pressure testing and pressures used.
    c. Cavitation chart showing flow rate, differential pressure, valve characteristic curve (Cv versus percent open), and system velocity.
    d. Pressure Switches.
    e. Pressure Transmitters.
    f. Air valves.
    g. Check valves.
    h. Ball valves.
9. Tab M9, Motor Operated Butterfly Valve Data.
    a. Commercial products (catalog) data including:
        1) Manufacturer’s name.

2) Model number.

3) Bill of material.

4) Name plate list.

5) Settings for the limit switches and the torque switches.

b. Explicit torque calculations showing that the motor operator is of sufficient size to seat or unseat the valve and hold the disk at any intermediate position under the maximum unbalanced pressure conditions.

c. Certification for the following.

1) The valves met the testing requirements of AWWA C504.

2) The valves are capable of performing under the specified operating conditions without damage to valve body, valve seats, or motor operator.

d. Valve data:

1) Maximum torque required (foot-pounds)

2) Test data of rated flow coefficient (Cv). Provide data in graph or table format with data points at a maximum of 10° intervals, for disk angles of 10° through 90.

e. Motor data:

1) Locked rotor torque (foot-pounds).

2) Full load torque (foot-pounds).

3) Horsepower rating (horsepower).

4) Voltage rating (volts).

5) Locked rotor amps (amperes).

6) Full load amps (amperes).

7) Time rating (minutes).

8) Assembly drawings.

9) Schematic diagrams for each motor operated butterfly valve.

a) Show schematic details of actual circuitry, regardless of whether circuitry is located within motor control center or elsewhere.

b) Show motor and switch terminals for the motor operated butterfly valves.

c) Clearly mark the interface for remote devices.

d) Show designations on device terminals and wire numbers.

e) Show spare contacts.

f) Show wire numbers including wire numbers for remote devices.

10) Wiring diagrams.

a) Submit actual wiring diagrams for this specific job.

b) Typical wiring diagrams will not be accepted.

11) Interconnection diagram.

10. Tab M10, Seismic Calculations:

a. Calculations and supporting data reviewed and stamped by a Registered Professional Structural Engineer in the State of New Mexico for the pumping units.

11. Tab S1, Pumping Plant Building Foundation and Thrust Restraints Approval Drawings and Calculations:

a. Design drawings of concrete foundations for each building including:

1) Concrete foundation layout, elevations and dimensions.

2) Typical sections through foundation.

3) Steel reinforcement details and sizes including bar lengths, location of construction joints and lap splices.

4) Anchor bolt setting plan including size, location and projection of anchor bolts, and any building base mounting details.

5) Signed and sealed by design engineer.

b. Design drawings of concrete thrust restraints for each building including:

1) Concrete thrust restraint layout, elevations and dimensions.

c. Calculations validating sizing and selection of all foundation primary structural elements and thrust restraints. Signed and sealed by design engineer.

12. Tab S2, Pumping Plant Building Certification:

a. Letter of design certification for building system.

b. Include manufacturer’s order number.

c. List design criteria including codes, standards, and loads.

d. Certify that structural design complies with specified design requirements.

e. Sign and seal by design engineer.

13. Tab S3, Pumping Plant Building Approval Drawings, Data, Color Charts, and Samples:

a. Building code analysis including occupancy summary, construction type, allowable areas and heights, fire resistance ratings, egress requirements,

hazardous materials summary, insulation requirements for roof and wall assemblies and other pertinent items.

b. Manufacturer's shop drawings for each pumping plant building:

1) Show building layout and dimensions; sections through building; wall and roof framing plans; roof and wall openings; gutters and downspouts; erection details; ridge, eave, corner, sill, opening, and trim details; roof and wall penetration details; doors, overhead roll-up doors; and type, grade, size, and thickness of materials.

2) Show special seismic requirements, if required, on connection details.

3) Include an anchor bolt assemblies plan which shows building support reaction forces, support type, material, length, location, diameter, projection, and embedment length of anchor bolts required to secure pumping plant buildings to foundations.

4) Sign and seal by architect and/or design engineer.

c. Manufacturer's product data.

1) Descriptions of building system components, accessories, and materials.

d. Manufacturer's original standard color charts, finish samples, and texture samples for selection of panel color, finish and texture.

14. Tab E1, Electrical:

a. Building Single-Line Diagram.

b. Panelboard Schedules.

c. Equipment Layouts.

d. Foundation and Building Grounding System Layouts.

e. Lighting scheme, including types of luminaires and lamps.

f. Motor Control Equipment Schematic and Wiring Diagrams.

g. Manufacturer's cut sheets.

h. Transformer sizing criteria:

1) 4160 - 480 Volt.

2) 480 - 208/120 Volt.

15. Tab E2, SCADA Conceptual Function Descriptions:

a. Pump, Valve, and manifold operations: Fill, Startup, Shutdown, etc. for manual and automatic operation.

b. Other sub-system operations required by RTU.

C. RSN 22 11 35-2, Manufacturer Post Production Testing Results.

1. Tab E1, Electrical:
    a. Manufacturer Factory Test Reports.
    b. Equipment Nameplate Data.
    c. Pumping Plant Factory Test Report.
    d. Final Drawings.
2. Tab M1, Government Witnessed Pump Shop Test Data and Reports:
    a. Certified shop performance test report:
        1) Pump Data:
            a) Manufacture, model number.
            b) Impeller type/identification.
            c) Number of impellers.
            d) Impeller diameter.
            e) Impeller material alloy.
            f) Nominal speed.
            g) Inlet and outlet nozzle sizes.
            h) Serial number.
        2) Test Condition Data:
            a) Test code and acceptance grade.
            b) NPSHA.
            c) Test liquid temperature.
        3) Test Data:
            a) Rate of flow.
            b) Head.
            c) Pump horsepower input.
            d) Operating speed.
            e) Pump efficiency.
        4) Job Motor Data:
            a) Nominal speed.
            b) Nameplate horsepower.
            c) Serial number.
        5) Test date, tester name, and test witness name.

b. Plot curves of certified shop performance test data including head, efficiency, and pump horsepower input curve as a function of flow rate.

1) Indicate on head/flow rate plot the head and flow tolerance limits from the guarantee point for the specified acceptance grade and tolerance band.

2) Indicate on the efficiency/flow rate plot the efficiency tolerance limits from the guarantee point for the specified acceptance grade and tolerance band.

3) Use ANSI/HI 14.6 Appendix H as a guide.

c. Present pumping unit test data at full rated speed.

d. Pump hydrostatic pressure test records and test certificate per ANSI/HI 14.6.

1) Include pumping unit serial number and designation for all data.

2) Report data in U.S. customary units.

3. Tab M2, Motor Factory Test Report:

a. Factory test reports.

4. Tab M3, Pumping Unit Field Test Plan.

D. RSN 22 11 35-3, Manufacturer On-site Testing Results and Final Documents:

1. Tab E1, Electrical:

a. As-built Drawings.

b. Equipment Operations and Maintenance Manuals.

2. Tab E2, SCADA Function Descriptions:

a. Pump, Valve, and manifold operations: Fill, Startup, Shutdown, etc. for manual and automatic operation.

b. Other sub-system operations required by RTU.

3. Tab M1, Mechanical Systems Final Drawings and Data:

a. Operation and Maintenance Manuals:

1) Maintenance data and schedules.

2) Description of operation and spare parts information.

3) Applicable test records and reports.

4. Tab M2, Training Plan:

a. Pumping unit training outline.

5. Tab M3, Pump Final Data and Drawings:

    a. Service manual:

        1) Final drawings, part number lists with material descriptions and standard references.

        2) Certified material test reports for the pump impellers, shafts, casings, wear rings and shaft sleeves with reference to applicable material ASTM standard.

        3) Previously approved certified performance shop test data and plotted curves of certified shop performance test data including head, efficiency, and pump horsepower input curve as a function of flow rate.

        4) Pumping unit field operational test reports.

        5) Certified pump hydrostatic pressure test records and test certificate per ANSI/HI 14.6.

        6) Installation, operation, and maintenance instructions for assembly and disassembly of the pump and associated components.

        7) Pumping unit lifting procedure and pumping unit component weights.

        8) Pump short term and long term storage/maintenance instructions.

        9) Mounting details including pump manufacturer's recommended tightening torques for base frame anchor bolts, pump mounting bolts, and pump/motor shaft coupling bolts.

        10) List of special tools and accessories for assembly and disassembly of the pumping unit.

        11) Spare parts list with photo or rendered drawing of parts. Include which pumping units the parts are intended for use with, description of the part, and manufacturers' specific part number.

        12) Maintenance schedule in tabular form.

        13) Recommended lubricants.

6. Tab M4, Steel Pipe Final Drawings.

    a. As-built drawings.

    b. Detailed drawings which clearly show steel piping sections exactly as they exist after completion, including dimensions and tolerances, material data, joint details, coating, pipe supports, and welding.

7. Tab M5, Motor Final Data and Drawings:
    a. Drawings:
        1) Assembly and sectional drawings with parts number lists and materials descriptions with standard references, and component weights.
        2) Motor outline drawing including dimensioned location of terminal boxes.
        3) Mounting instructions and detail drawings including tightening torques for component assembly bolts.
        4) Motor nameplate drawings complete with nameplate data.
        5) Standard drawing 40-D-6032 completed for each size motor.
        6) "As-built" schematic and wiring diagrams for motor approval drawings.
    b. Field test reports.
    c. Installation, operation, and maintenance information including:
        1) Tools and accessories for assembly and disassembly of motor.
        2) Mounting details including the motor manufacturer's recommended tightening torques for the motor mounting bolts.
        3) Detailed procedure for removal of bearings in installation, operation, and maintenance instructions.
        4) Spare parts list with photo or rendered drawing of parts. Include which pumping units the parts are intended for use with, description of the part, and manufactures specific part number.
        5) Maintenance schedule in tabular form.
        6) Bill of materials.
        7) Recommended lubricants.
        8) Winding and bearing temperatures and locations.
        9) RTD product data.
    d. Motor storage and maintenance instructions.
    e. Motor bearing relay trip set points.
8. Tab M6, Valve Service Manuals.
    a. For items in RSN 22 11 35-1, Tab M8 and Tab M9.
9. Tab M7, Pumping Unit Field Test Reports:
    a. Drawing showing specific locations of vibration probes and bearing temperature sensors.

b. Vibration analysis, noise level, shaft alignment and runout measurements, pump and motor bearing temperatures, motor voltage and amperage, and motor stator temperature.

c. Presentation of vibration data in a summary form and as a comparison with specification requirements for allowable vibration.

d. Observations and equipment adjustments performed during testing.

e. Detailed discussion and summary of conclusions drawn from vibration, motor bearing and winding temperature, and motor voltage and amperage data that were recorded.

10. Tab S1, Pumping Plant Building Erection Plans, Manual, and Documentation:

a. Manufacturer's erection plans and manual for building system.

1) Manufacturer's instructions for field touch-up of finishes.

b. Building erector qualifications.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing.

B. Section 03 30 00 - Cast-in-Place Concrete.

C. Section 03 63 00 - Epoxy Grout.

D. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC Equipment.

E. Section 25 08 10 - Automation System Testing, Acceptance, and Training.

F. Section 26 05 10 - Conductors and Cables.

G. Section 26 05 13 - Medium-Voltage Power Cable Systems.

H. Section 26 05 90 - Wiring Checkout and Tests.

I. Section 26 18 42 - Medium-Voltage Motor Control.

J. Section 27 20 10 - Radio Equipment.

K. Section 31 23 22 - Pipe Trench Earthwork.

1.06 SCOPE OF WORK

A. Design and provide:

1. Two factory-built, above-grade, raw water pumping plants, complete with internal piping, pumps, motors, valves, control, and other appurtenances installed on a fabricated steel base and enclosed in a structure as shown on the drawings and specified herein.

2. Two concrete foundations to support the fabricated steel base of the water pumping plants and transfer the design loads of the pumping plant to the ground below.

3. Concrete thrust restraints as required beneath the pumping plants to secure steel piping.

1.07 QUALIFICATIONS

A. Ten years' experience providing pumping plants similar in type, design and function as defined in this section.

B. Designer: Professional Engineer registered in the State of New Mexico.

C. Erector: Authorized by manufacturer to erect building.

D. Welding:

1. Welding and related work in accordance with AWS D1.1 and AWS D1.3.

2. Welding symbols on fabricator's shop drawings in accordance with AWS A2.4, unless otherwise noted.

E. Bolting: In accordance with AISC 325, AISC 360, AISC RCSC, and AISI S100.

1.08 MAINTENANCE

A. Spare Parts:

1. New and properly packaged for long term storage.

a. No refurbished parts.

2. Interchangeable with and of the same materials and workmanship as corresponding original pump and motor parts.

3. Clearly mark or tag each part to identify.

a. Include in service manual a photo or rendered drawing of spare parts.

b. Include on spare part marking or tag with a description of the part and manufactures specific part number.

4. For each Pumping Plant:

a. Pump bearings: 1 set to replace bearings in one pump.

b. Gaskets and seals: 1 set to replace gaskets and seals in one pump.

c. Wearing rings: 1 set to replace wearing rings in one pump.

d. Motor bearings: 1 set to replace motor bearings in one motor.

e. Packing to repack each pump 1 time.

f. Stainless steel shaft sleeves: 1 set to replace shaft sleeves in one pump.

B. Special Tools.

1. One set of special tools required for assembly and disassembly of the pumping unit (pump and motor) and other appurtenances and accessories that may be required for assembling, installing, aligning, or dismantling part of the pumps and to make the unit complete and ready for operation.

   a. Special tools are considered to be those tools, which because of their limited use, are not normally available but which are necessary for the particular equipment.

2. High-grade, forged alloy, tool steel.

3. Professional grade steel tool box for storage of special tools.

4. Major parts of pumping units with eyebolts, lugs, or lifting devices (i.e., lifting beam) to facilitate handling of pump and motor with a mobile crane.

   a. Lifting equipment to comply with performance standards.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pumping unit components and associated equipment during loading, transportation, unloading, and storage.

B. Protect from corrosion, deformation and other types of damage.

C. Store items indoors, free from contact with soil and weather.

D. Remove and replace damaged items with new items.

E. Store products in accordance with equipment manufacturer's recommendations and perform recommended and required maintenance.

PART 2 PRODUCTS

2.01 FOUNDATION DRAINAGE

A. See Section 22 13 16 - Foundation and Building Drainage Piping.

2.02 MECHANICAL

A. Water to be pumped is raw water and may contain varying amounts of sand, silt, organic material and aquatic growth 1/8 inch or smaller. Maximum water temperature 55 degrees F.

B. Pumping unit: suitable for operation at an elevation of 6,210 feet and with an ambient temperature of 104 degrees F.

C. Design Pumping Plants to operate with either one, two, three, or four pumps running.

D. HVAC Units:

1. Factory assembled and tested, single-piece, wall-mounted, pre-charged, pre-wired, compressor-driven refrigerant heat pump.
2. Provide with supplementary electric heat for heating with automatic limit reset switch and one time high temperature thermal cut out for additional safety back up protection.
3. Unit to maintain maximum 90 degrees F in summer and minimum 55 degrees F in winter based on a 110 degrees F summer ambient temperature and minus 27 degrees F winter ambient temperature.
4. Unit to be provided with economizer mode: Capable of utilizing outside air to meet cooling requirements without the use of the compressor when ambient temperatures allow.
5. Coils shall be of copper tube construction with extruded aluminum fins.
6. Compressor to have internal vibration isolators and built in thermal and over current protection devices.
7. Cabinet shall be NEMA 3R rated with mounted disconnect switch.
8. Single point 480 volt, 3 phase power connection.
9. Minimum SEER rating of 13.
10. UL Listed.

E. Seal Water Filtration System.

1. Provide a fully operational filtration system for the seal water supplied to the packing glands of each pumping unit, if required, to meet or exceed published water quality minimums recommended by packing and pump manufacturers.
2. System shall:
    a. Be capable of providing sufficient flow and pressure to the packing glands, as defined by the pump manufacturer, to all pumping units.
    b. Filter particles from the water to meet or exceed published water quality minimums recommended by packing and pump manufacturers.
    c. Be fully automatic and self-cleaning.
    d. Be capable of providing continuous flow under all conditions, including self-cleaning cycle.
    e. Be skid mounted.
3. Supply water to the filtration system at a minimum pressure of 20 psi greater than the pumping units intake, or, as required by pumping unit manufacturer.

F. Pumping Unit Design Requirements:

1. Horizontal-shaft, split-case, two-stage, centrifugal type pumps, complete with accessories, piping, anchor bolt assemblies, suitable for direct connection through flexible couplings to motors.

2. Design and construct each pump in accordance with this section and ANSI/HI 1.1 - 1.4, 9.4, 9.6.2, and 9.8.

3. Pump and motor assembled on common base frame.

4. Design each pump to operate safely at maximum reverse runaway speed due to water returning through the pump when power to the motor is interrupted and the pump discharge valve fails to close. Determine maximum runaway speed using the maximum total head calculated in Table 22 11 35A - System Characteristics.

5. Design each pump to ensure natural frequency of vibration (reed frequency) of combined horizontal split-case pump and motor after installation is at least 10 percent greater than pump operating speed or maximum runaway speed, whichever is greater.

   a. If, after installation, the pumping unit does not meet this requirement, modify the pump and motor to meet this requirement.

   b. Plans for modification to be reviewed and approved by the Government before implementation.

6. Normal operating conditions:

   a. Soft starting of the unit will be controlled from a control device in the control cabinet.

   b. Design each pump to start and stop against a closed discharge valve with discharge line full of water and to operate satisfactorily over the expected range of total heads.

   c. Under normal shutdown conditions, each discharge valve will close, at which time power to the pump motor will be interrupted after the discharge valve is fully closed.

   d. Under emergency shutdown or power failure conditions, power to the motor will be interrupted prior to closure of the butterfly valve and closure of the check valve will prevent reverse flow through the pump.

   e. Initial filling of the discharge line will be accomplished by using the filling line on one of the pumps discharge unit piping equipped with a pressure sustaining valve.

7. Finish of pump parts not to exceed the following maximum surface roughness in accordance with ASME B46.1:

   a. Impeller:

      1) Outside, finish over concentric with axis: 125 microinches.

      2) Water passages: 63 microinches.

b. Shafts:

1) Exposed: 63 microinches.

2) Journal: 32 microinches.

c. Wearing rings:

1) Clearance surface: 63 microinches.

2) Other: 125 microinches.

d. Split Face and Casing Flange.

1) Flange surfaces: 125 microinches.

e. Grooves for O-rings:

1) Stationary parts: 125 microinches.

2) Relative motion parts: 63 microinches.

8. Seismic requirements:

a. Meet ASCE 7, Chapter 13.

b. Seismic design data reference drawing 1695-D-60017.

9. Calculations shall take into account forces and loads including seismic to which pumping units will be subjected.

10. Do not use valves to throttle flow during operation except for filling and pump start-up or shut-down.

G. Pump Performance Requirements:

1. Select pumps to comply with acceptance grade and tolerance 1U for rate of flow, total head, and efficiency at the guarantee point.

2. Four interchangeable pumping units per Pumping Plant.

3. Guarantee point for Pumping Plant No. 1 and Pumping Plant No. 2:

a. Guarantee flow per pump of 2.48 cfs at guarantee head calculated based on system with 4 pumps operating at guarantee flow and normal static head. Reference Table 22 11 35A.

4. Pump efficiency when operating at guarantee point:

a. Pumping Plant No. 1: 75 percent, minimum.

b. Pumping Plant No. 2: 73.5 percent, minimum.

5. Select pump with a head-capacity curve that has a continuously rising head with decreasing capacity over expected range of total heads.

6. Pump maximum speed 1,800 revolutions per minute in the pumping direction.

7. Locate and design pumps and Pumping Plants to exceed NPSHR by pumping units under system operating conditions. The pumps' NPSHA shall exceed NPSHR for the pump by the amount of margin specified in ANSI/HI 9.6.1

considering suction specific speed and the operating environment for the calculated range of total heads in Table 22 11 35A - System Characteristics.

8. Locate and design pumps and Pumping Plants to ensure the hydraulic grade line is a minimum of 1.5 pipe diameters above whichever is higher, the suction manifold or the pump suction piping when Forebay Tank and Regulating Tank No. 1 are at the low tank emergency off elevation for the calculated range of flows. Low tank emergency off elevation is 11.5 feet above the bottom tank surface elevation of the Forebay Tank and Regulating Tank No. 1.

Table 22 11 35A - System Characteristics

Pumping Plant	Numbers of pumps operating in Pumping Plant	Capacity per pump (cfs)	Static head (feet)		Friction and minor loss head (feet)	Total head (feet)
Pumping Plant No. 1	1		Minimum Static	385		
			Normal Static	397.5		
			Maximum Static	405		
	4		Minimum Static	385		
		2.48*	**Normal Static**	**397.5***		
			Maximum Static	405		
Pumping Plant No. 2	1		Minimum Static	420		
			Normal Static	430.5		
			Maximum Static	442.5		
	4		Minimum Static	420		
		2.48*	**Normal Static**	**430.5***		
			Maximum Static	442.5		

* Values used to determine Guarantee Point

H. Pumps shall be from the same manufacturer.

1. Pumping Plant No. 1: Patterson Pump Model 6x5 DMD-A, 1800 rpm; Aurora Pumps Model 6x8x17A Type 420 multiple stage split case, 1800 rpm; Fairbanks Nijhuis Model 1900 multiple stage split case, 1800 rpm; or equal, which meet the salient features in 2.01 I.

2. Pumping Plant No. 2: Patterson Pump Model 6x5 DMD-F, 1800 rpm; Aurora Pumps Model 6x8x17A Type 420 multiple stage split case, 1800 rpm; Fairbanks Nijhuis Model 1900 multiple stage split case,1800 rpm; or equal, which meet the salient features in 2.01 I.

I. Pump: Material grade chemical composition of pump components not to exceed 0.03 percent lead content.

1. Casing:

a. Cast iron or ductile iron casing construction: ASTM A48 or ASTM A536.

b. Impeller between bearings.

c. Design to produce smooth flow with gradual changes in velocity.

d. Split on the horizontal centerline, with suction and discharge connections cast integral with the lower half.

e. Casing minimum design pressure: 225 pound per square inch or shutoff pressure, whichever is larger.

f. Design for easy removal of impeller(s) and bearings.

g. Provide with casing wearing ring of aluminum bronze material: ASTM B505 (Brinell hardness not greater than 70 BHN).

h. Provide suitable drilled and tapped holes for air release valve and drain connections.

1) Provide a standard NPT tapped hole at top of casing for installation of an air release valve.

2) Locate drains such that the casing can be completely unwatered.

i. Casing construction to permit pump to be readily assembled and dismantled.

j. Following cleaning, inspect castings thoroughly.

1) Ensure surfaces used to direct water flow through pump casing are as smooth as practicable and free of blow holes, chilled areas, slag, or foreign matter.

2) Repair or reject defective castings.

2. Impeller:

a. Enclosed and made in one piece entirely of aluminum bronze material: ASTM B148.

b. Provide with impeller wearing rings of aluminum bronze material: ASTM B505 (Brinell hardness not less than 170 BHN).

c. Securely fastened to shaft in such a manner as to make it readily removable.

d. Wearing rings shrink-fit to the impeller.

e. Radial clearances between rotating and stationary wearing rings to be as small as possible consistent with safe operation and with the clearances required in the pump guide bearings.

f. Hand-finish impeller water passages to remove rough spots and excessive irregularities.

g. Statically and dynamically balance rotating parts to prevent whipping and vibration throughout operating range from shutoff head to run out.

h. Balance in accordance with ISO-1940-1-(E) to a balance quality grade of at least G6.3.

1) Balance to pump manufacturer's quality control standards provided the residual imbalance during operational field testing performed after installation at the job site does not exceed vibration limits established by ANSI/HI 9.6.4.

i. Following cleaning inspect castings thoroughly.

1) Ensure surfaces of hub and blades are as smooth as practicable and free of blow holes, chilled areas, slag, or foreign matter.

2) Repair or reject defective castings.

3. Shaft:

a. Carbon steel shaft construction: ASTM A29 or ASTM A108, Grade 1045 or equal.

b. Provide a shaft of sufficient size to operate without objectionable distortion or vibration at maximum speed in both forward and reverse.

1) Size shaft to prevent torsional and flexural deflection which could cause whipping and vibration under condition.

2) Shaft first critical speed to be at least 125 percent of maximum operating speed in forward and reverse rotations.

c. Finish of shaft surfaces as specified in Pumping Unit Design Requirements.

d. Provide with removable and renewable shaft sleeves where shaft passes through the stuffing boxes and water passages.

1) Made of stainless steel.

e. Provide water deflectors on shaft to prevent water from passing along shaft and entering pump bearings.

4. Packed Stuffing Box:

    a. Design packed stuffing box to prevent leakage and exclude air from the casing.

    b. Packed stuffing box with lantern ring on each side of the pump:

        1) Take lantern ring water from the pump casing or Pumping Plant manifold and filter as needed to meet the required water quality as published by packing and pump manufacturers. Supply the lantern ring with the flow rate and pressure of water required by the packing and pump manufacturers.

            a) Provide dielectric fittings to isolate dissimilar material pipe from pump casing, dissimilar metal piping and stuffing box.

        2) Materials of construction to be able to withstand a 6 month shutdown, without benefit of lubrication.

        3) Gland:

            a) Split and held in place with stainless steel fasteners.

            b) Type 316 stainless steel.

        4) Suitable for heads over entire pump operating range.

        5) Provide water ports in stuffing boxes with standard NPT tapped connections.

        6) Minimal leakage to be within manufactures published recommended leakage rate or, if manufactures does not provide recommended leakage rate, approximately 60 drops per minute per inch of shaft diameter.

5. Coupling and Guard:

    a. Connect pump and motor shafts with a metal gear-type or disc-type, flexible coupling to compensate for parallel offset and angular misalignment.

    b. Flexible coupling to be the heavy-duty type sized for 1.5 service factor at the motor horsepower and rotational speed nameplate rating.

    c. Provide an all metal OSHA-compliant coupling guard that is removable and supported from the base frame with stainless steel fasteners.

6. Pump Bearings:

    a. Support pump shaft by 2 bearings of suitable design with one located on each side of the pump.

    b. Removable in the field without damage to the bearings or shaft.

        1) Bearings requiring application of heat for removal are not acceptable.

c. Connections for grease-lubricated bearings to be button-head type.

d. Bearings shall not require external cooling.

e. Design bearings for minimum L_{10} life of 5 years in accordance with ABMA 9 or ABMA 11.

f. Provide neoprene seals with the bearings to prevent loss of lubrication and entrance of moisture and dirt.

1) Labyrinth seals are not acceptable.

7. Base frame:

a. Provide pumping unit with an epoxy grouted structural steel base frame.

b. Mount pump and motor on a common base frame with separate mounting plates attached to base frame for the pump and the motor.

c. Sufficient size and rigidity to maintain the pump and motor in proper alignment and position without the benefit of epoxy grout, when subjected to the stresses imposed by normal operation or when pump dead headed or during reverse flow following emergency shutdown.

d. Machine contact surfaces between the pump and mounting plate on the base frame and between the motor and mounting plate on the base frame to within flatness of 0.002 inch, level to 0.002 inch per linear foot.

1) Elevation difference between each motor mounting plate to be machined and installed to 0.002 inch within plane of each other.

2) No welding after final machining.

e. Transmit the load due to pump shutoff head to the concrete structure with shear keys. The shear key area with the maximum bearing stress imposed on the epoxy grout from pump shutoff head is not to exceed 800 pounds per square inch.

f. Provide with standard NPT threaded drain connections and grout holes.

g. Grout per Section 03 63 00 - Epoxy Grout.

h. Provide stainless steel drain piping to direct packing leakage to floor drain per Section 22 13 16 - Foundation and Building Drainage Piping.

J. Indicating and Protective Devices:

1. Determine scale range for the required operating conditions when scale range for instrument is not specified.

2. Pressure scales graduated in pounds per square inch.

3. Temperature scales graduated in degrees F.

4. Provide nameplates for each instrument, electrical control device, and alarm switch supplied under this paragraph.

5. Provide indicating meters in accordance with Medium Voltage Motor Control.

K. Resistance Temperature Detectors (RTDs):

1. Provide each pump with 2 RTDs for producing a signal for remote indication of the temperature of each pump bearing at respective MCE and interface terminal cabinet.

2. Three wire RTD, 100 ohm platinum type.

3. Furnish RTD complete with necessary fittings, connectors, conduit, terminal box, terminal board, and wiring from detector through the low-voltage motor terminal box to respective MCE. See drawings for wiring termination interface.

L. Nameplates:

1. Provide in accordance with standard drawing 40-D-6234.

2. Include in the nameplate captions, the device function number (where applicable) and the nameplate device description.

a. Nameplate captions can be changed by COR at the time the nameplate list drawing is first submitted for approval at no change in contract price or delivery.

b. Device function numbers to be assigned at the time the drawings are first submitted for approval.

M. Provide means for lifting pumping unit individual components.

1. Entails below-the-hook devices required to lift these components.

2. Lifting eyes attached to motor housing that are suitable for attaching slings for lifting with a crane.

3. Lifting hooks or similar devices are not acceptable.

N. Pipe, Valves, Supports, and Fittings:

1. Piping:

a. Butt-welding steel fittings: ASME B16.9 or ASTM A105.

b. Flange insulation:

1) Manufactured by PSI, complete with the "Linebacker" type of gasket, Pipeline Seal and Insulator, Inc., 6525 Goforth Street, Houston TX 77021; Advanced Products and Systems, complete with the "Trojan" type of gasket, PO Box 60399, Lafayette LA 70596-0399; or equal with the following salient characteristics:

a) Full-faced, type E gaskets. Outside diameter of gasket shall be same as outside diameter of flange.

b) Retainer with integral Nitrile sealing element ("Linebacker" or "Trojan" type).

c) Retainer material suitable for cold water service as recommended by gasket manufacturer.

d) One insulating sleeve and 2 insulating washers for each bolt. Material to be suitable for cold water service as recommended by gasket manufacturer.

e) Asbestos gaskets are not acceptable.

f) Supply required bolt torques, recommended bolt tightening sequence, and flange face finish for insulating flanged joints.

g) Suitable for 150 psig cold water service.

c. Flanges:

1) Slip-on ring type, flat faced: AWWA C207 or ASME B16.5.

2) Flat face with a finish suitable for full face gasket for flanged joints.

d. Flange gaskets:

1) Model No. 22, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:

a) Full flat face-type.

b) For AWWA C207 flanged joints.

c) For cold water service.

e. Elastomeric Connector:

1) Inlet side of pumps shall include an elastomeric connector to isolate vibration and noise in piping system.

2) Single sphere design.

3) The elastomeric connector shall pass through the plate steel flanges designed to grip the connector so the connector seals without gaskets when the flange bolts are drawn up.

4) Furnish a control joint limiting pipe connector movement with each pipe connector.

5) Include with pumping plant piping compression type, flexible coupling to prevent binding and facilitate removal of associated equipment. In lieu of a compression coupling, a grooved, flexible coupling may be used.

f. Provide connection between suction and discharge manifolds. Provide pressure dissipation devices as necessary.

g. Provide drain on suction or discharge manifold and route to floor drain.

h. Locate pipe supports on the pump suction and discharge piping in accordance with ANSI/HI 9.6.6.

2. Valves:

a. Include configuration and quantity of valves in Pumping Plants as shown on drawing: 1695-D-60051, 1695-D-60052, 1695-D-60055, and 1695-D-60056.

b. Manually-Operated Butterfly Valves:

1) Valves shall be suitable for intended service and pressure.

2) AWWA C504.

3) Bubbletight at rated pressure in either direction and suitable for operation after long periods of inactivity.

4) Axis of valve leaf: Horizontal when valve is in installed position.

5) Valve seat:

a) Located either in valve body mating with a stainless steel seating surface located on valve disc; or in valve disc mating with a stainless steel seating surface located in valve body.

b) Fully rubber lined bonded seat in body type seats are not acceptable.

6) Rubber seated with single seat on upstream side only.

7) Manual operators. Provide:

a) Manually-operated butterfly valves with a worm-gear traveling nut type manual operator in accordance with AWWA C504.

b) Operators that open and close the valves under maximum unbalanced pressure conditions.

c) Gears of self-locking type, holds valve in all positions without fluttering or creeping.

d) Rim pull and component strength: AWWA C504.

c. Motor-Operated Butterfly Valves:

1) Valves shall be suitable for intended service and pressure. AWWA C504.

2) Bubbletight at rated pressure in either direction and suitable for operation after long periods of inactivity.

3) Axis of valve leaf: Horizontal when valve is in installed position.

4) Valve seat:

   a) Located either in valve body mating with a stainless steel seating surface located on valve disc; or in valve disc mating with a stainless steel seating surface located in valve body.

   b) Fully rubber lined bonded seat in body type seats are unacceptable.

5) Rubber seated with single seat on upstream side only.

6) The valves are required to operate from the fully opened to the fully closed position without damage to the seats, valve body, or motor under the operating conditions described below.

7) Provide actuators that will open and close the valves under maximum unbalanced pressure conditions.

   a) Operating conditions:

      i. The valve will open and close under unbalanced conditions.

      ii. The valves are to function as pump discharge valves.

8) Located immediately downstream of pumps.

   a) During pump start-up procedure, the valve will start to open simultaneously as the pump is started.

   b) During pump shut-down procedure, the valve will be closed while the pump is delivering water. Once the valve reaches its 100 percent closed position, the pump will shut-down.

9) Maximum velocity through fully opened valve: 15 feet per second.

10) Mark the valve body with a flow arrow which indicates the manufacturer's recommended flow direction through the valve.

11) Install complete and lubricated in accordance with the manufacturer's instructions.

12) Provide 2 extra seats for each size of butterfly valve.

13) Flanged ends suitable for connection to AWWA pressure class flanges suitable for pressure in adjoining pipe.

14) Suitable for exposed service.

15) The motor is to supply at least two times the torque required to open and close the valves under maximum full differential pressure.

16) Open and closing times:

a) 1 minute/diameter foot.

17) Provide NEMA 250 4X enclosures for electrical equipment.

18) Motor operator: manufactured by EIM Company, Inc., 13840 Pike Road, Missouri City TX 77459; or equal, having following essential characteristics:

a) Reduction gears.

b) Mechanical position indicator.

19) Electric motor:

a) Suitable for operation with ambient temperatures ranging from 0 degrees C to 40 degrees C.

b) Induction type rated 480 volts, 3 phase, 60 hertz, conforming to NEMA MG1 and designed for required service.

c) Enclosure: Totally-enclosed, fan-cooled (TEFC).

d) Minimum time rating: 15 minutes.

e) Designed for full-voltage starting and reversing duty.

f) Locked-rotor torque: Not less than 250 percent of full-load torque.

g) Insulation: Class F or H.

20) Integral motor starter:

a) Full-voltage, reversing type with mechanical and electrical interlocks.

b) Coils: 120 volts, 60 Hertz.

c) Provide with thermal overload device. Thermal protector integral with motor may be used in lieu of motor starter overload device.

d) Control power transformer:

e) Voltage: 480-120 volt, 60 Hertz.

f) Provide with primary and secondary fuses.

21) Torque limit mechanism:

a) Integral part of motor operator which functions to protect valve and motor operator in opening and closing directions.

b) Independently adjustable for both travel directions.

22) Valve Position Discrete Contacts:

a) Integral part of motor operator.

b) Heavy-duty type.

c) Adjustable to operate at any valve position.

d) Provide with A600 contact designation in accordance with NEMA ICS-5.

23) Handwheel:

a) Provide a handwheel for manual operation that does not rotate during motor operation.

b) Failure of the motor shall not prevent manual operation.

c) Provide a declutching mechanism to engage the handwheel for manual operation.

24) Pushbuttons:

a) Momentary contact type.

b) Provide for OPEN, CLOSE, and STOP functions.

c) Operable from outside the enclosure.

25) Selector Switch:

a) Two position type LOCAL-REMOTE.

b) Operable from outside the enclosure.

26) Provide strip space heater.

a) 120 volts, 60 Hertz from discharge valve motor control transformer.

27) Provide terminal blocks for terminating external cables.

a) Suitable for connection to SCADA system.

28) Mounting options:

a) Mount the motor operators for all the valves with the butterfly valve bodies.

b) The axis of the shafts for the valves shall be horizontally or vertically orientated as shown on the drawings.

29) Integral Disconnect Switches:

a) Single throw switch.

b) Rating: 480V, 60 A.

c) Equip operator handles with means for padlocking operator in either open or closed position.

d) Position of disconnect switch shall be marked OPEN or CLOSED.

30) Communication:

a) Communication protocol: Modbus RTU.

b) Communication method: Single RS-485 twisted pair, shielded wire network.

d. Air Valves:

1) Val-Matic model 201C manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th street, Lyons, IL 60534; APCO Bulletin 623 manufactured by Valve and Primer Corporation, 1420 South Wright Boulevard, Schaumburg, IL 60193-4599; Crispin series C Air and Vacuum Valve manufactured by Crispin-Multiplex Manufacturing Company, 600 Fowler Avenue, Berwick, PA 18603; or equal, having the following essential characteristics:

a) Combination air-inlet and air-release type actuated by a float.

b) Remains open for filling line until water has displaced air at point of attachment of valve assembly after which it closes.

c) Opens whenever pressure in pipeline drops sufficiently to create a vacuum.

d) Releases trapped air when pipeline is under pressure.

e) Furnish with petcocks:

i. One on top, permits checking effectiveness of air valve,

ii. One at bottom, allows valve to be drained.

f) Stainless steel internal parts such as guides, bushings, and screws.

g) Stainless steel floats.

h) Float-pivot supports are brass, bronze, stainless steel, or cast iron.

i) Cold-water pressure rating for body: Minimum of 300 psi.

j) Operating pressure for seat materials: equal to or greater than adjacent steel piping in which they are installed.

k) Pressure and temperature rating equal to or greater than adjacent steel piping in which they are installed.

l) Inlet connection: Internally threaded NPT.

e. Check Valves:

1) Val-Matic series 1400A (wafer style) or 1800 (globe style) manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th street, Lyons, IL 60534 or equal;

a) Flanges:

i. Class 125 or 250: In accordance with ASME B16.1.

ii. Class 150 or 300: In accordance with ASME B16.5.

b) Resilient seated suitable for cold water service.

i. Buna-N or EPDM.

c) Globe or wafer style silent operating type.

d) Body: ASTM A536 ductile iron.

e) Trim: Type 304 stainless steel.

f) Seat and disc: Type 304 stainless steel.

g) Spring: Type 316 stainless steel.

h) Pressure and temperature rating equal to or greater than adjacent steel pipe in which they are installed.

i) Flow area through the body shall be equal to or greater than the cross sectional area of the equivalent pipe size.

j) Component parts shall be field replaceable without need of special tools.

k) The valve disc and seat shall have a seating surface required to ensure positive seating at all pressures. The leakage rate shall not exceed one-half of the allowable rate for metal seated valves allowed by AWWA C508 or 0.5 ounces (15 ml) per hour per inch (mm) of valve diameter.

f. Suction Diffusers:

1) Series 731-D, manufactured by Victaulic, P.O. Box 48776, Atlanta, GA 30362; or equal, having following essential characteristics:

a) Suction diffusers shall be provided if the minimum number of straight pipe diameters required by ANSI/HI 9.8 upstream of the pump suction flange cannot be met.

b) Provide uniform flow at pump suction flange in accordance with ANSI/HI 9.8.

c) Match pump and piping connections.

d) Removable strainer and disposable fine mesh sleeve for initial Pumping Plant start-up.

e) Install suction diffuser with blowdown located at the lowest position for the most effective clearing.

f) Locate suction diffuser to allow removal of strainer for maintenance without requiring removal of other Pumping Plant component or the suction diffuser from the piping.

g. Pressure Sustaining/Pipe Filling Valve:

1) Model No. 100-01KO, manufactured by: Cla-Val Company, Newport Beach, CA 92663; or equal, having following essential characteristics:

a) Provide anti-cavitation trim if required.

b) Flanged ends suitable for connection to AWWA pressure class flanges suitable for pressure in adjoining pipe.

c) Ductile iron, globe-style body.

d) Diaphragm operated.

e) Stainless steel trim.

f) Control system components to be manufactured by the same company as the main valve.

g) Pilot piping for the valves:

i. Hydraulic (water) operated control pilots.

ii. Manual shut off valves.

iii. Opening and closing speed control valves.

iv. Pilot "Y" strainers.

v. Check valve.

vi. Adjustable from 100 to 300 psig.

h) Automatically sustain the pressure upstream of the valve to allow proper operation of the pumps during filling operations.

i) Valve pressure sustaining settings shall be fully adjustable.

O. Pressure Switches and Transmitters:

1. Pressure Switches: B-series Type 400 by Aschcroft Inc., 250 East Main Street, Strafford, CT 06614 or equal with the following essential characteristics:

a. Pumping Plant No. 1 and No. 2 suction manifold pressure switches shall have a nominal pressure range of 0 to 15 psig with an approximate dead

band of 0.1 to 0.35 psi. Field verify set point to align with pump operation.

b. Pumping Plant No. 1 and No. 2 discharge manifold pressure switches shall have a nominal pressure range of 0 to 300 psig with an approximate dead band of 4.0 to 7.5 psi. Field verify set point to align with pump operation.

c. Switch elements shall be general purpose, 15A, 125/250/480 Volt AC.

d. Actuator seals: Buna-N.

e. Pressure switches shall be field adjustable from 15 to 100 percent of nominal pressure range.

2. Pressure Transmitters: Rosemount Model 3051TG in-line pressure transmitters by Emerson Process Management, Rosemount Measurement, 8200 Market Boulevard, Chanhassen, MN 55317 or equal with the following essential characteristics:

a. HART communication protocol.

b. Enclosure type: NEMA 4X, IP 67 or 68.

c. Pumping Plant No.1 discharge manifold pressure transmitter shall measure pressure from minus 14.7 to 300 psig.

d. Pumping Plant No. 2 discharge manifold pressure transmitter shall measure pressure from minus 14.7 to 300 psig.

e. Output shall be 4-20 milliamperes DC.

f. Transmitter shall be suitable for operation on 10 to 36 volt DC external power supply.

g. Adjustable offset (zero) and span shall be provided.

h. Accuracy shall be plus or minus 0.25 percent.

i. Vent/Drain valve shall be provided.

j. Process connection shall be 1/2 inch 14 NPT female.

k. Isolating diaphragm shall be 316L stainless steel.

l. Sensor fill shall be silicone oil.

m. Housing shall be Low-copper aluminum or CF-8M with 1/2 inch-14 NPT conduit entry size.

n. Transmitter materials in contact with potable water shall be National Sanitation Foundation listed.

o. Liquid Crystal Display with local operator interface shall be provided.

p. Transient Protector:

q. Protects pressure transmitter from damage due to lightning and switching surges.

r. Compatible with pressure transmitter output of 4 to 20 milli-amperes.

s. Same manufacturer as pressure transmitter.

2.03 MOTORS

A. Type: Horizontal, induction squirrel-cage designed for duties specified.

B. Nameplate Ratings:

1. Voltage: 4000 volt, 3 phase, 60 Hertz.
2. Synchronous Speed: as required by pump manufacturer.
3. Duty: Continuous.
4. Service factor: 1.0.

C. Service Conditions:

1. Altitude: 6210.00 feet.
2. Maximum ambient temperature: 40 degrees C.
3. Minimum ambient temperature: 0 degrees C.

D. Enclosure: Totally-enclosed, fan cooled (TEFC).

E. Horsepower Rating: Sufficient to carry continuously the maximum possible pump load developed under specified conditions without benefit of service factor. Horsepower rating to be value listed in NEMA MG1.

F. Temperature Rise:

1. Armature winding: Not to exceed 80 degrees C when measured by resistance.
2. Other motor parts: In accordance with NEMA MG1.

G. Starting Method: Soft starters will be used with a closed butterfly valve and check valve on pump discharge, and pump discharge line full of water.

H. Starting Capability:

1. Number of starts: 2 starts in succession (coasting to rest between starts) with motor initially at ambient temperature or one start with motor initially at a temperature not exceeding its rated load operating temperature NEMA MG1.
2. Estimated maximum number of starts per day: 8.

I. Nameplate Marking: As listed in NEMA MG1 for alternating-current polyphase squirrel-cage motors.

J. Conform to NEMA MG1.

K. Stator:

1. Stranded copper conductors.
2. Insulation: Class F or H.
3. Coils completely sealed and moisture-tight.
4. Winding configuration: Manufacturer's standard wye or delta.
5. Completed winding subjected to two vacuum pressure impregnations in a solventless epoxy resin.

L. Rotor: Squirrel-cage windings of suitable impedance for starting under specified conditions. Rotor structure constructed in accordance with current industry practice.

M. Bearings:

1. Provide manufacturer's standard anti-friction type.
2. Lubrication: Grease or oil.
3. Self-cooled and sealed against loss of lubricant and entrance of dirt.
4. Provide means for removing the lubricant and relubricating the bearings without disturbing bearing housing.

N. Indicating and Protective Devices:

1. RTD: 100 ohm platinum, 3 wire.
2. Location:
   a. Two RTD's per phase, located in stator slots between coil sides.
   b. One RTD for each motor bearing.
3. Provide oil sight glass for oil lubricated bearings.

O. Main Lead Terminal Box:

1. Size: Oversized and suitable for terminating main leads with stress cones.
2. Provide clamp-type ground lug suitable for connecting conductor shields inside terminal box.
3. Manufacturer's standard cover with gasket.

P. Low-Voltage Terminal Box:

1. Size: Suitable for terminating leads from indicating and protective devices, and motor accessories.
2. Provide terminal blocks for terminating indicating and protective devices, and motor accessories.
3. Manufacturer's standard cover with gasket.
4. Provide with back panel for mounting terminal blocks.

Q. Accessories:

1. Space heaters:

a. Provide space heaters to prevent condensation in the motor armature windings when the motor is shut-down for extended periods.

b. Rating: 1 phase, 120 volt, 60 hertz.

c. Thermostatically controlled when motor is de-energized.

2. Grounding Provisions:

a. Provide pad with drilled and tapped bolt holes on motor enclosure.

b. Pad to be machined flat and left unpainted.

3. Provide means for lifting the entire pumping unit and/or individual components.

a. Entails below-the-hook devices required to lift these components.

b. Lifting eyes attached to motor housing that are suitable for attaching slings for lifting with a crane.

c. Lifting hooks or similar devices are not acceptable.

4. Wire Markers:

a. Type: Machine-printable, self-laminating label or tubular heat-shrink sleeve label.

b. Color: White.

R. Motor Fabrication:

1. Stator Armature Winding and Armature Leads:

a. Seal armature lead insulation to be equal to armature coil insulation with regard to moisture resistance and voltage class.

b. Armature leads brought out of stator frame to motor lead conduit box for external connections. Terminate armature leads with individual bolted-type solderless connectors.

2. Wire Identification:

a. Provide computer-generated or labeling machine lettering.

b. Wire identification: in accordance with Division 26.

2.04 STRUCTURAL

A. Pumping Plant Enclosure:

1. Design in accordance with the following codes and standards:

a. ICC IBC.

b. ASCE 7.

c. MBMA MBSM.

d. NFPA 70.

2. Loading:

a. Design building to support the anticipated dead loads, live loads, environmental loads, and equipment loads in accordance with ASCE 7 and IBC ICC.

b. Design building to transfer loads to the building foundation and design the anchorage for securing the building to the building foundation.

c. Structural design data for the project shown on drawing 1695-D-60017.

3. Materials:

a. New, unused, and fabricated in a workmanlike manner in a factory environment.

b. Hot rolled steel: ASTM A36.

c. Galvanized steel: ASTM A653.

4. Perimeter Angle System:

a. Base:

1) Hot rolled steel angle framework, welded, primed and painted, with maximum deflection of L/240.

2) Pre-drilled for anchoring to a pumping plant structural support.

3) Weld standards: Meet AWS recommended practices.

5. Framework:

a. Complete, internal, self-supporting, structural steel frame which does not rely on the exterior panels or roof cover panels for its structural strength or framing.

b. Include 8 to 16 gauge, cold-formed, galvannealed steel structural members.

c. Have a flush wall, post and beam format with girts and purlins, and full trusses on both end walls which easily allows for future expansion and modifications.

d. Design wall and ceiling structural support system to provide load carrying capability for anticipated equipment loads using 16 gauge galvanized steel hat channels behind liner panel for reinforcement, with locations shown on approval drawings.

e. Roof to have 8 to 14 gauge solid web hot rolled steel trusses.

B. Pumping Plant Structural Support.

1. Pumping plant built on a structural steel base with adequate structural support for the pumps, motors, piping and internal components of the pumping plant.

2. Design structural steel base:

a. With such rigidity that the base, when lifted, will not deflect more than 1 inch per 180 inches of length or width.

b. For attachment to building foundation.

c. Allow finished concrete fill by Contractor.

d. Accommodate floor drains.

C. Pipe Supports:

1. Four inch and small piping: 2 inch by 2 inch by 3/16 inch wall rectangular tubing.

2. Six inch through 12 inch piping: 3 inch by 3 inch by 1/4 inch wall rectangular tubing,

3. Fourteen inch through 24 inch piping: 4 inch by 4 inch by 1/4 inch wall rectangular tubing.

4. Rectangular tubing shall have capped ends.

5. Fully weld pipe supports at the base. Support pipe by a saddle. Do not weld to the support.

a. Locate pipe supports on the pump suction and discharge piping in accordance with ANSI/HI 9.6.6.

6. Simple pipe stands made of pipe welded only at the flow and upholding a bracket with or without a threaded jack bolt or a U-bolt are not acceptable.

D. Pumping Plant Building Foundation.

1. Design in accordance with the following codes and standards:

a. ICC IBC.

b. ASCE 7.

2. Loading:

a. Design foundation to support completed structures or equipment safely, without uncontrolled settlement, heave, lateral displacement, or other movement.

b. Design foundation to transfers dead loads, live loads, and environmental loads of completed structure or equipment to the earth in such a way that the structure or equipment is supported evenly and total and differential movements are minimized.

3. Provide reinforced concrete loadbearing members as required by code and designed to distribute dead loads, live loads, and environmental loads to not exceed bearing capacity of the site soil conditions.

    a. Extend bearing portions of foundation below frost line at project location; not less than 30 inchees below grade.

    b. Minimum Wall Thickness: Not less than thickness of superstructure walls supported by foundation walls.

    c. Minimum Wall Thickness: 8 inches.

    d. Minimum Wall Reinforcement: Steel with minimum yield strength not less than 60,000 pounds per square inch.

    e. Spread Footings: Designed not to exceed allowable bearing capacity for subgrade material.

    f. Footings: Minimum thickness of 8 inches.

    g. Concrete mix design and strength in accordance with Section 03 30 00 - Cast-in-Place Concrete.

E. Reinforcing steel in accordance with Section 03 20 00 - Concrete Reinforcing and detailing of reinforcing steel in accordance with Drawing 40-D-6263.

F. Pumping Plant Pipe Thrust Restraints.

1. Design in accordance with the following codes and standards:

    a. ASCE 7.

    b. ICC IBC.

2. Loading:

    a. Design pipe thrust restraints for anticipated pipe thrust forces in such a way that the pipe is supported evenly and pipe movements are minimized.

3. Provide concrete loadbearing members as required by code and designed to distribute thrust forces to surrounding soil and not exceed bearing capacity.

    a. Concrete mix design and strength in accordance with 03 30 00 Cast-in-Place Concrete.

2.05 ARCHITECTURAL

A. Pumping Plant Enclosure:

1. Insulation:

    a. Exterior walls: R-19, continuous insulation.

    b. Above ceiling: R-30 continuous insulation.

2. Roof:

    a. Monosloped Roof with pitch of 1/2 inch in 12.

1) Roof slope direction to match slope direction of Air Chamber Building No. 1 or Air Chamber Building No. 2.

2) 900 High Rib Panel, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: www.kingspanpanels.us, or equal with the following essential characteristics.

a) Factory-formed insulated metal roof panels.

b) ASTM A755.

c) Exterior Face:

i. Gauge: 24.

ii. Overlapping rib 1-1/2 inch to 2 inch high at panel joint.

iii. Color: To be determined by Government from submitted color samples.

iv. Finish and texture: Manufacturer's standard.

b. Provide properly sized attic space ventilation.

c. Heavy duty steel lift eyes to be supplied and mounted to the roof trusses as needed for lifting the roof.

d. Wall assembly to meet R-19, continuous insulation.

e. Sheathed with 1/2 CDX plywood with a deflection design no greater than L/240.

f. Provide water infiltration barrier.

g. "Non-ricochet" bullet resistant fiberglass panels to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

1) ArmorCore 102641 Level 4 Bullet Resistant Panel by Waco Composites, Waco, TX 76710, Website: www.armorcore.com, or equal with the following essential characteristics.

a) Panel Rating: UL752 Level 4.

b) Bullet resistance of joints: equal to that of the panel.

i. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4 inches, centered on panel joints.

h. Concrete Masonry Unit (CMU) Veneer with the following characteristics:

1) Split-faced texture CMU veneer affixed in a running bond.

a) Nominal Veneer dimensions 16 inch long by 8 inch high.

2) ASTM C90.

3. Exterior Trim:

a. Include stepped or boxed eave, rake, fascia, base, corner, jamb, and header trim.

b. Material: 26 gauge Galvalume with Government's choice of standard KYNAR colors.

4. Interior Finish:

a. Line interior walls and ceiling with flush-fit, 22 gauge, roll-formed liner panels, with concealed fasteners and a baked-on white polyester finish over G-90 galvanized substrate.

b. Feature a complete matching trim system including base, jamb, header, and ceiling trim. Liner to be reinforced with 14 gauge hat channels mounted vertically as needed for heavy wall mounted items.

5. Fasteners, Adhesives, and Sealants:

a. Use fasteners, adhesives, and sealants utilized approved for use on this type of structure.

6. Closures:

a. Install matching, pre-molded, closed cell elastomeric closures provided by the siding and roof panel manufacturer according to the manufacturer's recommendations at the eave line, beneath the roof panels, and where the trim meets the wall panels.

7. Doors and Hardware:

a. Door(s)

1) Comply with SDI A250.8.

2) Meets UL752 Level 4 Bullet Resistance.

3) Insulated Door Materials: Minimum U Value of 0.37.

b. Provide keyed, low profile rim device type panic interior openers, with cylinder lock entry and thumb latch exterior trim, by Von Duprin or equal.

1) Door(s): Keyed with a common key.

2) Provide 8 original keys to COR.

c. Door closer:

1) Heavy duty, floor mounted.

2) For winds up to 90 miles per hour.

3) Equipped with a built-in positive dead stop to prevent the door from swinging beyond opening degree of 105 degrees.

4) Have separate and independent valves for closing speed, latch speed and backcheck.

5) ASSA ABLOY Rixson model L27 or approved equal.

6) Provide redundant, heavy duty crash chain.

d. Provide equipment access door that meets the following characteristics:

1) Motor operated.

2) Wall mounted.

3) Capable of withstanding 20 pounds per square foot, minimum horizontal windload without deformation or damage to door and components.

4) Cycle Life:

5) Insulated Door Materials: Minimum R-Value of 6.29 and U Value of 0.159.

6) Meets UL752 Level 4 Bullet Resistance.

7) Wireless safety edge system.

8) Color to be approved by government to match other doors.

e. A threshold, weather-stripping and sweeps for each door as manufactured by Reese or equal.

f. A drip cap for each door, extending 3 inches past door edge.

g. Door(s) shall be equipped with a 24 VDC magnetic switch that shall be wired back to the Pumping Plant PLC in order to provide an intrusion alarm.

h. Rain canopies.

1) Mounted above the door(s)

a) Dimensions: 5 foot by 1 foot.

2) Mounted above the equipment access door:

3) Dimensions: 11 foot by 1 foot

4) Fourteen gauge galvanized metal to match roof color.

8. Gutter and downspouts:

a. Twenty six gauge galvanized steel.

b. Mount over eave trim.

c. Provide eave wall with 2 downspouts with elbows.

9. Overhead crane:

a. Capacity: 2 ton.

b. Entirely supported by the ceiling trusses and building frame with trim matching interior liner panel.

c. Bridge cranes requiring additional supports are unacceptable.

10. Building enclosure accessories:

a. Two tube enclosed fluorescent lights: 8.

b. Wall mounted, interior convenience outlets: 6.

c. Wall mounted, exterior convenience outlet located adjacent to HVAC unit: 1.

d. Exterior mounted weatherproof, HPS, lamp with photocell: 1.

e. Interior emergency lighting fixture: 1.

f. De-humidifier: 1.

g. Wall mounted, HVAC unit: 1.

2.06 ELECTRICAL

A. Incoming Electrical Service:

1. 4160 volts, 3 phase, 60 Hertz.

2. Provided by others.

B. Electrical Design:

1. In accordance with applicable IEEE, NEMA, and UL Standards, and the latest revision of the National Electrical Code (NEC).

2. Manufacturer shall be responsible for the design, assembly, installation, and integration of electrical components and features.

C. Conduit:

1. Rigid Steel Conduit (RGS): Used for exposed conduit runs.

2. Plastic Coated Rigid Steel (PCRS): Used for buried conduit runs.

3. Liquid-Tight Flexible Metal Conduit (LFMC): Used where flexibility is necessary.

4. Wireways: Sheet steel, lay-in type without knockouts. Manufacturer’s standard grey coating.

D. Medium-Voltage Cables (5/8 kVolt):

1. Type: MV-105 single-conductor shielded.

2. Ratings:

a. Rated Voltage: 5/8 kilovolts.

1) Operating voltage: 4.16 kilovolts.

2) Frequency: 60-hertz.

3) Operating temperature: 105 degrees C, maximum.

4) Insulation level: 133 percent insulation.

5) Circuit configuration: Delta.

3. Conductor:

a. Stranded bare annealed copper in accordance with ASTM B8.

b. Size: As shown.

4. Insulation: Solid-dielectric EPR (ethylene-propylene rubber).

5. Screens:

a. Strand Screen: Extruded, semi-conducting EPR.

b. Insulation Screen: Extruded, semi-conducting EPR strand screen applied directly over the insulation.

6. Shield: 5 mil copper tape, coated, helically applied.

7. Jacket: PVC (polyvinyl chloride).

8. Suitable for conduit installation.

9. Date of Manufacture: No more than 24 months before Notice-to-Proceed.

10. Have AWG or circular mil designation.

11. Conform to ICEA S-93-639 NEMA WC 74 and AEIC CS8, where applicable.

E. Low-Voltage Wires and Cables (600 Volt):

1. Conductors to be stranded copper. Conductors for wiring devices and luminaire circuits should be solid copper.

2. Insulation Type: THHN/THWN or XHHW, 600 volt.

3. Phase Identification:

a. 120/240, single-phase: Black.

b. 120/208 or 240 volt. 3 phase: Black, red, blue. Colored phase tape may be used in lieu of colored insulation.

c. 277/480 volt, 3 phase: Black with brown, orange, yellow phase tape.

d. Neutral (Grounded) Conductors: In accordance with NEC.

e. Equipment Grounding Conductors: Green insulation for conductors 6 AWG and smaller. Conductors larger than 6 AWG provide green tape at both ends and visible points between.

F. Grounding:

1. Grounding System Design: Minimum of four ground risers attached to embedded foundation ground ring.

2. Supplemental Grounding Electrodes:
   a. Ground Rods: 10 foot, solid, copper-clad steel.
   b. Ground Ring: At least of 20 feet of 2 AWG bare stranded copper conductor.
3. Grounding Electrode Conductors: Stranded, bare copper sized in accordance with NEC.
4. Ground Connections: Welded, bolted, or compression type. Buried or embedded connections to use exothermic process only.

G. Instrument Transformers: Conform to IEEE C57.13.

H. Motor Control Equipment (MCE):
1. Voltage Rating: 4160 volts, 3 phase, 60 Hertz.
2. Horizontal Bus: 1000 amperes, copper tin-plated, solid bar type, insulated.
3. Medium Voltage Controllers: Integrated interrupting rating of 200 MVA with current limiting fuses.
4. Maximum Short-Circuit Current: 30 kA RMS symmetrical.
5. Enclosure: Dust tight.
6. Metering: Multifunction Power and Energy Meter with Modbus RTU communication protocol.
7. Main Pumping Unit Motor Starters: Solid-state reduced voltage type. Consist of SCR-based power section, logic board, bypass contactor, and power factor capacitor contactor. Control and monitoring functions using Modbus RTU protocol.
8. Provide starter with fused control power transformer, RED and GREEN indicating lights, Local/Remote, Interlock Bypass, and Soft Start Bypass selector switches, and Start/Stop pushbuttons.
9. Motor Protection Multifunction Relay:
   a. Self-powered, solid-state type.
   b. Protective functions:
      1) Phase overload standard curves (device 51).
      2) Phase overload custom programmable curve (device 51).
      3) It modeling (device 49).
      4) Stator overtemperature/ bearing overtemperature with 10 independent RTD inputs (device 49).
      5) Negative sequence unbalance/ single-phase (device 46).
      6) Phase reversal (device 47).

7) Starts per hour and time between starts (device 48).

8) Short circuit (device 50).

9) Ground fault (devices 50G/50N/51G/51N).

10) Undercurrent (device 37).

11) Mechanical jam/stall.

c. Management functions:

1) Statistical data.

2) Pre-trip-data.

3) Ability to learn, display and integrate critical parameters to maximize motor protection.

4) Communication with external devices using a RS485 port and ModBus RTU protocol.

5) A keypad and LCD display.

10. Power Factor Correction Equipment.

a. Minimum corrected power factor: 93 percent at full load.

b. Operation to be coordinated with Soft Starter manufacturer requirements.

c. Suitable for mounting within the motor control equipment lineup.

d. Sized not to exceed motor Max kVAR rating.

e. Conform to NEMA CP 1 and NFPA 70.

I. Station Transformer.

1. General purpose, self-cooled, dry-type.

2. Primary Voltage: 4160 volts, 3 phase, 60 Hertz.

3. Secondary Voltage: 480 volt, 3 wire, 60 Hertz.

4. Protection: Primary and secondary circuit breakers.

5. Finish: Manufacturer's standard gray.

J. 480 Volt Panelboard:

1. Main Circuit Breaker (MCB), 480 volt, 3 phase, 3 wire, 60 Hertz.

2. Metering: Multifunction Power and Energy Meter with Modbus RTU communication protocol.

3. Include 5 spare 3 phase circuit breakers to provide for future expansion.

4. Surge Protection Device.

5. Loads:

a. Pumping Plant Building Load. To be determined by supplier based on equipment provided and NEC requirements. Pumping Plant 1 to provide 480V single phase feeder to the Flow Control Valve Vault 10 kVA transformer installed with the Reach 22A contract. Design Load 5.4 kVA.

K. Lighting Transformer:

1. General purpose, self-cooled, dry-type.
2. Primary Voltage: 480 volts, 3 phase, 60 Hertz.
3. Secondary Voltage: 208/120 volt, 4 wire, 60 Hertz.
4. Protection: Primary and secondary circuit breakers.
5. Finish: Manufacturer's standard gray.

L. Lighting Panelboard:

1. Main Circuit Breaker (MCB), 208/120 volt, 3 phase, 4 wire, 60 Hertz.
2. Include 5 spare circuit breakers and 5 empty spaces to provide for future expansion.
3. Surge Protection Device.
4. Loads:
   a. Pumping Plant Building Load: To be determined by supplier based on equipment provided and NEC requirements.
   b. Air Chamber Building Panelboard. Design Load: 8.5 kVA.

M. Lighting:

1. Interior Lighting:
   a. LED.
   b. Lamps: 60 minimum.
   c. Color Temperature: 80 CRI, 4000K.
   d. UL Wet listed.
2. Emergency Lighting:
   a. 120 VAC fixture for mounting inside pumping plant.
   b. Two adjustable heads.
   c. Maintenance free battery for backup power.
   d. UL listed for damp location.
3. Exterior Lighting:
   a. 120 VAC, LED.
   b. BUG Rating: 1, 0, 1.

c. Equipped with photo cell for automatic dusk to dawn operation.

d. UL Wet listed.

e. International Dark Sky Association Compliance.

N. Power Receptacles:

1. Type: Heavy duty, NEMA 4X, corrosion/impact resistant enclosure.
2. Configuration: 3-wire, 4-pole, Non-Fused, with mechanical interlock and disconnect switch.
3. Rated Voltage: 600 volts.
4. Rated Current: 60 amperes.
5. Provided with threaded cap with chain.
6. Quantity: 2.

O. Receptacles (120 VAC):

1. Duplex, GFCI type.
2. Mount in weather-proof enclosure.
3. UL listed and in accordance with NEMA WD6.

2.07 FABRICATION OF STEEL PIPE

A. Fabricate steel piping as indicated on drawings, and in accordance with AWWA C200.

B. Longitudinal, girth, and spiral joints, other than field welds:

1. Double-welded butt joints with complete penetration.
2. Stagger longitudinal joints.
3. Longitudinal, girth, and spiral joints shall not intersect at outlet connections.

C. Coatings:

1. Exposed surfaces of steel structure to receive SSPC SP10 Near White blast cleaning. Apply coats of 2 component high solids epoxy and 1 coat of polyurethane topcoat.
2. Protective coating for interior and exterior piping, pumps and fittings to receive SSPC SP10 Near White blast cleaning and 3 coats of 2 component high solids epoxy, NSF 61 approved.
3. Three coat epoxy system shall provide a DFT of 18 to 24 mils.

D. Cut plates accurately to size and shape.

E. Bend or roll plates to true circular form with curvature continuous from edges of plates.

F. Properly form edges to be joined by welding to suit type of welding and to allow complete penetration.

G. Tolerances, inside surface of the pipe:

1. Inside surface of pipe: It shall not be possible to insert at any point a feeler gauge greater than 3/8 inch thickness between a template made to nominal curvature of inside surface extending over an arc of 30 degrees and inside surface of pipe.

2. Ends of straight pipe sections shall lie in a plane normal to longitudinal axis of section with maximum deviation of 1/8 inch on either side of plane.

H. Perform welding with a process that protects molten metal from atmosphere.

1. Where practicable, use automatic machines.

2. Where weld metal is deposited in successive layers, clean each layer before subsequent layer is deposited.

3. Align and separate edges of plates to be joined by butt welding to allow complete penetration and fusion of weld.

4. After welding is complete, remove weld spatter.

I. Protect work and operator from weather during welding operations.

1. Welding is not permitted on wet surfaces or when temperature of steel is lower than 0 degrees F.

2. Apply heat to welding areas during field installation. At pipe surface temperatures between 0 and 32 degrees F, heat surface of areas within 3 inches of start of weld to at least 60 degrees F.

J. End to be joined by sleeve-type coupling:

1. Exterior surface of pipe end to be connected with sleeve-type coupling shall be free from weld reinforcement (bead), seams, scars, dents, flats, or other defects likely to interfere with joint-sealing process in accordance with coupling manufacturer instructions.

K. Flanges and flanged connections:

1. During attachment of flanges to steel pipe, ensure that face of flanges remain flat and perpendicular to centerline of attached piping.

2. Limit irregularities or warping in face of flanges to 0.0015 inch measured from:

a. A high point on face of flange at an inside diameter to a corresponding low point on face of flange at an outside diameter, along any radial line, (concave orientation of the flange is not permissible) and,

b. A high point on face of flange along a circumferential line at centerline of flange bolt holes, to a low point on face of flange along same

circumferential line, within a distance equal to circumferential distance between every third bolt hole.

3. Remove by machining, irregularities or warping that remains in face of flange after its attachment to steel piping that exceeds the above.

4. After machining, flange thickness shall not be reduced below minimum thickness specified in AWWA C207, ASME B16.5, or as shown on drawings.

5. Weld pipe flanges to piping so that bolt holes straddle vertical centerline when in installed position.

6. Provide pipe flanges that connect to valve body flanges with same number of bolt holes, bolt pattern, and bolt circle diameter as connecting valves.

L. Maintain circularity of pipe sections during coating, lining, transporting, and installing operations.

1. Provide stulls or adjustable spiders.

2. Measured deviation between maximum and minimum diameters at stulls or spiders shall not exceed 0.5 percent of nominal pipe diameter.

M. Continuously weld joints of flange supports and pipe supports.

2.08 CONTROL AND MONITORING

A. Supply equipment through final testing and full automated operation through OAT completion in accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

B. SCADA System:

1. Refer to Section 25 00 01 - Control and Monitoring.

2. Provide location for SCADA Equipment Cabinet (36 inches wide by 24 inches depth by 80 inches height) with adequate room for opening single door to 180 degrees for operation and maintenance tasks.

3. Contractor is responsible for power cabling and conduit supplied to SCADA Equipment Cabinet.

a. Minimum of 2 isolated 120 VAC, 20 Amp circuits.

4. Pumping Plant subsystems tied into the SCADA shall have signal cabling and conduit back to the SCADA Equipment Cabinet location.

a. Size conduit twice minimum calculated size.

b. Conductor cabling shall have a minimum of 20 percent spares.

5. The following set of signal/data shall be made available to the SCADA RTU as a minimum. Complete conduit and cabling for the following signals:

a. Water Pump Controller Interface:
   1) Unit is Running.
   2) Motor Controller Fault.
   3) Unit Lockout Soft Start.
   4) Auto Mode.
   5) Seal Water Pressure OK.
   6) Start/Stop.
   7) Start/Stop Interlock.

b. Water Pump Manifold Valves.
   1) Inlet Pressure Switch.
   2) Outlet Pressure Switch.
   3) Valve Full Open/Full Closed Indications.
   4) Valve Position.
   5) Valve Torque Switches.
   6) Valve Selector Switch Position: Local/Manual.

c. Electrical Bus Telemetry:
   1) KWH.
   2) Voltage.
   3) Faults/Alarms.

d. Support System Telemetry:
   1) Seal Water System.
   2) Fire Control System.
   3) Facilities Security System.
   4) Facility Water Sensor for flooding indication.

e. External Tank Telemetry.

f. Remote Flow Vaults:
   1) Flow.
   2) Forebay Tank Pressure Transducers.
   3) Flood alarm.

g. Other telemetry for Pumping Plant operation.

C. Local Area Network:
   1. Supplied by others.

D. Communications System:

1. Supplied by others.
2. Structure shall allow support of 3 inch pole adequate for antenna placement 30 feet above grade.

E. Security System:

1. Supplied by others.
2. Doorways shall allow for flush-mount placement and through wall conduit for card reader/keypad modules.

F. Telephone System:

1. Supplied by others.
2. Main doorway shall allow for flush-mount placement and through wall conduit for telephone enclosure.

2.09 CONTRACTOR SOURCE QUALITY TESTING

A. Pump Shop Assembly and Test Requirements:

1. Assemble mating parts of pumping unit (pump and motor). Match-mark pump components before disassembly for shipment to aid correct field assembly.
2. Shop test each pumping unit before delivery to site.
    a. In accordance with ANSI/HI 14.6 performance test.
        1) Pumping unit shall comply with acceptance grade and tolerance 1U for rate of flow, total head, and efficiency at the guarantee point.
3. Perform tests with job motor at motor rated voltage.
4. Government to witness pump test. Notify COR 14 days to before pump and motor are ready to be tested.

B. Pump Hydrostatic Test: Test pump pressure-sustaining parts per ANSI/HI 14.6.

C. Motor Shop Test:

1. Assemble and test motor at the manufacturer's shop to establish that performance requirements of these specifications and warranties under this contract have been fulfilled.
2. Perform manufacturer's routine factory tests and the following routine tests required by Part 20 of NEMA MG1.
    a. Measurement of winding resistance.
    b. No-load motoring readings of current, power, and nominal speed at rated voltage and frequency.

c. DC high-potential test.

3. Perform tests in accordance with requirements of NEMA MG1 and IEEE 112.

D. Shop test AWWA butterfly valves in accordance with AWWA C504 for butterfly valves and AWWA C507 for ball valves.

1. Leak test valves at manufacturer's facility or an alternate facility approved by COR.

2. Tests will be Government witnessed. Notify Government in writing 30 days prior to testing valves.

3. Testing of valves shall occur during same trip for Government from each manufacturer.

4. Prior to shop leakage test and in presence of Government, verify that when valve is fully closed, valve indicator indicates closed.

5. If indicator is not in closed position (exactly at closed), remove operator from valve, fully close valve, reinstall operator so that it indicates "CLOSED".

6. Shop leakage test:

a. Test valves and seats for leaks with water in 100 percent closed position for timed period of 5 minutes with a pressure equal to rated design pressure. Valves shall be drip tight with no leakage.

b. Upstream position of valve shall be visible to Government.

c. Spray or high velocity leakage will not be acceptable.

d. If valve leaks, adjustments shall be made until valve is drip tight with no leakage. Adjustments may include adjusting valve stops, seats, actuators, etc.

e. If a valve is not drip tight (any leakage), valve will not be acceptable.

7. After adjustments are made, inspect valve indicator again and correct.

E. Shop test Check Valves, Pressure Sustaining Valves, Pressure Switches and Pressure Transmitters in accordance with manufacturers' requirements.

PART 3 EXECUTION

3.01 SERVICES OF MANUFACTURER'S INSTALLATION REPRESENTATIVE

A. Provide separate Manufacturer's Installation Representatives for the pump and motor.

B. Perform operational field testing of the pumping units under the direction and oversight of the on-site Manufacturer's Installation Representatives.

C. Do not perform work on pumps or motors without applicable Manufacturer's Installation Representative being on-site to direct/oversee the work.

D. Applicable Manufacturer's Installation Representatives on-site for:

1. Pumping Plant leveling and anchoring.
2. Pumping Plant unit base frame grouting.
3. Setting of pump and installation to base frame.
4. Alignment and coupling of pump to suction and discharge lines.
5. Alignment and coupling of motor to pump.
6. Motor field acceptance tests, including heat run.
7. Functional testing.
8. Operations and Maintenance training.

3.02 INSTALLATION

A. Install Pumping Plant foundations in accordance with Section 31 23 10 - Earthwork and Section 03 30 00 - Cast-In-Place Concrete.

B. Unload and install Pumping Plant buildings in accordance with manufacturer's instructions.

C. Install valves complete and lubricated in accordance with manufacturer's instructions.

D. Configuration of valves in Pumping Plant as shown on drawing 1695-D-60051, 1695-D-60052, 1695-D-60055, and 1695-D-60066.

E. Valves with flanged connections: Bolt holes straddle vertical centerline when in installed position.

F. Service each pumping unit before installing.

1. Servicing consists of complete lubricating, adjusting, and cleaning of unit.
2. Lubricants in accordance with pump and motor manufacturers' recommendations.

G. Correctly assemble and align parts of each pumping unit.

H. Apply an anti-seize compound meeting the requirements of TT-S-1732 (MIL-PRF-907F) to the shaft threads before assembling.

I. Furnish fine thread leveling bolts, anchor bolts, and other devices applicable to install and align pumping units.

J. Apply a suitable lubricant to the pump base frame leveling screws and pump base frame anchor bolts to prevent bolt threads from seizing to epoxy grout, if applicable.

K. After servicing and concrete within Pumping Plant has cured:

1. Install pumping unit by a qualified millwright.

2. Under supervision of Pump and Motor Manufacturer's Installation Representatives.

3. In accordance with ANSI/HI 1.1 - 1.4 and manufacturer's installation instructions.

L. Tighten base frame anchor bolts, pump mounting bolts, and motor mounting bolts to manufacturer's recommended torque, as submitted in the approval data, prior to beginning the field tests on each unit.

1. At conclusion of field tests on each unit, check respective bolt torques.

2. If bolts are insufficiently torqued, COR may direct the tests be conducted again, at no additional cost to Government.

M. Couplings and Flanges:

1. Clean dirt and burrs from couplings, flange faces, and machined surfaces before connection to ensure tight fit and true alignment.

2. Coat finished surfaces of flanged joints with joint compound before bolting.

3. Make flanged joints with undamaged full face gaskets properly centered to the joint before bolting.

4. Tighten flange bolts several times at intervals until the initial stretch is taken up and it is positively ensured that there will not be leakage.

N. Base frame and Pump/Motor Installation:

1. Clean the base frame before installation to remove paint, dirt, rust, and other foreign matter.

2. Level and set elevation of each base frame to within 0.002 inch per linear foot under each working component of the unit during field installation of Pumping Plant and verify before and after placement of concrete within Pumping Plant.

a. 0.002 inch per linear foot under the pump.

b. 0.002 inch per linear foot under the motor.

3. Install base frame assembly so that mating surfaces of the pump feet and motor feet to the mounting plates have 100 percent contact, if shims are not used. Wedges or lead washers not allowed.

4. Shims used to align the pumping units:

a. Shim material 316 stainless steel.

b. Shims have 100 percent contact with pump and/or motor feet and mating surfaces of base frame.

c. No more than 2 shims stacked between the base frame and pump or motor feet. Replace stacks of more than two shims with 2 or less shims of equal thickness.

d. Do not use distorted or damaged shims.

5. Set pump on mounting plate of base frame and align the pump and connect to the suction and discharge piping.
6. Final installation of the pump to be at the elevation and position that lines up the suction and discharge piping with the pump.
    a. Account for the offset between the centerline of the suction and discharge connections on the pump and respective connections on the intake and discharge manifolds.
7. Set motor on mounting plate of base frame and align pump and motor.
    a. Perform alignment using dial indicators or laser alignment to check both parallel and angular misalignments. Verify alignment after field installation of Pumping Plant.
    b. Maximum allowable total angular runout, with indicating point approximately 12 inches apart: 0.003 inch, or manufacturer's recommendation, whichever is less.
    c. Maximum allowable total indicated parallel runout is 0.004 inch, or manufactures recommended, whichever is less.
8. Grout base frame in place using epoxy grout in accordance with Section 03 63 00 - Epoxy Grout.
9. Perform grout placement in a manner to ensure 100 percent contact between the base frame and the concrete pad.
10. After epoxy grout has set recheck alignment of the pump and motor.
    a. Take corrective measures as required until alignment and leveling tolerances meet manufactures and specification requirements.
11. Fully tighten bolts to manufacturer's recommended torque value.
12. After final alignment, dowel pump and motor to their respective mounting plates on the common base frame.
13. Turn motor shaft and pump shaft by hand to ensure free rotation in their bearings.
14. After determining correct direction of rotation, connect water piping and make electrical connections.
15. Connect pump shaft and motor shaft and make necessary adjustments in accordance with manufacturer's instructions after electrical connections have been made and correct direction of rotation has been determined.
16. After field installation, completely, service each pumping unit.
    a. Completely lubricate, adjust, and clean each unit.
    b. Check lubricating devices and water piping systems for correct operation before thoroughly lubricating unit.
    c. Furnish lubricants in accordance with the pump and motor manufacturers' recommendations.

O. Electrical Conduit, General:

1. Wiring outside of electrical control panels, panelboards, and enclosures shall be installed in galvanized rigid steel conduit or metallic wireways.
2. Liquidtight flexible metal conduit may be used where flexibility is necessary. 3 feet maximum.

P. Direct-Buried Electrical Conduit:

1. Direct buried service entrance conduit shall be plastic coated rigid steel.
2. The metal conduit may be either plastic-coated rigid steel or galvanized rigid steel.
3. Buried Depth: 24 inches, minimum.
4. Install 2 inches of sand around conduit.
5. Install detectable warning tape 18 inches above buried conduit.
6. Backfill and compact trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

Q. Ground Rods:

1. Drive ground rods vertically until tops of rods are within 2 inches above installation location of ground cables to which rods will be connected.
2. If solid rock is encountered within 3 feet of the subgrade, grout ground rod into 1-1/4 inch vertical hole such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.
3. If solid rock is encountered deeper than 3 feet below the subgrade, drive ground rod to refusal at approximately a 45 degree angle, then bend ground rod horizontally such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.

R. Ground Connections: Make ground connections that will be direct buried with an exothermic process and in accordance with manufacturer's instructions.

S. Wires and Cables (600 Volt):

1. Determine conductor sizes in accordance with NEC.
2. Install wire and cable in accordance with NEC.
3. Use solid conductor wire and cable for lighting circuits and 120 volt receptacles unless shown otherwise.
4. Do not splice wires and cables.

T. Electrical Distribution Equipment:

1. Install in accordance with manufacturer’s instructions and recommendations.
2. Provide working space about the equipment in accordance with NEC.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Submit operational field testing procedures for approval.
2. Furnish lubricating devices and grease in accordance with the pump and motor manufacturers' recommendations.
3. Before performing operational field tests, completely lubricate, adjust, and clean the pumping unit.
4. Check lubricating devices and water piping systems for correct operation before thoroughly lubricating unit.
5. Check lubricating devices for correct operation. Furnish lubricating devices and grease in accordance with the pumping unit manufacturer's recommendations.
6. Cleaning:
    a. Clean testing area before and after each test.
    b. Internal surfaces of and system components to assure the effective removal of contaminants.
        1) Remove loose solid contaminants.
        2) Remove rust from surfaces.
        3) Furnish materials, supplies, labor and equipment for cleaning the system components.
7. Furnish temporary instruments, gauges, recording and sensing devices, and special brackets required for the operational field tests.
8. Calibrate permanent instruments, gauges, and recording and sensing devices and adjust equipment until operation is approved by the Government.
9. Schedule construction work so that these tests can be conducted. Notify COR 30 days in advance of testing planned start.
10. Have the necessary craftsman available to make necessary changes (either temporary or permanent).
11. Responsible for operating the units, recording the data, and enforcing safety procedures.
12. Schedule, conduct, and coordinate tests required to be witnessed by the Government.

B. Before making electrical connections and energizing the distribution equipment, perform the following checks and tests:

1. Cable Systems: Successfully test motor control, monitoring, and protective wiring in accordance with Section 26 05 10 - Conductors and Cables, Section 26 05 13 - Medium-Voltage Power Cable Systems, and Section 26 05 90 - Wiring Checkout and Tests.

2. Motor Control Equipment:

   a. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

   b. Bus megger test.

   c. Ground test.

   d. Verification mechanical interlocks are functioning properly.

   e. Record settings of motor protection relay and other protective devices.

3. Panelboards:

   a. Continuity tests using a DC device with buzzer.

   b. Insulation test using a 500 volt minimum insulation-resistance test set.

      1) Record readings after 1 minute and until the reading are constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

   c. Record test data and include the identification of panelboard and megohms readings verses time.

4. Pump Motors: Perform required tests in accordance with ANSI/NETA ATS.

C. Perform an operating test on each pumping unit under load for 8 hours or as directed by COR.

1. Perform tests in accordance with ANSI/HI 14.6 and manufacturer's operational field testing procedures.

2. Supply testing equipment with current calibration record.

3. Government will witness pump test.

   a. Perform tests for each pump.

   b. Do not test more than 1 pump at a time.

4. Observe and record:

   a. Pumping unit operation and record noise level,

   b. Vibration analysis:

      1) Vibration analysis to be full spectrum analysis using a monitor that records and prints analysis results.

      2) Vibration levels not to exceed the acceptable field vibration limits established by ANSI/HI 9.6.4.

   c. Shaft alignment and run-out measurements,

   d. Pump and motor bearing temperatures,

   e. Motor voltage and amperage,

   f. Motor stator temperature.

g. Take readings for as long as the system will allow, up to 8 hours:

1) Hours 1-2: Every 15 minutes;

2) Hours 2-7: Every hour;

3) Hour 8: Every 15 minutes.

5. If testing for less than 8 hours; once every 15 minutes for the last hour. Without additional cost to Government, make changes and correct errors for which Contractor is responsible.

D. Test HVAC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC Equipment.

E. Hydrostatic Pressure Testing:

1. Notify COR in writing a minimum of 14 days before test.

2. Government will witness hydrostatic test and examine calibration of pressure gauges.

3. Use 2 or more pressure gauges with 1 being a recording type.

a. Upper limit of pressure gauges shall be between 1.5 and 3 times required test pressure. Calibrate pressure gauges with a deadweight tester.

b. At least 1 gauge, which is used for acceptance of test, shall be calibrated within 30 days prior to use.

c. Make a time-pressure record of hydrostatic pressure test.

4. Hydrostatically test steel pipe.

5. Furnish equipment necessary to perform hydrostatic tests.

6. If a flange is attached to a piping section, after piping section has been hydrostatically tested, piping section will not require retesting.

7. Water temperature for tests: Greater than 45 degrees F.

8. Vent air from test sections.

9. Fill each section with water and uniformly increase pressure until required test pressure is reached.

a. Hold test pressure for a minimum of 15 minutes.

b. Apply and release test pressure 3 successive times.

c. After each application, hold pressure to 2/3 of required pressure until welded joints and seams can be examined.

d. Repair defects. After defects are repaired, repeat complete test procedure.

10. After hydrostatic testing is complete, cut sections for handling purposes on planes normal to pipe axis.

F. Nondestructive Testing of Field Welds:

1. Joint welds and other partial penetration joint field welds and fillet welds by magnetic particle or dye penetrant.

   a. Magnetic particle testing: ASTM E709.

   b. Dye penetrant: ASTM E165.

2. Complete inspections and tests in presence of Government and in accordance with AWS D1.1.

3. Defective welds: Repair in accordance with AWS D1.1.

   a. Re-examine to ensure adequacy of repairs.

4. Visual inspection: Visually inspect welds following procedures, techniques, and standards of AWS D1.1.

G. Valve Testing:

1. After each valve has been completely installed, test valve in pipeline by opening and closing valve through its full range of operation 3 times.

2. Make changes or adjustments until operation is approved by COR, valves are bubbletight and do not leak water past seats.

3. Ensure means for inspecting area downstream of valve during testing by Government.

H. Test Resistance of Grounding System:

1. Notify COR at least 24 hours in advance of time of test in order that test may be witnessed by COR.

2. Perform test within 30 days after completion of the grounding system installation.

3. Measured Resistance: Less than 10 ohms.

4. Use fall of potential method in accordance with IEEE 81.

5. Testing Device: Earth resistance tester.

   a. Heavy-duty, low-resistance type with direct-reading and direct-current ohmmeter.

   b. Capable of measuring ground resistance to an accuracy of 0.5 ohms or better.

6. Test Performance:

   a. Initial distance between remote current electrode (C) and grounding system under test (X): At least 6 times longest diagonal dimension of grounding system.

   b. Beginning at electrode X, drive potential reference electrode (P) into ground at a number of test points on a straight line between electrode X and electrode C.

c. Distance between test points: Approximately 5 percent of actual distance between electrodes X and C.

d. Continuously log apparent resistance readings for each test point and plot curve of resistance versus distance to ensure that the electrode C location is giving acceptable results as indicated in IEEE 81.

I. Measure and record test points until reaching electrode C or as directed by COR. If plot of resistance versus distance curve indicates remote current electrode is in area of influence of grounding system, increase distance between electrode C and grounding system, and measure and record a new set of test data.

J. Field Water Test: After installation of Pumping Plant building, including metal roof panel accessories and trim, test a 2 bay area for each building selected by the COR for water penetration in accordance with AAMA 501.2.

3.04 TRAINING

A. Pump and Motor Operations and Maintenance:

1. Manufacturer's recommended training for the operation, maintenance, and repair of pumping units.

2. Duration: 1 day.

3. No. of attendees: 8.

END OF SECTION

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SECTION 22 13 16
FOUNDATION AND BUILDING DRAINAGE PIPING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Pre-manufactured Pump Station No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Pre-manufactured Pump Station No. 2.

C. Cost:

1. Include in the price offered in Price Schedule for Air Chamber No. 1.

D. Cost:

1. Include in the price offered in Price Schedule for Air Chamber No. 2.

E. Cost:

1. Include in the price offered in Price Schedule for Regulating Tank No. 1.

F. Cost:

1. Include in the price offered in Price Schedule for Regulating Tank No. 2.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A74-13	Cast Iron Soil Pipe and Fittings
2.	ASTM C564-12	Rubber Gaskets for Cast Iron Soil Pipe and Fittings

B. International Code Council (ICC)

1.	IBC-12	International Building Code
2.	IPC-12	International Plumbing Code

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 22 13 16-1, Approval Data:

1. Manufacturer's literature, specifications, and engineering data including dimensions, size and materials for products provided.

PART 2 PRODUCTS

2.01 PRE-MANUFACTURED PUMP STATION NO. 1 AND 2.

A. See Section 22 11 35 - Pre-manufactured Pump Station.

2.02 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.03 PIPING

A. Hub and Spigot Cast Iron Soil Pipe and Fittings:

1. Pipe and Fittings: ASTM A74.
2. Weight: Service Weight.
3. Joints:
   a. Hub and Spigot Compression Type:
      1) Gasket: Neoprene Rubber, ASTM C564.
      2) Lubricant: As recommended by pipe manufacturer.

2.04 FLOOR DRAINS

A. Fig. No. 2140C Floor Drain, manufactured by Jay R Smith Mfg. Co., 2781 Gunter Park Dr. East, Montgomery, AL 36109, Phone: 334-277-8520; or equal, having the following essential characteristics:

1. Materials:
   a. Body: Coated cast iron.
   b. Grate: 12 inch round cast iron, removable with vandal proof screws.
2. Outlet Connection: 4 inch bottom caulk outlet.
3. Contains internal bucket for catching solids or debris.

2.05 PIPE COUPLING

A. Amor-Link stainless steel coupling, manufactured by Romac Industries, Inc., 21919 20th Avenue SE Bothell, WA 98021, Phone: 800-426-9341; or equal, having the following essential characteristics:

1. Materials:
    a. Stainless steel shell and hardware.
    b. Ethylene Propylene Diene Monomer (EPDM) gasket.
2. Molded in bushing.
3. Compatible for use with cast iron soil pipe and HDPE pipe.
4. Provide stainless steel pipe stiffener, as required by manufacturer, for installation on HDPE pipe.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pumping Plant Floor Drainage:
    1. Install floor drains to prevent flooding under the Pumping Plants' structures.
    2. Locate drains based on approved Pumping Plants and foundation design.
    3. Locate drains to accommodate pump casing, as well as, pump suction and discharge manifold drainage.

B. Air Chamber Building Drainage: Install single floor drain to prevent flooding.

C. Route drainage piping from floor drains to the extents of the foundation: Locate as needed to tie into site drainage piping shown on drawings.

D. Install piping in accordance with IBC and IPC.

E. Install floor drain and pipe coupling in accordance with manufacturer’s instructions and recommendations.

F. Pitch drainage piping uniformly at 1/4 inch per foot grade to daylight.

G. Extend cast iron soil pipe 12 inches beyond foundation.

H. See Section 33 11 18 - HDPE Pressure Pipe for HDPE pipe requirements.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Tests may be witnessed by Government.

B. Notify COR in writing at least 7 working days prior to testing. Include:
    1. Date and time system is ready for testing.
    2. Period of time required for testing.

C. Test piping in accordance with IPC:

1. Test gravity drainage piping system with a minimum of 10 feet of water or 5 pounds per square inch of air.
2. Conduct pressure test at least 15 minutes to verify system is tight with no leakage or reduction in pressure.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Associated Air Balance Council (AABC)

1.	AABC MN1-02	National Standards for Total System Balance, 7th Edition

B. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

1.	ASHRAE 111-08	Testing, Adjusting and Balancing of Building HVAC Systems

C. Natural Environmental Balancing Bureau (NEBB)

1.	NEBB-15	Testing, Adjusting, and Balancing of Environmental Systems

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 05 93-1, Approval Data:

1. Qualification certification that indicates compliance with the requirements of this section.

C. RSN 23 05 93-2, Certified Testing Adjusting and Balance Reports:

a. Title Page:

1) Testing, Adjusting, and Balancing Agency:

2) Name.

3) Address.

4) Telephone and facsimile numbers.

5) Project name.

6) Project location.

7) Project Contractor.

8) Report date.

b. Summary Comments:

1) Design versus final performance.

2) Notable characteristics of system.

3) Description of systems operation sequence.

4) Summary of outdoor and exhaust flows to indicate building pressurization.

5) Nomenclature used throughout report.

6) Test conditions.

c. Instrument List:

1) Instrument.

2) Manufacturer.

3) Model number.

4) Serial number.

5) Range.

6) Calibration date.

d. Electric Motors:

1) Manufacturer.

2) Model/Frame.

3) HP/BHP and kW.

4) Phase, voltage, amperage; nameplate, actual, no load.

5) RPM.

6) Service factor.

7) Starter size, rating, heater elements.

8) Sheave Make/Size/Bore.

e. Fans:

1) Identification/number.

2) Location.

3) Manufacturer.

4) Model number.

5) Serial number.

6) Air flow, design and actual.

7) Static pressure drop, design and actual.

f. Air Inlets and Outlets.

1) Identification/number.

2) Location.

3) Size.

4) Air flow, specified and actual.

g. Unit Heaters:

1) Identification/number.

2) Location.

3) Size.

4) Heating setpoint, design and actual.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with one of the following:

1. AABC MN-1.
2. ASHRAE 111.
3. NEBB Procedural Standard for Testing, Balancing and Adjusting of Environmental Systems.

B. Prior to commencing work, calibrate each instrument to be used.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify systems are complete and operable before commencing work:

1. Systems are started and operating in safe and normal condition.
2. HVAC control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Dampers are in place and in normal position.
8. Access doors are closed and duct end caps are in place.
9. Air outlets are installed and connected.
10. Duct system leakage is minimized.

3.02 PREPARATION

A. Perform Work under supervision of one of the following:
1. AABC Certified Test and Balance Engineer.
2. NEBB Certified Testing, Balancing and Adjusting Supervisor.
3. Registered Professional Engineer experienced in performance of this Work.

B. Furnish instruments required for testing, adjusting, and balancing operations.

C. Make instruments available to COR to facilitate spot checks during testing.

3.03 INSTALLATION TOLERANCES

A. Air Outlets and Inlets: Adjust to within plus 10 percent or minus 5 percent of design airflow to space.

3.04 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by COR.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. General Air System Procedures:

1. Make air flow rate measurements in main ducts by pitot tube traverse of entire cross sectional area of duct.
2. Measure air quantities at air inlets and outlets.
3. Vary total system air quantities by adjustment of fan speeds.

B. Air System:

1. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
    a. Measure total airflow.
        1) Where sufficient space in ducts is unavailable for pitot tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
    b. Measure fan static pressures as follows to determine actual static pressure:
        1) Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
        2) Measure static pressure directly at the fan outlet or through the flexible connection.
2. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values.

C. Motors:

1. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
    a. Manufacturer's name, model number, and serial number.
        1) Motor horsepower rating.
        2) Motor RPM.
        3) Efficiency rating.
        4) Nameplate and measured voltage, each phase.
        5) Nameplate and measured amperage, each phase.
        6) Starter thermal protection element rating.

D. Schedules:

1. List of Equipment Requiring Testing, Adjusting, and Balancing:
    a. Fans.

b. Air Inlets and Outlets.

c. Unit Heaters.

END OF SECTION

SECTION 23 33 10
DUCT ACCESSORIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in price in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc. (AMCA)

1.	AMCA 501-09	Application Manual for Air Louvers
2.	AMCA 502-06(2009)	Damper Application Manual for Heating, Ventilating and Air Conditioning

B. ASTM International (ASTM)

1.	ASTM A603-14	Zinc-Coated Steel Structural Wire Rope

C. Code of Federal Regulations (CFR)

1.	40 CFR 59	Consumer and Commercial Products, Group IV: Control Techniques Guidelines in Lieu of Regulations for Miscellaneous Metal Products Coatings, Plastic Parts Coatings, Auto and Light-Duty Truck Assembly Coatings, Fiberglass Boat Manufacturing Materials, and Miscellaneous Industrial Adhesives

D. Sheet Metal and Air Conditioning Contractors (SMACNA)

1.	SMACNA 1966-05	HVAC Duct Construction Standard - Metal and Flexible

E. Underwriters Laboratories (UL)

1.	UL 181-13	Factory-Made Air Ducts and Connectors
2.	UL 723-08	Tests for Surface Burning Characteristics of Building Materials

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 33 10-1, HVAC Accessories Approval Data:

1. Equipment: Manufacturer's product data that includes sizes, finish, and type of mounting.

C. RSN 23 33 10-2, HVAC Accessories Final Data:

1. Bound copy of signed, stamped, previously approved data.

1.04 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by a Nationally Recognized Testing Laboratory.

1. For indoor applications, sealant shall have a VOC content of 250 g per L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g per L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm per 100 square foot at 1 inch wg and rated for 10 inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.03 HANGERS AND SUPPORTS

A. Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA 1966.

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

2.04 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4 inch wide, 0.028 inch thick, galvanized sheet steel or 0.032 inch thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 ounces per square yard.

2. Tensile Strength: 480 lbf per inch in the warp and 360 lbf per inch in the filling.

3. Service Temperature: Minus 40 to plus 200 degrees F.

2.05 RECTANGULAR STATIONARY LOUVERS

A. Type: Drainable. Blades on 45 degree slope with center baffle and return bend, heavy channel frame.

B. Fabrication: 18 gage thick galvanized steel welded assembly, with factory baked enamel finish. Finish color to be selected by Architect from approval data submittal.

C. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

D. Free Area Required: 45 percent nominal:

1. Meet the maximum static pressure losses listed on drawing schedule. Performance data to be AMCA 500 certified.

E. See schedule on drawings for additional information.

2.06 DAMPER ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full stroke cycles at rated torque.

1. Dampers: Size for running torque calculated as follows:

a. Opposed-Blade Damper with Edge Seals: 5 inch pounds per square foot of damper.

2. Coupling: V-bolt and V-shaped, toothed cradle.

3. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

4. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.

5. Power Requirements (Two Position Spring Return): 24 VAC.

6. Temperature Rating: Minus 22 to plus 122 degrees F.

7. Run Time: 120 seconds.

2.07 ELECTRONICALLY ACTUATED DAMPERS

A. Dampers: AMCA rated, opposed blade design; 0.108 inch minimum thick, galvanized steel or 0.125 inch minimum thick, extruded aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064 inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2 inch diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 degrees F.

3. Edge Seals, Standard Pressure Applications: Closed cell neoprene.

2.08 POWER SUPPLIES

A. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.

2. Combined 1 percent line and load regulation with 100 micro second response time for 50 percent load changes.

3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.09 CONTROL CABLE

A. Control devices and panels containing low voltage power sources shall inherently comply with NEC Class 2 requirements (current limiting), or shall be supplied with branch circuit fusing to limit control circuit current to NEC Class 2. Control transformers shall be of the inherent current limiting type, or be installed with primary disconnects and overload protection.

B. Shielded Cable: Use twisted shielded cable where called for and where required to properly protect the control system from false signals and electrical noise. Shielding shall be fine braided tinned copper (90 percent coverage) or aluminum foil (100 percent coverage).

C. Minimum Requirements: Twisted shielded pair, 18 gauge.

PART 3 EXECUTION

3.01 FABRICATION

A. Seal joints with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.

1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
2. Sealing products shall bear UL approval markings.

3.02 INSTALLATION

A. Hanger and support installation:

1. Comply with SMACNA 1966 to determine rectangular duct hangers minimum size and minimum hanger sizes for round duct.
2. Hanger Spacing: Comply with SMACNA 1966 for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
3. Hangers Exposed to View: Threaded rod and angle or channel supports.
4. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Use double nuts and lock washers on threaded rod supports.

C. Where dampers are not noted on the control drawings install backdraft damper on inlet. Install backdraft dampers at inlet of fans or ducts as close as possible to fan as noted on the drawings.

D. Install flexible connectors to connect ducts to equipment.

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc. (AMCA)

1.	AMCA 204-05	Balance Quality and Vibration Levels for Fans
2.	AMCA 210-07	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

B. Underwriters Laboratories (UL)

1.	UL 705-11	Power Ventilators

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 34 00-1, Approval Data:

1. Submit manufacturer's product data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.

C. RSN 23 34 00-2, Final Data:

1. Operation and Maintenance Data. Submit manufacturer's operation and maintenance manuals including instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
2. Bound copy of signed, stamped, previously approved data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.06 EXTRA MATERIALS

A. Furnish 2 sets of belts for belt-driven fans.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 PROPELLER FAN

A. Construction:

1. Impeller: Shaped steel reinforced aluminum blade with hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or furnished with V-belt drive.
2. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

B. Accessories to be provided:

1. Integral Housing: 18 gauge galvanized steel wall housing.
2. Inlet Guard Safety Screens: Expanded galvanized metal over inlet, motor, and drive comply with OSHA regulations.

C. Performance Ratings: Conform to AMCA 210.

D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

E. Balance Quality: Conform to AMCA 204.

F. See schedule on drawings for additional information.

PART 3 EXECUTION

3.01 FAN INSTALLATION

A. Secure fans with cadmium plated steel lag screws to structure.

B. Install backdraft dampers on inlet to roof and wall exhaust fans.

C. Install safety screen where inlet or outlet is exposed.

D. Provide sheaves required for final air balance.

3.02 CLEANING

A. Vacuum clean inside of fan cabinet.

3.03 PROTECTION OF FINISHED WORK

A. Do not operate fans until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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SECTION 23 82 39
UNIT HEATERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 1.

B. Cost:

1. Include in the price offered in the Price Schedule for Air Chamber No. 2.

1.02 REFERENCE STANDARDS

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1.	ASHRAE 62.1-13	Ventilation for Acceptable Indoor Air Quality

B. Underwriter's Laboratories (UL)

1.	UL 499-14	Electric Heating Appliances
2.	UL 1030-15	Sheathed Heating Elements

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 82 39-1, Approval Data:

1. Manufacturer's product data indicating:
   a. Heating capacity.
   b. Throw Distance.
   c. Dimensions.
   d. Materials of construction.
   e. Weights.
   f. Electrical requirements with electrical characteristics and connection requirements.
   g. Controls.
   h. Accessories.

C. RSN 23 82 39-2, Final Data:

1. Operation and Maintenance Data. Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

2. Bound copy of signed, stamped, previously approved data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location.

PART 2 PRODUCTS

2.01 AIR CHAMBER NO. 1 AND NO. 2

A. See Section 33 16 14 - Air Chambers.

2.02 PROPELLER UNIT HEATERS

A. Description: A horizontal assembly including casing, coil, fan, and motor in with adjustable, discharge configuration louvers.

B. Description: Factory packaged units constructed according to UL 499 and UL 1030.

C. Cabinet: Removable panels for maintenance access to controls.

D. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and tested propeller unit heater before shipping.

E. Airstream Surfaces: Comply with requirements in ASHRAE 62.1.

F. Electric-Resistance Heating Elements:

1. Nickel-chromium heating wire, free from expansion noise and 60 Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch.

2. Element ends shall be enclosed in terminal box.

3. Fin surface temperature shall not exceed 550 degrees F during normal operation.

4. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

5. Wiring Terminations: Stainless-steel or corrosion-resistant material.

G. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

H. Manufacturer provided wall mounting bracket.

I. Control Devices:

1. Unit-mounted on-off PID thermostat.
2. Non-fused disconnect switch and a 24 VAC Class II transformer/relay package.

J. See schedule on drawings for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Coordinate installation with air chamber building structures.

B. Install propeller unit heaters level and plumb at mounting heights called out on drawings.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers.

3.03 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

END OF SECTION

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SECTION 25 00 01
CONTROL AND MONITORING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. SCADA System:

1. Payment: Lump sum price offered in the Price Schedule.

1.02 DEFINITIONS

A. NGWSP: Navajo Gallup Water Supply Project.

B. PLC: Programmable Logic Controller.

C. OIT: Operator Interface Terminal.

D. Facility Systems: Pumping plant, Forebay and Regulating Tank control, NAPI Turnout, Air Chamber Control, Fire Control, HVAC control, Communications and security systems, Telephone system, and systems for complete SCADA operation of the Pre-manufactured Pump Stations and the Reach 22B Lateral.

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 802.3-12	Standard for Ethernet
2.	IEEE C2-12	National Electric Safety Code (NESC)
3.	IEEE C37.90.2-04	Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
4.	IEEE C62.41.1-08	Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FU 1-12	Low Voltage Cartridge Fuse
3.	NEMA ICS 1-00(2015)	Industrial Control and Systems: General Requirements
4.	NEMA WC 70-09	Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

C. International Electrical Testing Association (NETA)

1.	NETA ETT-15	Certification of Electrical Testing Technicians

D. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 25 00 01-1, Approval Data - Monitoring and Control Systems Technical Specialist Work Summary:

1. Description of previously completed similar projects.

C. RSN 25 00 01-2, Approval Drawings and Data:

1. Drawings in government format:
    a. Layout of equipment in each SCADA Equipment Cabinet.
    b. Schematic and wiring diagrams of connected equipment.
    c. Networking Diagram.
2. Bill of Materials.
3. Manufacturer’s product data.

D. RSN 25 00 01-3, Approval Data - Software Development Documentation.

1. For each of the Facilities Systems:
    a. I/O points data base.
    b. Logic diagrams.
    c. Variables.
    d. One line diagram (proposed OIT touch panel display) for each screen provided as part of the HMI for the SCADA Equipment Cabinet OIT.
    e. HMI graphical screenshots with operational overview.
2. Include plant SCADA Software and Ladder Logic for equipment interlocks.

E. RSN 25 00 01-4, Check Prints:

1. Schematic and wiring diagrams.

F. RSN 25 00 01-5, Approval Data - Final Drawings, Documentation, and Operations and Maintenance Manuals:

1. Final drawings of approved layouts, schematic diagrams, and wiring diagrams including “as-built” changes.
2. Final version of approved software documentation including “as-built” changes.
3. Operations and Maintenance Manuals.
4. Spare parts list.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store hardware in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

1.06 PROJECT CONDITIONS

1.07 PERFORMANCE REQUIREMENTS

A. Hardware:

1. The PLC’s shall communicate with the network switches and radios via Modbus TCP/IP.
2. Radio shall communicate in accordance with Section 27 20 01 - Radio Equipment.
3. The Pumping Plants PLCs shall communicate through the LAN and Fiber Optic communications with the Navajo Gallup Reach 22B Sub-master station located at the Cutter Water Treatment Plant (WTP).
4. Fiber Optic communications will be the primary means of communications for Reach 22B with 900 MHz radio communications as a backup systems. In the event that the fiber optic communications goes out the system will automatically fail over to the radio system without disruption of service or loss of data.
5. The PLC’s shall communicate with Facilities Systems via Modbus RTU or Modbus TCP when available through those systems or controllers.
    a. Setup master to query for status of these systems continuously.
    b. Other telemetry and control will be discrete and analog I/O.
        1) Discrete: 24 VDC or 120 VAC.
        2) Analog: 4 to 20 mA.
6. Terminate input signals inputs in the SCADA Equipment Cabinet.
    a. A common redundant 24 VDC power supply located inside the SCADA Equipment Cabinet shall provide power for discrete signals.
    b. Have points go through termination blocks before connecting to PLC I/O modules.

7. Determine the size and ratings of the following:
    a. Fuses.
    b. Power Supplies.
    c. Surge Suppression Devices.
    d. Uninterruptible Power Supply (UPS).
8. Environmental Controls:
    a. Furnish circulation fans in solid state control system enclosures.
    b. Utilize over-temperature switches to provide special cooling to maintain operating temperatures within the manufacturer's specified range.
9. Where the PLC is utilized to control multiple systems of equipment, assign PLC components (I/O modules, power supplies, etc.) so that the failure of a component does not affect equipment on systems.
1. Allow for 50 percent overage for future expansion of the SCADA system components.
    a. Module I/O Points.
    b. Rack Slots.
    c. Data Processing: Processing, Ram, Storage.
10. Failure of a PLC, remote I/O hardware, or network communication link shall be individually alarmed at HMIs.
11. Provide additional equipment not specified in this section but necessary to make the system complete and operational at no cost to the Government.

B. Software:

1. Section 25 00 02 - Programmable Controller describes the general concept of the water supply system. Develop detailed software based on process control drawings, this section, and design coordination meetings to make a fully functional water supply system.
2. Drawing 1695-D-60096 gives a general overview of network and telemetry and control equipment for each pumping plant.
3. Control of programs: Protect access to PLC program loading with password protection or with locked, key operated selector switches.
4. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay, and circuit breaker noise or conducted and radiated radio frequency interference.
5. Provide software not mentioned specifically, but essential for the system to meet the functional requirements. Determine additional information required to complete the configuration tasks; and obtain this information from the COR.

6. Provide Contractor generated software with extensive documentation and descriptions listed within the software for turnover. Include a description for each rung.

7. The HMI screens shall display the status of system processes tied into the control and monitoring system. This includes processes controlled via the PPs RTU, and water conveyance processes.

8. Design displays, subject to Government's review and approval. Submit color hard copies of each applicable OIT screen. Submit 4 screens minimum.

   a. Reach 22B Water Conveyance Overview.

   b. Pumping Plants Overview (PP1 and PP2).

   c. Major Equipment Detail.

   d. Alarm and Telemetry Screen.

C. Incorporate the following minimum safety measures:

1. Watchdog function to monitor:

   a. Internal processor clock failure.

   b. Processor memory failure.

   c. Loss of communication between processor and I/O modules.

   d. Processor ceases to execute logic program.

2. Safety function wiring: Do not wire emergency shutdown switches into the controller.

3. Initial safety conditions:

   a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.

   b. Utilize program each time PLC is re-initiated and the control program activated.

4. Monitoring of internal faults and display:

   a. Monitor and display internal PLC system status and faults with:

      1) Memory ok/loss of memory.

      2) Processor ok/processor fault.

      3) Scan time overrun.

5. Operator intervention:

   a. Logic system failure shall not preclude proper operator intervention.

   b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

1.08 EXTRA MATERIALS

A. Spare Parts:

1. Furnish minimum 20 percent spare parts or quantity specified, whichever is greater, for the following:
    a. Fuses: 3 of each rating.
    b. Disconnecting terminal blocks.
    c. Transient protection modules: 2 each.
    d. Analog signal splitters: 2 each.
    e. Power Supplies.
2. Spare parts:
    a. Identical and interchangeable with similar parts furnished under this section.
    b. Packed in containers suitable for long term storage.
    c. Bear labels clearly designating the contents of equipment or components for which they are intended.
3. Recommended spare parts list applicable to equipment furnished under this section. Include name of each part, component, module, or printed circuit card; item part number, manufacturer's name and address, quantity recommended, and approximate price (current at time list is prepared) of each item.

PART 2 PRODUCTS

2.01 SCADA SOFTWARE

A. Unity Pro Development software as manufactured by Schneider-Electric: http://www.schneider-electric.com/en/product-range/548-unity-pro/ with the following essential characteristics:

B. General.

1. Software:
    a. "All-in-one" software.
    b. FDT / DTM standard for field device integration.
    c. Standard objects and libraries.
    d. Customizable integrated Function Block Library (DFB).
    e. PLC simulator on PC, Built-in test and diagnostic.
    f. Animation tables, Operator Screens and Trending Tool.

g. Have an open architecture which allows for interaction with other software programs not of the same manufacturer.

h. Be easily modified and expanded.

i. Licenses allow for an unlimited number of graphic displays and operator logins.

j. Be licensed to collect plant I/O points and tags, plus 200 percent for future expansion.

k. Be a field proven, real-time system.

2. HMI/OIT software:

a. Utilize object oriented software, such that the objects will represent real world devices such as PID loops, Motors, Pumps, Valves.

b. Display critical plant status and alarms.

c. Control and monitoring functions shall normally be accomplished through the use the HMI/OIT.

d. Date display: Display date in form of "YYYY-MM-DD" on every format.

e. Time display: Display time of day in form "hours:minutes:seconds" on every format. Update time display automatically once every second.

f. Page title: Each format shall have an appropriate page title.

g. Trending:

1) Allow for multiple analog values to be displayed in x-y format.

2) Display both historical and real-time data directly on the same screen.

3) Allow for export of trending data to a file which is readily accessed from standard spreadsheet software.

3. Alarm:

a. Allow for alarm monitoring for discrete and analog inputs/outputs and communication links.

b. Color coded to the state and priority of the alarm.

c. Indicate acknowledged alarms, unacknowledged alarms, and unacknowledged alarms which have returned to normal.

2.02 INDUSTRIAL NETWORK SWITCH(S)

A. Industrial, managed Ethernet switch.

B. Physical Features:

1. Integrated Firewall.

2. Copper ports:

a. 10/100 BaseTX, RJ-45, minimum: 12.

3. Status indicators on each port.

4. Power: Redundant inputs.

5. Enclosure: Metal Enclosure.

C. Network Features:

1. Ethernet.

2. IP Routing.

3. IEEE 802.3 compliance.

4. IEEE 802.3af/at compliance.

5. Full/Half Duplex operation.

6. 100 Mbps throughput, minimum.

2.03 SCADA EQUIPMENT CABINET

A. Located in the Electrical Room at each pumping plant if available.

1. Adequate room for 180 degree opening of cabinet door.

2. No less than 3 feet by 3 feet accessibility in front of cabinet.

B. Designation: Single Door Floor-Standing.

C. NEMA 250, Type 12.

D. Size: 72 inches by 36 inches by 24 inches (H x W x D).

E. Constructed of sheet metal no lighter than 12 gauge.

F. Seams continuously welded and ground smooth; no holes or knockouts.

G. Continuous hinge on door.

H. Finish: Manufacturer’s standard coating.

I. Back panel.

J. Ventilation kit.

K. Light kit.

L. Separate UPS and battery compartment on bottom of cabinet as shown on drawing 1695-D-60097.

2.04 INDUSTRIAL NETWORK CABINET

A. Located in the SCADA Equipment Cabinet at each Pumping Plant.

B. 19 inch standard size.

C. 16U minimum or adequate to house rack-mount equipment.

D. Lockable.

E. Mesh cooling design.

F. Built-in utility outlets to plug into UPS.

2.05 DC POWER SUPPLY

A. Type:

1. Switch-mode power supply.
2. Din-Rail mountable.

B. Input Voltage: 100 to 240 VAC.

C. Output Voltage: 24 VDC plus or minus 1 percent.

D. Output Current: 5 Amps, minimum.

E. Connection Type: Screw clamp.

F. Operating Temperature Range: minus 20 degrees C to 60 degrees C.

2.06 UPS DEDICATED RECEPTACLE STRIP

A. Provide adequate receptacles for each enclosure.

B. Voltage: 120 volts, 60 Hertz.

C. Current: 20 amperes.

D. UL listed.

2.07 SCADA CABINET UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Type: Tower.

B. Minimum status display and outputs to Plant PLC:

1. On line.
2. On battery.

3. Overload.
4. Replace battery.

C. UPS trouble output to Plant PLC.

D. Input voltage: 120 volts, 60 Hertz.

E. Output voltage: 120 volts, 60 Hertz.

F. Batteries:

1. Leak-proof.
2. Hot-swappable, user replaceable.
3. Maintenance-free sealed Lead-Acid battery with suspended electrolyte.

G. Sized to provide at least 200 percent of full load current for the following equipment inside the SCADA cabinet and inside the Network Cabinet for at least 30 minutes:

1. Everything inside SCADA equipment cabinet.
2. Networking equipment.
3. Security and Surveillance System.
4. Telephone equipment.

2.08 TELEMETRY WIRE

A. Insulated conductors used to connect components external to enclosure are in accordance with Section 26 05 10 - Conductor and Cables.

1. No less than 18 AWG from terminal blocks inside cabinet enclosure.
2. No less than 16 AWG from terminal blocks to facility equipment.
3. Size telemetry wiring appropriately for equipment outside facility.

2.09 FABRICATION

A. Internal Wiring:

1. Provide wiring duct system with removable covers for performing wiring within enclosure.
2. Install with wiring duct covers accessible for removal and replacement.
3. Do not attach wiring to duct system covers.
4. Make wiring within ducts accessible for operation, maintenance, removal, and replacement.
5. Design wiring duct system with capacity to wire devices, present and future that can practicably be mounted in enclosure.

B. Wire Connections:

1. Make connections at device terminals or terminal blocks. Maximum 2 wires per termination point.
2. Install incoming 120 volt branch circuits on adjacent terminal block terminals.
3. Install ring tongue connectors for terminations at terminal blocks and electrical devices. Use pin-type terminal connectors where use of ring tongues is not practical such as terminations at selector switches, pushbuttons, indicating lamps, and auxiliary relays.
4. Do not terminate wire without terminal connector.
5. Wire splices are not acceptable.

C. Terminal Blocks:

1. Arrange terminal blocks to segregate signal types and account for spare space.
2. Arrange terminal blocks to allow external cabling to be supported.
3. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 12 inches separation minimum. Access to front of terminal blocks shall be unobstructed.
4. Machine lettered terminal numbers on terminal block marking strips. Do not use hand lettering.
5. Identify vertical columns of terminal blocks with a single letter such as “A”, “B”, or “C”. Vertical columns may contain more than 12 termination points.
6. Terminals:
    a. Binding-head or washer-head screws with serrated or grooved contact surfaces.
    b. Spring-clamp type terminal blocks are not acceptable.
7. Voltage rating: 300 Volts.
8. Current rating: 20 Amps.
9. Analog Inputs shall be of disconnecting switch type terminal blocks.

D. Cable and Wire Identification:

1. Color: White.
2. Install wire markers on conductor end.
3. Print conductor designation first followed by conductor destination and terminal number.
4. Lettering:
    a. Machine typed.
    b. Do not print wire markers by hand.

E. DIN Rail Disconnects: Provide disconnect for each 120 Volt circuit entering enclosure.

F. Fuse block and fuses:

1. Type: Finger-Safe terminal block.
2. DIN Rail mountable.
3. Fuse:
   a. Rated for size required.
   b. 250 Volts, current limiting.

G. Ground Bus:

1. Material: Copper.
2. Size: Sufficient to attach equipment ground conductors.
3. Length: Sufficient to attach equipment ground conductors plus 20 percent spare.
4. Insulated mounting bracket.

2.10 SURGE SUPPRESSION

A. 4 to 20 mA transient protection modules:

1. Triple stage hybrid protection.
2. Surge Current (8/20 microsecond wave form): 10 kA, minimum.
3. Clamping Voltage: 30 VDC.
4. Response Time: Less than 5 nanoseconds.
5. Throughput Resistance: 12 Ohms, maximum.
6. Automatically resets after each transient.

B. Line voltage surge protection device:

1. Rated Voltage: 120 volt, 60 Hertz.
2. Rated Current: 15 amperes.
3. Single-phase service.
4. Surge Current (8/20 microsecond wave form): 10 kA, minimum.
5. Clamping Voltage: 270 volts.
6. Maximum Continuous Operating VAC (MCOV): 115 percent rated line voltage.
7. Response Time: Less than 5 nanoseconds.
8. Modes of Protection: L-N, L-G, N-G.
9. Automatically resets after each transient.

C. For automation equipment in outdoor enclosures, surge suppression is required for power supply inputs and wiring leaving the enclosure, including digital I/O, analog I/O, and communication wiring.

2.11 NAMEPLATES

A. Attach nameplate to enclosure with self-tapping screws. Use of adhesives for attaching nameplates is not acceptable.

2.12 OPERATOR INTERFACE TERMINAL

A. Color TFT LCD, WVGA

B. Touch Screen, 8 Function keys.

C. Modbus TCP/IP, RS485, RS232.

D. Vijeo Designer Development Tools, Magelis OS.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's recommendations, with suitable and secure fasteners.

B. Install PLC equipment inside the SCADA Equipment Cabinet as shown on drawing 1695-D-60097.

C. Install networking, radio, telephone equipment inside the Network Cabinet in the SCADA Equipment Cabinet as shown on drawing 1695-D-60097.

D. Install OIT on SCADA Equipment Cabinet at eye level.

E. Make connections to place the control and monitoring system into operation.

F. Supply line power for control and monitoring equipment UPS system(s).

G. Provide networking cabling with designated and easily identified to-and-from location marker at each end of the cable.

H. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

I. Make grounding and bonding connections in accordance with Section 26 05 20 - Grounding and Bonding and NFPA 70.

J. Control Cable and Wire Identification: In accordance with Section 26 05 10 - Conductors and Cables and Section 27 15 00 - Communications Cabling.

K. Provide software and associated programming/configuration required to meet performance requirements in this section.

1. At substantial completion of the Project:

a. Turn current licenses for software over to the Government in the Bureau of Reclamation’s name.

b. Install the latest version, upgrade or service pack for software.

2. Provide the respective software supplier's Comprehensive Support Contract for software covering a full 1 year warranty period following substantial completion which provides no cost software upgrades, service packs and tech support from the software supplier.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

3.03 TRAINING

A. In accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

END OF SECTION

SECTION 25 00 02
PROGRAMMABLE CONTROLLER

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for SCADA System.

1.02 ABBREVIATIONS

A. PP - Pre-manufactured Pump Station.

B. WTP - Water Treatment Plant.

C. PLC - Programmable Logic Controller.

D. RTU - Remote Terminal Unit.

E. HMI - Human Machine Interface.

F. OIT - Operator Interface Terminal.

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI/ISO/IEC 9797-09	Information Technology - Security Techniques Message Authentication Codes
2.	ISO/IEC 13817-1-12	Information Technology - Programming Languages, Their Environments and System Software Interface

B. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 25 00 02-1, Approval Drawings.

1. Layout Drawings.
2. Wiring Drawings.

3. Schematic Drawings.

C. RSN 25 00 02-2, Approval Data.

1. Software overview drawings and descriptions.

2. Data flow chart.

D. RSN 25 00 02-3, Final Drawings, Documentation, and Operations and Maintenance Manuals.

1. Final drawings of approved and provided layouts, schematic diagrams, and wiring diagrams including “as-built” changes.

2. Final version of approved software documentation including “as-built” changes.

3. Final version of SCADA I/O list.

4. Operations and Maintenance Manuals.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store programmable controllers in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

1.06 PERFORMANCE REQUIREMENTS

A. Function:

1. Pipeline and Instruments Diagram (P&ID), see drawing 1695-D-60203 through 1695-D-60212.

2. Existing Reach 22A Alignment Structures:

a. Flowmeter: see drawing 1695-D-60204.

1) Analog Flowmeter.

b. Forebay Tank: see drawing 1695-D-60204.

1) Analog Level Indications.

3. Pumping Plants No. 1 and No. 2, see drawings 1695-D-60096:

a. Monitoring and/or control of pumps, manifold valves, instruments, security and surveillance system, HVAC system, and fire system of each facility.

b. Pump Startup and Shutdown Interlocks.

1) Interlock shall require configuration of manifold valves and any support equipment/systems for safe and proper Startup and Shutdown of pumps.

c. The pump control strategy.

1) Attempts to operate the Pumping Plants' pumps at their maximum efficiency by maintaining a water supply through Reach 22B alignment system.

2) Requires pump run times and/or alternate starts based on level in downstream regulating tank.

3) Based upon level in downstream regulating tank.

4. NAPI Turnout Flowmeter Vault, see drawing 1695-D-60212.

5. Regulating Tank No. 1, see drawing 1695-D-60208.

6. Regulating Tank No. 2, see drawing 1695-D-60212.

B. Remote Terminal Unit (RTU):

1. Pumping Plants No. 1 and No. 2 PLCs.

C. Programmable Logic Controllers (PLC):

1. Remote I/O:

a. NAPI Turnout.

b. Regulating Tank No. 2.

c. Air Chambers.

D. PLC Functions:

1. Remote auto and manual of pumps and butterfly valves.

2. Lockout control for pumps that will shut down the pump when running in local or remote mode.

a. Control through the local PP OIT.

b. Control through remote supervisory control (Cutter WTP Master Station).

3. Provide lockout control in accordance with low upstream tank level.

4. Calculate motor run time.

5. Calculate pump unit time between starts.

6. Provide pump control in accordance with Section 33 16 14 - Air Chambers.

7. Configuration Register defining equipment available for 2020 and 2040 flow requirements. Coordinate with COR for final equipment definitions.

E. Level and Flow Monitoring:

1. Monitor tank levels using pressure indicating transmitters.

2. PP1 monitor level in the upstream tank (Reach 22A Forebay Tank) and the downstream tank (At PP2 site - Regulating Tank No. 1).

3. PP2 monitor level in the upstream tank (At PP2 site - Regulating Tank No. 1) and the downstream tank (Regulating Tank No. 2).
4. System flow will be monitored at Reach 22A and the NAPI Turnout.
5. High and low alarms for each tank level and flow measurement.

F. Manifold Pressure Monitoring:

1. Monitor manifold pressures on plants discharge lines.
2. Monitor unit piping pressure before and after each pump. Suction pressure switch provides indication of suction valve position and pump net positive suction pressure sufficient for pump operation. Discharge pressure switch for verification of pump discharge pressure prior to opening the discharge valve.

G. Plant Facility Control:

1. Monitor fire panel.
2. Monitor security intrusion system.
3. Large alarm display on OIT screen for fire or security alarm that gets operator's attention at the Fort Defiance control room.
4. Status alarms for the UPS system(s).
5. Status alarms for SCADA equipment malfunctions.

H. Multiple Pump Start Interlock:

1. Provide software interlock with an operator adjustable time delay to ensure that only 1 pump is called to start at a time.
2. Provide an operator adjustable time delay to enable the next pump to run when start conditions have been satisfied for more than one pump.
3. Provide a user configurable interlock to determine the number of pumps allowed to run.
4. Interlock logic also Operator HMI lockout and Configuration Register inputs.

I. Pump Alternator Control:

1. Sequence control for pumps so that the operator can assign the start and stop sequence for each of the pumps.
2. If a running pump fails, or a pump fails to start when called, call next pump in the sequence.
3. Provide operator adjustable start and stop level set points to be adjusted in elevation units for both the upstream tank and downstream tank.
4. If downstream tank is below an adjustable level setpoint and the upstream tank is above an adjustable level, call next pump in the sequence to start.

5. Provide operator adjustable pump alternator to equalized run time on available pumps.

J. Pump Start Interlock:

1. Upstream tank level above low water level elevation setpoint.
2. Downstream tank level below high level elevation setpoint.
3. Plant inlet manifold pressure OK.
4. The respective Air Chamber not in Lockout.
5. One Air Chamber isolation valve is full open.
6. That Pump's manifold valves are properly configured for the starting of that pump. Differentiate the pump designated for the manifold fill pump or other unique valve positions for each pump to start.
7. Check mechanical seal water pressure OK.
8. The pump is not in Operator Lockout.
9. Configuration Register defining system equipment available for 2020 and 2040 flow requirements. Coordinate with COR for final system configuration definitions.

K. Operation Procedure:

1. Filling line, manifold or Regulating Tank No. 1 (initial), Pump 1 only:
   a. Manual control only.
2. Normal/Auto Start-up:
   a. Verify Pump Start Interlock is met.
   b. Start Pump.
   c. Soft Start bypass contactor ON.
   d. Open Pump discharge valve.
3. Normal/Auto Shutdown:
   a. Close Pump discharge valve.
   b. Stop Pump.

L. Design the software to allow maximum number of pumps to operate.

M. Develop PLC Functions to safely and properly operate equipment in final design.

N. Monitor and alarm contact inputs to support security of facility on the following locations:

1. Air Chamber entry doors.
2. Water tank hatches.

3. Equipment Vault hatches.

4. Use of balanced magnetic contact device or similar appropriate for each location. Coordinate with CO for locations, contact type and installation.

1.07 DESIGN COORDINATION MEETINGS

A. In accordance with Section 25 00 01 - System Control and Monitoring.

B. The intention of the design conferences is to determine hardware, software, or compatibility issues with the Sole Brand controllers.

PART 2 PRODUCTS

2.01 PROGRAMMABLE CONTROLLER

A. The Modicon M340 Programmable Automation Controller PAC/PLC with accessories shall meet the following requirements:

1. Din rail:

   a. Chassis.

   b. Power Supply: 24 VDC.

2. Spare I/O capacity: 20 percent.

3. Ethernet capable.

4. Remote I/O chassis' for Air Chamber Control ruggedized for outside atmospheric conditions.

2.02 INTERPOSING RELAYS

A. Type: General Purpose Relay.

B. Double-Pole, Double-Throw (DPDT).

C. Contact Rating: 10 Amps, 120 VAC/DC, minimum.

D. Coil Voltage: 24 VDC or 120 VAC, as required.

2.03 INSULATED CONDUCTORS

A. Insulated conductors used to wire the programmable controllers in accordance with Section 26 05 10 - Conductors and Cables and Section 27 15 00 - Communications Cabling.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install programmable controller in the SCADA Equipment Cabinets at 4-6 feet above the floor. See drawing 1695-D-60097 at both PP1 and PP2.

B. Install remote I/O chassis in the Flow Vault at the NAPI Turnout SCADA Equipment enclosure at a location designated by the COR.

C. Install remote I/O chassis in the Flow Vault at Regulating Tank No. 2 SCADA Equipment enclosure at a location designated by the COR.

D. In the event a remote location is without utility power, supply a solar power system to adequately power SCADA, network, communications for the location.

E. Remote vault locations with SCADA remote I/O, install dry contacts for vault lid, door, etc. as an input to the SCADA indicating the vault has been opened and alarmed as a security item on the HMI indicating vault.

F. Make connections to place the programmable controllers into operation.

G. For connections to the programmable controllers which run outside the Pre-manufactured Pump Stations, install surge suppression, including digital and analog I/O.

H. Drawing 1695-D-60097 shows a typical rack layout. Determine the final installed layout, wiring connections and schematic diagrams based on field installed equipment and design coordination meetings.

I. Power for the programmable controller shall be available from a rack mounted power supply from the uninterruptable power supply UPS.

J. Wire I/O to terminal blocks in the SCADA equipment cabinet.

K. Make wire between the SCADA equipment cabinet terminal blocks and the programmable controller’s field wiring arms with NEC type SIS No. 18 AWG switchboard wire.

L. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

M. Make grounding and bonding connections in accordance with Section 26 05 20 - Grounding and Bonding and NFPA 70.

N. Control Cable and Wire Identification: In accordance with Section 26 05 10 - Conductors and Cables.

O. Input/Output Lists:

1. Table 25 00 02A indicates I/O for the respective equipment and the SCADA system RTU and Remote I/O PLC at their respective locations on Reach 22B. The I/O List also indicates telemetry and control points on adjacent Navajo Gallup Reach 22A and the Cutter WTP/Reach 21 alignments.

2. This table indicates a minimum number of I/O expected for design build pre-fabricated facilities and their systems. Use as a guide during this design build process and will vary depending on the number and type of equipment for the final design and is not intended to supersede requirements in respective section paragraphs for all equipment.

3. "Unit X" and "UX" will contain the unit or pump number, Unit 1 through Unit 4 on both Pumping Plant No. 1 and Pumping Plant No. 2.

4. Valve type and designation 1, 2, 4, 5, and 7 are for a typical manifold-filling pump. Booster pumps will typically result in a subset of the valves listed typically valves 1 & 2. Determine final design and valve designations.

5. Telemetry device references: Located in the Description column as part of the signal name (example: PP1-TE-101-UX); TE-101 is the device reference from the Pipeline and Instruments Diagram (P&ID), see drawing 1695-D-60203 through 1695-D-60212.

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PUMPING PLANT NO. 1			
PP1 Flowmeter Vault (360)	PP1-FIT-001 Reach 22A Flow	AI	4-20 mA
PP1 Flowmeter Vault (360)	PP1-FIT-001 Reach 22A Flow Direction	DI	24 VDC
PP1 Flowmeter Vault (360)	PP1-FIT-001 Reach 22A Flow Totalizer	DI	24 VDC
PP1 Flowmeter Vault (360)	PP1 Reach 22A Vault Water Level High	DI	24 VDC
PP1 Flowmeter Vault (360)	PP1 Reach 22A Hatch Open	DI	24 VDC
PP1 Flowmeter Vault (360)	PP1-PS-001 Reach 22A Strainer Diff Pressure	DI	24 VDC
PP1 Flowmeter Vault (360)	PP1-PIT-001 Forebay Tank Level	AI	4-20 mA
RVSS Modbus I/O			
PP1: Unit X Pump	PP1-UX Start/Stop Interlock	DO	MB RTU
PP1: Unit X Pump	PP1-UX Start/Stop	DO	MB RTU
PP1: Unit X Pump	PP1-UX Seal Water Pressure OK	DI	MB RTU
PP1: Unit X Pump	PP1-UX Unit is Running	DI	MB RTU
PP1: Unit X Pump	PP1-UX RVSS Fault	DI	MB RTU

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP1: Unit X Pump	PP1-UX Lockout Soft Start	DI	MB RTU
PP1: Unit X Pump	PP1-UX Interlocks Bypassed	DI	MB RTU
PP1: Unit X Pump	PP1-UX Local/Remote Mode	DI	MB RTU
PP1: Unit X Pump	PP1-TE-101-UX Motor Windings Phase A RTD	DI	MB RTU
PP1: Unit X Pump	PP1-TE-101-UX Motor Windings Phase B RTD	DI	MB RTU
PP1: Unit X Pump	PP1-TE-101-UX Motor Windings Phase C RTD	DI	MB RTU
PP1: Unit X Pump	PP1-TE-101-UX Motor Bearing RTDs	DI	MB RTU
PP1: Unit X Pump	PP1-TE-102-UX Pump Bearing RTDs	DI	MB RTU
Valves			
PP1: Unit X Valves	PP1-ZS-101-VX.1 Full Open	DI	24 VDC
PP1: Unit X Valves	PP1-ZS-101-VX.1 Full Closed	DI	24 VDC
PP1: Unit X Pump	PP1-PS-X01 Suction Pressure OK	DI	24 VDC
PP1: Unit X Pump	PP1-PS-X02 Discharge Pressure OK	DI	24 VDC
PP1: Unit X Valves	PP1-CV-VX.2 Full Open	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Full Close	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Position	AI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Selector Switch in LOCAL	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Selector Switch in REMOTE	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Torque Switch Tripped - Open Dir	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP1: Unit X Valves	PP1-CV-VX.2 Valve Not Moving on Command	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Full Open	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Full Close	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Position	AI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Selector Switch in LOCAL	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Selector Switch in REMOTE	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Torque Switch Tripped - Open Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.4 Valve Not Moving on Command	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Full Open	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Closed	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Position	AI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Selector Switch in LOCAL	DI	MB RTU

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP1: Unit 1 Valves	PP1-CV-V1.5 Selector Switch in REMOTE	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Torque Switch Tripped - Open Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.5 Valve Not Moving on Command	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Full Open	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Closed	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Position	AI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Selector Switch in LOCAL	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Selector Switch in REMOTE	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Torque Switch Tripped - Open Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP1: Unit 1 Valves	PP1-CV-V1.7 Valve Not Moving on Command	DI	MB RTU
Air Chamber			
PP1: Air Chamber	PP1-CV-ACCV3 Air Chamber Drain Valve Open	DO	120 VAC
PP1: Air Chamber	PP1-LS-002 Air Chamber Low Level	DI	120 VAC
PP1: Air Chamber	PP1-CV-ACCV2 Air Chamber Low Level Valve Close	DO	120 VAC
PP1: Air Chamber	PP1-LS-001 Air Chamber High Level	DI	120 VAC
PP1: Air Chamber	PP1-CV-ACCV1 Air Chamber High Level Valve Close	DO	120 VAC
PPI: Air Chamber	PP1-PIT-001 Air Chamber Water Level	AI	4-20 mA
PM1: Power Monitor			
PP1: PM1-Motor Bus	PP1 MCE Bus KW	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Voltage Phase A	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Voltage Phase B	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Voltage Phase C	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Current Phase A	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Current Phase B	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Current Phase C	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Power Factor	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus Frequency	AI	MB RTU
PP1: PM1-Motor Bus	PP1 MCE Bus KWH	AI	MB RTU
PM2: Power Monitor			
PP1: PM1-Motor Bus	PP1 DPA Bus KW	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Voltage Phase A	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Voltage Phase B	AI	MB RTU

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP1: PM1-Motor Bus	PP1 DPA Bus Voltage Phase C	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Current Phase A	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Current Phase B	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Current Phase C	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Power Factor	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus Frequency	AI	MB RTU
PP1: PM1-Motor Bus	PP1 DPA Bus KWH	AI	MB RTU
Facilities			
PP1: Fire Alarm	PP1 Fire System Alarm	DI	24 VDC
PP1: Mechanical	Mechanical Seal Water Pump On	DI	24 VDC
PP1: PLC	UPS Power Trouble	DI	24 VDC
PP1: Security	Security Sys Intrusion Alarm	DI	24 VDC
PUMPING PLANT NO. 2			
PP2: Flowmeter Vault (360)	PP2-FIT-001 Reach 22A Flow	AI	4-20 mA
PP2: Flowmeter Vault (360)	PP2-FIT-001 Reach 22A Flow Direction	DI	24 VDC
PP2: Flowmeter Vault (360)	PP2-FIT-001 Reach 22A Flow Totalizer	DI	24 VDC
PP2: Flowmeter Vault (360)	PP2 Reach 22A Vault Water Level High	DI	24 VDC
PP2: Flowmeter Vault (360)	PP2 Reach 22A Hatch Open	DI	24 VDC
PP2: Flowmeter Vault (360)	PP2-PS-001 Reach 22A Strainer Diff Pressure	DI	24 VDC
PP2: Flowmeter Vault (360)	PP2-PIT-001 Forebay Tank Level	AI	4-20 mA
RVSS Modbus I/O			
PP2: Unit X Pump	PP2-UX Start/Stop Interlock	DO	MB RTU
PP2: Unit X Pump	PP2-UX Start/Stop	DO	MB RTU
PP2: Unit X Pump	PP2-UX Seal Water Pressure OK	DI	MB RTU
PP2: Unit X Pump	PP2-UX Unit is Running	DI	MB RTU
PP2: Unit X Pump	PP2-UX RVSS Fault	DI	MB RTU
PP2: Unit X Pump	PP2-UX Lockout Soft Start	DI	MB RTU
PP2: Unit X Pump	PP2-UX Interlocks Bypassed	DI	MB RTU
PP2: Unit X Pump	PP2-UX Local/Remote Mode	DI	MB RTU
PP2: Unit X Pump	PP2-TE-101-UX Motor Windings Phase A RTD	DI	MB RTU
PP2: Unit X Pump	PP2-TE-101-UX Motor Windings Phase B RTD	DI	MB RTU
PP2: Unit X Pump	PP2-TE-101-UX Motor Windings Phase C RTD	DI	MB RTU
PP2: Unit X Pump	PP2-TE-101-UX Motor Bearing RTDs	DI	MB RTU

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP2: Unit X Pump	PP2-TE-102-UX Pump Bearing RTDs	DI	MB RTU
Valves			
PP2: Unit X Valves	PP2-ZS-101-VX.1 Full Open	DI	24 VDC
PP2: Unit X Valves	PP2-ZS-101-VX.1 Full Closed	DI	24 VDC
PP2: Unit X Pump	PP2-PS-X01 Suction Pressure OK	DI	24 VDC
PP2: Unit X Pump	PP2-PS-X02 Discharge Pressure OK	DI	24 VDC
PP2: Unit X Valves	PP2-CV-VX.2 Full Open	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Full Close	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Position	AI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Selector Switch in LOCAL	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Selector Switch in REMOTE	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Torque Switch Tripped - Open Dir	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP2: Unit X Valves	PP2-CV-VX.2 Valve Not Moving on Command	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Full Open	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Full Close	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Position	AI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Selector Switch in LOCAL	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Selector Switch in REMOTE	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Torque Switch Tripped - Open Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.4 Valve Not Moving on Command	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Full Open	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Closed	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Position	AI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Selector Switch in LOCAL	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Selector Switch in REMOTE	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Torque Switch Tripped - Open Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.5 Valve Not Moving on Command	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Full Open	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Closed	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Position	AI	MB RTU

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP2: Unit 1 Valves	PP2-CV-V1.7 Selector Switch in LOCAL	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Selector Switch in REMOTE	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Torque Switch Tripped - Open Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Torque Switch Tripped - Closed Dir	DI	MB RTU
PP2: Unit 1 Valves	PP2-CV-V1.7 Valve Not Moving on Command	DI	MB RTU
Air Chamber			
PP2: Air Chamber	PP2-CV-ACCV3 Air Chamber Drain Valve Open	DO	120 VAC
PP2: Air Chamber	PP2-LS-002 Air Chamber Low Level	DI	120 VAC
PP2: Air Chamber	PP2 Air Chamber Low Level Valve Close (CV-ACCV2)	DO	120 VAC
PP2: Air Chamber	PP2-LS-001 Air Chamber High Level	DI	120 VAC
PP2: Air Chamber	PP2 Air Chamber High Level Valve Close (CV-ACCV1)	DO	120 VAC
PPI: Air Chamber	PP2-PIT-001 Air Chamber Water Level	AI	4-20 mA
PM1: Power Monitor			
PP2: PM1-Motor Bus	PP2 MCE Bus KW	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Voltage Phase A	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Voltage Phase B	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Voltage Phase C	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Current Phase A	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Current Phase B	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Current Phase C	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Power Factor	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus Frequency	AI	MB RTU
PP2: PM1-Motor Bus	PP2 MCE Bus KWH	AI	MB RTU
PM2: Power Monitor			
PP2: PM1-Motor Bus	PP2 DPA Bus KW	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Voltage Phase A	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Voltage Phase B	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Voltage Phase C	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Current Phase A	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Current Phase B	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Current Phase C	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Power Factor	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus Frequency	AI	MB RTU
PP2: PM1-Motor Bus	PP2 DPA Bus KWH	AI	MB RTU
PP2: Fire Alarm	PP2 Fire System Alarm	DI	24 VDC
PP2: Mechanical	PP2 Mechanical Seal Water Pump On	DI	24 VDC
PP2: PLC	PP2 UPS Power Trouble	DI	24 VDC

Table 25 00 02A - Input/Output List

Location	Description	Type	Signal
PP2: Security	PP2 Security Sys Intrusion Alarm	DI	24 VDC
PP2: Regulating Tank No. 1A	PP2 Regulating Tank 1A Level	AI	4-20 mA
PP2: Regulating Tank No. 1A	PP2 Regulating Tank 1A Vault Open	DI	24 VDC
PP2: Regulating Tank No. 1B	PP2 Regulating Tank 1B Level (Future)	AI	4-20 mA
PP2: Regulating Tank No. 1B	PP2 Regulating Tank 1B Vault Open (Future)	DI	24 VDC
NAPI TURNOUT (REMOTE SITE)			
NAPI Turnout	NAPI-FIT-001 Flow	AI	4-20 mA
NAPI Turnout	NAPI-FIT-001 Flow Direction	DI	24 VDC
NAPI Turnout	NAPI-FIT-001 Flow Totalizer	DI	24 VDC
NAPI Turnout	NAPI Turnout Solar Low Voltage	DI	24 VDC
NAPI Turnout	NAPI Turnout Solar Load Shed	DI	24 VDC
REGULATING TANK NO. 2 (REMOTE SITE)			
Regulating Tank No. 2	Regulating Tank 2 Level	AI	4-20 mA
Regulating Tank No. 2	Regulating Tank 2 Vault Open	DI	24 VDC
Regulating Tank No. 2	Regulation Tank 2 Solar Low Voltage	DI	24 VDC
Regulating Tank No. 2	Regulation Tank 2 Solar Load Shed	DI	24 VDC

3.02 CONTRACTOR FIELD QUALITY CONTROL

A. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

3.03 TRAINING

A. Perform system training in accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

END OF SECTION

SECTION 25 08 10

AUTOMATION SYSTEM TESTING, ACCEPTANCE, AND TRAINING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for SCADA System.

1.02 DEFINITIONS

A. FAT: Factory Acceptance Test.

B. SPAT: System Performance Availability Test.

C. OAT: On-Site Availability Test.

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-12 National Electric Safety Code (NESC)

B. International Electrical Testing Association (NETA)

1. NETA ETT-10 Certification of Electrical Testing Personnel

C. National Fire Protection Association (NFPA)

1. NFPA 70-15 National Electrical Code (NEC)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 25 08 10-1, FAT Procedure and Start Date.

C. RSN 25 08 10-2, FAT Test Report:

1. Certification of performance and results of the FAT.

D. RSN 25 08 10-3, SPAT Procedure and Start Date.

E. RSN 25 08 10-4, SPAT Test Report.

1. Certification of performance and results of the SPAT.

F. RSN 25 08 10-5, OAT Procedure and Start Date.

G. RSN 25 08 10-6, OAT Report.

1. Certification of performance and results of the OAT.

H. RSN 25 08 10-7, Training Plan.

PART 2 PRODUCTS

2.01 SCADA SYSTEM

A. See Section 25 00 01 - Control and Monitoring.

2.02 FACTORY ACCEPTANCE TEST (FAT)

A. The purpose of the FAT is to demonstrate the functionality, performance and stability of the hardware and software.

B. Prior to FAT, burn in the equipment for a minimum of 72 hours at 120 degrees F. Provide certification of this prior to starting the FAT.

C. Government will witness test. Notify COR in writing at least 20 days prior to the beginning of the FAT.

D. Verify that hardware and software meet specifications and drawings requirements.

E. Do not ship control and monitoring system equipment until receipt of written authorization by COR.

F. Government will provide written acceptance after the FAT to proceed to the SPAT.

PART 3 EXECUTION

3.01 SYSTEM PERFORMANCE AVAILABILITY TEST (SPAT)

A. The purpose of the SPAT is to demonstrate the functionality, performance and stability of the hardware and software before proceeding to the OAT.

B. Government will witness test. Notify COR in writing at least 20 days prior to the beginning of the SPAT.

C. Government will provide written acceptance after the SPAT to proceed to the OAT.

3.02 ON-SITE AVAILABILITY (OAT)

A. The system shall undergo a 30 day on-site availability test under full plant process operation, without a single non-field repairable hardware/software malfunction.

B. Government will furnish a discrepancy list 20 days after satisfactory completion of the OAT.

C. Resolve discrepancy, deliver documentation and complete other contract requirements associated with the control and monitoring system.

D. Government will provide final acceptance.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. In accordance with Section 26 05 90 - Wiring Checkout and Tests.

3.04 TRAINING

A. Topics:

1. Operations: Personnel responsible for maintaining the HMI/SCADA system and for daily plant operations and maintaining controller hardware and instrumentation systems.

B. Operator training:

1. Goal: Upon completion of operator training, operator is capable of operating monitoring, annunciation, and control systems.
2. Cover HMI, Alarm and Events, and PLC programming software.
3. Hands-on training:
    a. Location: Pre-manufactured Pump Stations No. 1 and No. 2.
    b. Sessions: 2, minimum.
        1) Following SPAT and prior to OAT.
            a) At a mutually agreed upon date.
            b) Duration: At least 1 work days.
        2) Following OAT.
            a) At a mutually agreed upon date.
            b) Duration: At least 4 hours.
        3) Number of attendees: 8.

END OF SECTION

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SECTION 26 05 02
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Complete Electrical System:

1. Payment: For the lump sum price offered in the Price Schedule. Includes:
    a. Performing required design.
    b. Furnishing recently certified calibrated testing equipment.
    c. Performing testing.
    d. Transporting and storing equipment and materials.
    e. Modifying and relocating equipment.
    f. Assembling, adjusting, and installing equipment.
    g. Coating equipment and materials.
    h. Brackets, fasteners, bolts, nuts, lock washers, and other accessories required for mounting or installing electrical equipment and materials.
    i. Drilling holes in steel structures (other than tubular structures) as required for mounting or installing electrical equipment and materials.
    j. Furnishing, handling, and storing spare parts for electrical equipment.
    k. Furnishing special tools and appliances for maintenance and adjustment of equipment.
    l. Making electrical connections; furnishing miscellaneous materials, which are required for making the connections to electrical equipment.
        1) Estimate the number of connections to be made to the equipment based on prior knowledge or experience with similar equipment.
        2) No additional compensation will be allowed in the event that actual connections exceed the number estimated at the time of bidding.
    m. Performing wiring checkout and tests.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A123/A123M-15	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2.	ASTM A153/A153M-09	Zinc Coatings (Hot-Dip) on Iron and Steel Hardware

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-12	National Electric Safety Code (NESC)

C. National Electrical Installation Standards (NEIS)

1.	NECA 1-15	Good Workmanship in Electrical Contracting

D. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

1.03 EXTRA MATERIALS

A. Provide to Government special tools and equipment necessary to properly install, adjust, test, and check operation of electrical equipment. Furnish additional tools and equipment to properly install, adjust, and check the operation of electrical equipment.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Conform to NFPA 70 and IEEE C2.

B. Furnish electrical materials and equipment.

C. Galvanize mounting brackets, bolts, nuts, and washers for major items of electrical equipment such as the outdoor unit substations and the motor control centers in accordance with ASTM A123 and ASTM A153.

D. Provide galvanized steel or non-corrosive metal for mounting bolts, nuts, and washers for minor items of electrical equipment and lighter weight items. Do not use cadmium-plated mounting hardware.

E. Change designs as required where Contractor-furnished electrical equipment and materials differ in size, type, ratings, or other physical properties from designs in these specifications. CO will approve changes at Contractor's expense, unless Contractor can demonstrate that changes are necessary regardless of manufacturer.

F. Provide special tools and appliances furnished by manufacturer for maintenance and adjustment of manufacturer's electrical equipment.

G. Use test equipment that has been calibrated within 365 days of its use with the calibration sticker clearly visible.

H. Deliver spare parts required by this section to Government after completion of contract.

2.02 SOURCE QUALITY ASSURANCE

A. Government will inspect the outdoor switchgear and motor control equipment at supplier's manufacturing plant during fabrication and testing. However, final acceptance will not be made until the equipment has been installed and is operational.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, assemble, and adjust equipment in accordance with this subparagraph. These specifications requirements are based on the premise that no conflict exists between the specified design, the standards, and the codes. However, in the event a conflict is discovered, inform the COR of the conflict.

1. In the event of conflicting requirements, establish precedence by the following order:

   a. This section or as directed by the COR.

   b. The drawings included in this section.

   c. The latest edition of "National Electric Code" of the National Fire Protection Association for electrical wiring apparatus and the adopted electrical code of the State in which the construction is located. Cooperate with any agency designated by that State to inspect the electrical installation for conformance with the applicable State code.

B. Do not install electrical equipment until approval drawings and data for associated equipment have been approved by Government.

C. Electrical Installations, Assembly Operations, and Adjustments: Comply with NFPA 70, IEEE C2, and NECA 1.

D. Make electrical installations complete and ready for service.

E. Install electrical equipment in accordance with directions furnished by manufacturer's instruction books.

F. Make electrical wire, cable, conduit and grounding connections and furnish miscellaneous materials which are required for making these connections to equipment.

G. Install items of electrical equipment that are required to be in a lineup so appearance is uniform, including height, depth, color, and general construction.

H. Tighten nuts used in electrical equipment assembly with torque wrenches to torque values recommended by equipment manufacturers.

I. Drill holes in bolted steel structures and provide fastenings required for mounting or installing electrical equipment and materials.

J. Do not drill holes in tubular steel structures. Fasten to tubular steel structures by means of properly drilled and tapped pads or brackets welded to tubular members.

K. Installation of Electrical Equipment includes:

1. Leveling and grouting channel bases.
2. Drilling holes, furnishing hardware, and assembling components to each other.
3. Furnishing materials for and making connections correctly in accordance with final wiring diagrams.
4. Tagging wires and cables at each end.
5. Correcting errors made by the Contractor in the installation at no expense to the Government.
6. Wiring and checkout of equipment in accordance with Section 26 05 90 - Wiring Checkout and Tests.

L. Set electrical equipment installed on concrete foundations on channel bases and grout in place to provide full and even bearing.

3.02 REPAIR

A. Repair or replace damaged devices and repair damaged painted surfaces of equipment to match original finish.

B. Correct by repair or replacement, at the Contractor's expense, damage to or failure of part of the items of material and equipment which in the opinion of the COR was caused by faulty installation, faulty mechanical assembly, or mishandling.

3.03 FIELD QUALITY ASSURANCE

A. Government will inspect the outdoor switchgear and motor control equipment during construction. Acceptance of equipment will be made after equipment is operational.

END OF SECTION

SECTION 26 05 10
CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Complete Electrical System.

1.02 DEFINITIONS

A. Cable: Cable, cables, wire, or wires of one or more insulated conductors.

B. Power Cable: For power loads including motors; alternating-current distribution circuits; heating, ventilating, and air-conditioning and lighting circuits; and cable that is used for controlling heating, ventilating, air-conditioning, and lighting equipment.

C. Building Premises Wire: For connection of separately-housed components such as wiring devices and luminaire circuits to branch circuit breakers and to one another.

D. Multi-conductor Control Cable: For control, metering, indication, annunciation, and relaying circuits; and circuits not identified as power circuits.

E. Instrumentation Cable: For RTD, transducer output circuits, and MODBUS RTU.

F. Life Safety Cable: For fire protection system devices providing detection, notification, and suppression.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B8-11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA WC 57-14	Control, Thermocouple Extension, and Instrumentation Cables
2.	NEMA WC 70-09	Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy

C. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)

D. Underwriters Laboratories (UL)

1. UL 486B-13 Wire Connectors

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 05 10-1, Approval Data:

1. Manufacturer's catalog data.

C. RSN 26 05 10-2, Field Test Reports.

1.05 DESIGN REQUIREMENTS

A. Determine conductor sizes, except where shown or specified, in accordance with NFPA 70. In the event of conflict between design requirements and NFPA 70, the more stringent requirement applies.

PART 2 PRODUCTS

2.01 CABLE, GENERAL

A. Manufactured no more than 24 months prior to Notice to Proceed.

B. Round shape.

C. Conductors:

1. Copper in accordance with ASTM B8, class B or C.
2. Stranded conductors, except for solid conductor building premises wire.

D. AWG or kcmil designation.

2.02 POWER CABLE

A. Type:

1. Single-conductor or multi-conductor, non-shielded type.
2. Labeled type TC when installed in cable tray.

B. Size: No. 12 AWG, minimum.

C. 600 volt rated insulation unless specified otherwise.

D. Color Coding:

1. Power Cable Phase Conductors and Building Premises Wire:

a. 120/240, single-phase: Black, Red.

b. 120/208 or 240 volt 3 phase: Black, red, blue. Colored phase tape may be used in lieu of colored insulation.

c. 277/480 volt, 3 phase: Black with brown, orange, yellow phase tape.

2. Neutral (Grounded) Conductors:

a. 6 AWG and smaller: White insulation.

b. Larger than 6 AWG: White insulation or White tape at both ends and visible points including junction boxes.

3. Equipment Grounding Conductors:

a. 6 AWG and smaller: Green insulation or green with one or more yellow stripes.

b. Larger than 6 AWG: Green tape at both ends and visible points including junction boxes.

4. Where tape is allowed, do not use random wire on hand.

a. Obtain proper color coded wire needed for the various installations.

E. If proper color coded wire is not available, furnish written proof to COR that proper colors were not available.Suitable for:

1. Installation in raceways.

2. Installation in cable trays when required by specifications.

F. Insulation Type:

1. Single- or multi-conductor cable: THHN/THWN or XHHW.

G. Multi-conductor Overall Jacket:

1. Type: PVC (Polyvinyl chloride) or better, flame-retardant.

H. In accordance with NEMA WC 70. Cable UL listed and labeled.

I. Provide multi-conductor power cable with integral ground conductor. Size ground conductor in accordance with NFPA 70.

2.03 MULTICONDUCTOR CONTROL CABLE

A. Type:

1. Non-shielded type.
2. Labeled type TC when installed in cable tray.

B. Size: No. 16 AWG, minimum

C. 600 volt rated insulation unless specified otherwise.

D. Color Coding:

1. Colored insulation or jacket compound. Do not apply color coatings to insulation or jacket surface.
2. In accordance with NEMA WC 57, Table E-2.

E. Suitable for:

1. Installation in raceways.
2. Installation in cable trays when required by specifications.

F. Insulation Type: XHHW.

G. Multi-conductor Overall Jacket:

1. Type: PVC (Polyvinyl chloride) or better, flame-retardant.
2. Jacket thickness:
   a. 16 AWG conductors: 45 mils for 12 conductor or less. 60 mils for greater than 12 conductor.
   b. 14 AWG conductors: 45 mils for 9 conductor or less. 60 mils for greater than 9 conductor.

H. In accordance with NEMA WC 57. Cable UL listed and labeled.

2.04 BUILDING PREMISES WIRE

A. Type: Single, solid conductor.

B. Size: 12 AWG or as shown.

C. 600 volt rated insulation unless specified otherwise.

D. Color Coding:

1. Phase Conductors:
   a. 120/240, single-phase: Black, Red.
   b. 120/208 or 240 volt 3 phase: Black, red, blue.
   c. 277/480 volt, 3 phase: Brown, orange, yellow.

2. Neutral (Grounded) Conductors:

a. White insulation.

E. Suitable For: Installation in raceways.

F. Insulation Type:

1. 600 volt. THHN/THWN.

G. Conform to NEMA WC 70. UL listed and labeled.

2.05 INSTRUMENTATION CABLE

A. Type: Twisted, single-pair or twisted triad shielded or multiple individual twisted shielded pairs or twisted triads with overall shield.

B. Suitable for installation in raceways and cable tray.

C. Size: 16 AWG or as shown.

D. Insulation: 300 volt, 105 degrees C, minimum.

E. Single-Pair or Triad Shield: Aluminum mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.

F. Multiple Pair or Triad Shield:

1. Pair or triad shield: Aluminum mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.

2. Cable shield: Aluminum mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.

3. Each pair or triad sequentially numbered for identification.

G. Jacket: Black PVC with ripcord.

2.06 LIFE SAFETY CABLE

A. Shielded, solid copper, polyvinylchloride (PVC) insulation and an overall flame retardant PVC jacket.

B. UL listed as Fire Power Limited Plenum (FPLP).

C. Shielded: 0.007 inch thick insulation and 0.015 inch jacket thickness minimal.

2.07 ACCESSORIES

A. Single Conductor Markers:

1. Type: Heat-shrink, machine printable sleeve.
2. Color: White with black text.
3. Text size: As large as practical but at least 7 point (0.06 inch).
4. Be 1 inch in length, minimum and have diameter suitable for installation on the intended conductor.

B. Multi-conductor Cable Tags:

1. Type: Cross-laminated polyethylene film or Nomex. Be resistant to water, oil, solvent, abrasion, and tearing.
2. Rectangular shape and have minimum dimensions of 2 by 0.5 inches.
3. Color: White with black text.
4. Text size: As large as practical but at least 16 point (0.16 inch).
5. Attach to cable with standard nylon self-locking tie wraps or cable ties.

C. Terminal Connectors for Control and Instrumentation Cable:

1. Heavy-duty, insulated, pressure-crimp-type with ring tongues. 600 volt, pressure-crimp pin type may be used where the use of ring tongue connectors is not practical.
2. Tin-plated copper.
3. Serrated inner barrel.
4. UL listed.
5. Compatible with conductor size and type of cable for which it is used.

D. Terminal connectors for building premises wire.

1. Heavy-duty, insulated, pressure-crimp-type with fork tongues.
2. Tin-plated copper.
3. Serrated inner barrel.
4. UL listed.
5. Compatible with conductor size and type of cable used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 70.

B. Do not splice single or multi-conductor cables.

C. When using cable ties, do not over tighten, to ensure tie does not cut conductor insulation or cable outer jacket. Do not use cable ties to support cables.

D. Use building premises wire for lighting circuits and 120 volt receptacles unless shown otherwise.

E. Cable Installed in Conduit:

1. Do not pull cable into conduit until they have been cleaned and are free from obstructions and sharp corners.
2. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
3. Install cable using gradual and uniform pulling stresses. Do not exceed allowable pulling tensions and sidewall pressures as recommended by cable manufacturer.
4. Install cable to prevent cuts or abrasions in insulation or protective covering and kinks in cable.
5. When a lubricant is needed as an aid to pulling, use only soapstone or other suitable lubricant that is not injurious to cable insulation.
6. When mechanical cable pulling equipment is used, use a tension meter release mechanism to ensure pulling tension remains below tensile strength of the cable.
7. Remove and replace with new cable that is damaged during installation.
8. Do not install wiring for the fire alarm system in conduits, junction boxes, or outlet boxes with conductors of other systems. Conduit shall be dedicated to the fire protection system.

F. Cable Installed in Vertical or Inclined Plane:

1. Install in locations shown. If not shown, install in accordance with NFPA 70.
2. Support with cable grips leaving slack spans between supports.
3. Clamp cable entering enclosures, junction boxes, or equipment with commercial cable clamps.

G. Grounding:

1. Provide one non-active conductor, grounded at both ends, in each multi-conductor control cable.
2. Ground shielding of instrumentation cable only to source equipment ground bus using pressure crimp type connectors with ring tongues on drain wire.

H. Wiring Methods:

1. Terminate control and instrumentation cable with terminal connectors.
2. At termination point of multi-conductor cables, form conductors into neat packs and tie with self-locking cable ties.
3. Do not combine current and potential transformer circuits in same multi-conductor cable with control circuits
4. Leave sufficient length cable ends to make connections conveniently to equipment, fixtures, and devices.

5. Provide 5 conductor cable for each three-phase current and each potential transformer circuit. Use No. 10 AWG conductors for current transformer circuits.

6. Retain sufficient length of conductors in a current transformer cable length to reach farthest terminal used to select current transformer ratios.

7. Retain spare single conductors at each end of a multi-conductor cable in a length equal to longest single conductor of multi-conductor cable.

8. Terminate spare conductors of multi-conductor cable at terminal blocks. Ground spare conductors by using wire jumpers between terminations and equipment ground bus.

3.02 CABLE AND CONDUCTOR IDENTIFICATION

A. Power Cable:

1. Identify power conductors that are service conductors, panelboard and switchboard feeders, motor control center feeders, and motor power conductors with colored insulation or colored phase tape in accordance with this section. An additional conductor marker is not required.

2. Provide a single-line marker on the load end of feeder and branch-circuit conductors that originate at panelboards, switchboards, and motor control centers. The marker to include designation of source equipment and circuit number.

B. Conductor Markers:

1. Text to be machine or computer generated. Hand written text is not acceptable.

2. Provide individual conductors of multi-conductor control cable and instrumentation cable, with conductor marker. Print conductor designation, as shown on approved schematic diagram, on first line. Print conductor destination and device terminal number on second line.

3. A single line conductor marker will be acceptable provided the conductor designation is enclosed in parenthesis followed by the conductor destination.

4. Do not heat shrink marker onto conductor. Allow marker to rotate about the conductor.

5. Provide markers for spare conductors of multi-conductor cables. The marker to include cable designation and the word “SPARE”. Numerically sequence the spare conductor markers e.g. (1CSA-CSB-SPARE1, 2CSA-CSB-SPARE2, etc.).

C. Multi-Conductor Cable Tags:

1. Tag multi-conductor cables at each end.

2. Text to be machine or computer generated. Hand written text is not acceptable.

3. Mark tags with cable designations as shown on approved wiring and interconnection diagrams. Cable designation to be a single-line of text that

includes cable number, originating equipment designation, and destination equipment designation. Develop cable designations when not shown. Examples of cable designations are:

a. 1MCA-DV1 - First cable from motor control center MCA to discharge valve No. 1).

b. 3MCB-ACP - Third cable from motor control center MCB to auxiliary control panel ACP.

4. Attach tags to cable with self-locking tie wraps or cable ties.

3.03 CONTRACTOR FIELD QUALITY CONTROL

A. Notify COR, in writing, of date, time, and cables to be tested at least 5 working days before testing. Testing dates to be mutually agreeable between Contractor and COR.

B. Perform testing after installation, but before connection to equipment.

C. Test cables in large groups to minimize number of testing sessions.

D. Perform following tests.

1. Continuity test: Test continuity of each conductor prior to performing insulation resistance test.

2. Insulation resistance tests:

a. Measure insulation resistance between each conductor and station ground with all other conductors in same cable or conduit grounded.

b. Test voltage: 1,000 volts direct current, minimum.

c. Minimum acceptable insulation resistance: R in MΩ (rated voltage in kV + 1) x 1000/length in feet.

E. Record following test data on test report for each conductor tested.

1. Date of test.

2. Name or names of Contractor's personnel who performed test.

3. Name of Government inspector who witnessed test.

4. Conductor identification.

5. Continuity.

6. Megohms between conductor and ground.

7. Total length of conductor.

F. If conductor fails continuity or insulation resistance testing, remove and replace cable and conductor.

END OF SECTION

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SECTION 26 05 13
MEDIUM-VOLTAGE POWER CABLE SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. Association of Edison Illuminating Companies (AEIC)

1.	AEIC CS8-13	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

B. ASTM International (ASTM)

1.	ASTM B8-11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 48-09	Alternating-Current Cable Terminations 2.5 kV Through 765 kV

D. National Electrical Manufacturers Association (NEMA)

1.	ICEA S-93-639 NEMA WC74-12	5-46 KV Shielded Power cable for Use in the Transmission and Distribution of Electric Energy

1.03 PERFORMANCE REQUIREMENTS

A. Provide 5/8 kilovolt cable systems.

B. Determine actual cable length and cable termination configurations.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 05 13-1, Approval Drawings and Data:

1. Manufacturer's catalog data.

C. RSN 26 05 13-2, Field Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver cable on reels which are sufficiently sturdy to withstand normal handling during shipping, hauling, and installation.

B. Seal ends of cable on reels from moisture with suitable heat-shrinkable caps and mastic compounds.

C. Do not drag cable across ground, fences, or other sharp projections during shipping or placement of cable reels at the jobsite.

PART 2 PRODUCTS

2.01 POWER CABLE

A. Type: MV-105 single-conductor shielded.

B. Ratings:

1. Rated Voltage: 5/8 kilovolts.
    a. Operating voltage: 4.16 kilovolts.
    b. Frequency: 60 hertz.
    c. Operating temperature: 105 degrees C, maximum.
    d. Insulation level: 133 percent insulation.
    e. Circuit configuration: Delta.

C. Conductor:

1. Stranded bare annealed copper in accordance with ASTM B8.
2. Size: As shown.

D. Insulation: Solid-dielectric EPR (ethylene-propylene rubber).

E. Screens:

1. Strand Screen: Extruded, semi-conducting EPR.
2. Insulation Screen: Extruded, semi-conducting EPR strand screen applied directly over the insulation.

F. Shield: 5 mil copper tape, coated, helically applied.

G. Jacket: PVC (polyvinyl chloride).

H. Suitable for conduit installation.

I. Date of Manufacture: No more than 24 months before Notice-to-Proceed.

J. Have AWG or circular mil designation.

K. Conform to ICEA S-93-639 NEMA WC74 and AEIC CS8, where applicable.

2.02 CABLE TERMINATIONS

A. Type: Kit form, heat shrinkable, suitable for outdoor use and with the cable specified. Include stress tube, ground kit, and appropriate lug.

B. Conform to IEEE 48.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations, and recognized industry practice.

B. Install cable terminations in accordance with manufacturer's instructions and recommendations.

C. Reel Procedures:

1. Remove cable from reel by turning mounted reel.
2. Do not end feed from reel.
3. Do not allow cable reel to rest upon reeled cable.
4. Inspect cable as removed from reel for visible defects.

D. Do not drag cable across ground, fences, or other sharp projections.

E. Installation in Raceways:

1. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.
2. Use lubrication in accordance with manufacturer's recommendations.
3. Pull cable by hand, or use tensiometer or release mechanism on cable pulling equipment to ensure pulling tension remains below tensile strength of cable.
4. Pull all cable in each conduit run at the same time.

F. Terminate or seal cut ends of cable immediately after cutting operation. Seal ends of cable against moisture with waterproof end caps.

G. Do not splice cables.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform testing after cable terminations have been installed, but before connections have been made to bus or apparatus.

B. Notify COR, in writing, of date, time, and cables to be tested at least 14 working days before testing. Test dates shall be mutually agreeable between the Contractor and the COR.

C. Perform Following Tests:

1. Insulation resistance.

2. D.C. high potential.

D. Insulation Resistance Test:

1. Perform test prior to D.C. high potential test.

2. Measure cable insulation resistance with megohm meter.

3. Test voltage: 2,500 volts direct current for 1 minute.

4. Reject cable if resistance is less than 25 megohms.

E. D.C. High Potential:

1. Test voltage: 35 kilovolts or not to exceed maximum recommended dc field acceptance testing value specified by the cable manufacturer.

2. Apply voltage between conductor and metallic shield with the shield and other metallic components of the cable grounded.

3. Initially applied DC voltage shall not exceed 3 times rated AC voltage of cable.

4. Test duration: 15 minutes or until current reading levels off and remains steady for at least three minutes.

5. Test failure is detected by excessive leakage current tripping the internal circuit breaker of the test equipment.

F. Record the following data on test report for each test performed and for each conductor tested:

1. Date of test.

2. Name or names of Contractor's personnel who performed test.

3. Name of Government inspector who witnessed test.

4. Conductor identification.

5. Test data for each conductor tested. Record the current magnitude at 2, 5, 10 and 15 minutes after the maximum test voltage has been reached.

6. Result of test: Pass or fail.

END OF SECTION

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SECTION 26 05 20
GROUNDING AND BONDING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B3-13	Soft or Annealed Copper Wire
2.	ASTM B8-11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3.	ASTM B228-11	Concentric-Lay-Stranded Copper-Clad Steel Conductors

B. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 81-12	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
2.	IEEE 837-02	Qualifying Permanent Connections Used in Substation Grounding
3.	IEEE C2-12	National Electrical Safety Code (NESC)

C. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

D. Underwriters Laboratories (UL)

1.	UL 467-13	Grounding and Bonding Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 05 20-1, Approval Drawings and Data:

1. Manufacturer’s catalog data.

C. RSN 26 05 20-2, Test Reports.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ground Cable:

1. Annealed bare-copper cable:
    a. ASTM B8, class B.
    b. Solid wires used in forming the copper cable: ASTM B3.
2. Copper-clad steel cable: ASTM B228.
3. Concentric stranded.
4. Sizes:
    a. As indicated on drawings.
    b. Where not shown, minimum sizes:
        1) Ground risers and electrode conductors: 4/0 AWG.
        2) Equipment grounding conductors:
            a) Major equipment: Equal to size to electrode conductors.
            b) Minor equipment: No. 4 AWG.
        3) Electrode interconnecting conductors: Equal in size to electrode conductors.

B. Ground Rods:

1. Type: Solid, copper-clad steel.
    a. Bond 0.018 inch thick layer of copper inseparably to steel core.
2. Length: 10 feet.
3. Diameter: 3/4 inch, nominal.
4. In accordance with UL 467.

2.02 ACCESSORIES

A. Cable Connectors:

1. Welded, bolted solderless or compression type.
2. Current-carrying capacity: Equal to cable with which they are used.
3. Connectors for ground cables, including fittings, lugs, bolts, nuts, and washers: Copper alloy containing not more than 4 percent zinc.

4. Bolted solderless or compression type connectors: IEEE 837.

5. Ground connectors that will be direct buried or embedded in concrete: Use exothermic process.

B. Ground Plates:

1. High-strength, high-conductivity, cast-copper alloy.

2. Four-hole type, except where indicated on drawings.

3. Suitable for concrete construction.

C. Flexible Copper Braid:

1. Flat, extra flexible, tinned, pure copper braid.

2. Unplated, seamless, pure copper ferrules formed into a rectangular shape on each end.

3. Outdoor ampacity: 400 amperes, minimum.

4. Overall length: Suitable for the application.

2.03 WELDING PROCESS

A. Use Cadweld, Thermoweld, or equivalent exothermic process.

B. Molds and Weld Metal:

1. Use fresh stock from same manufacturer.

2. Weld metal and starting material: No significant quantities of hazardous ingredients.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 70, IEEE C2, and this Section.

B. Make grounding connections in accordance with standard drawings 40-D-4334, 40-D-4335, and 40-D-4753; and as shown.

C. Use at least No. 4 AWG stranded bare copper as equipment grounding conductors.

D. Do not connect equipment grounding conductors directly to steel reinforcing bars.

E. Ground or Bond as applicable:

1. Electric motors.

2. Metal enclosures for electrical equipment.

3. Unit substations.

4. Elevated steel tanks.
5. Regulating tanks.
6. Air chambers.
7. Shielding and armor on insulated conductors.
8. Steel structural columns.
9. Pre-manufactured Pump Stations' service yard fence.
10. Metal structures located within 200 feet of power or distribution line centerlines.

F. Grounding Electrodes at Pre-manufactured Pump Stations:

1. Use steel reinforcing bar system within concrete floor as grounding electrode.
    a. Steel reinforcing bars used for electrodes:
        1) Diameter, minimum: 1/2 inch.
        2) Length, minimum: 20 feet.
        3) Concrete encasement, minimum: 2 inches thick.
2. Ground risers:
    a. Connect grounding electrodes to ground bus.
    b. Install at least 6 ground risers for connection to grounding electrodes, unless shown otherwise.
3. Ground bus:
    a. Embed in floor of structure.
    b. Connect equipment grounding conductors, grounding system risers, and building structural steel to ground bus.
4. Ground ring:
    a. Attach to ground rods to serve as grounding electrode for water storage tanks.
    b. Encircle each tank completely.
    c. Bury in direct contact with the earth.
    d. Depth: Not less than 2-1/2 feet.
    e. Conductor: At least 20 feet of No. 4/0 AWG stranded bare copper.

G. Service Yard Fence:

1. Ground service yard fence, gate posts, and gate frames.
2. Ground fence fabric on each side of a corner post or location where the fabric is not continuous.

H. Ground Electrode Interconnections:

1. Install minimum of 2 physically separate grounding electrode tie conductors as interconnections between ground electrodes of the Pre-manufactured Pump Stations' ground system, Air Chamber Buildings, and Regulating Tanks.
2. Installation depth: At least 2-1/2 feet.
3. Separation: At least 10 feet.

I. Ground Rods:

1. Drive ground rods vertically until tops of rods are within 2 inches above installation location of ground cables to which rods will be connected.
2. If solid rock is encountered within 3 feet of the subgrade, grout ground rod into 1-1/4 inch vertical hole such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.
3. If solid rock is encountered deeper than 3 feet below the subgrade, drive ground rod to refusal at approximately a 45 degree angle, then bend ground rod horizontally such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.

J. Connections:

1. Make all ground connections between equipment, miscellaneous metalwork, and ground plates whether or not such grounding connections are shown.
2. Number of grounding connections for equipment may be one, two, or more in some cases.
3. Remove paint, enamel, scale, oil, grease, or other foreign nonconductive material from point of contact on metal surfaces before making ground connections.
4. Repair damaged or removed paint or galvanizing material on metal finishes.
5. Make ground connections that are direct buried or embedded in concrete using an exothermic process and in accordance with manufacturer's instructions.
    a. In accordance with manufacturer's instructions.
    b. Inspect in accordance with pocket handbook A7D Installers and Inspectors Guide for CADWELD Electrical Connections written by ERICO Products, Inc., Cleveland, Ohio.
    c. Remove and replace rejected connections.

K. Excavate, place, and compact backfill in accordance with Section 31 23 11 - Earthwork and Section 31 23 02 - Compacting Earth Materials, respectively.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Test Resistance of Grounding System:

1. Notify COR in writing at least 5 working days in advance of time of test in order that test may be witnessed by COR.
2. Perform test no sooner than 30 days after completion of structural concrete work.
3. Measured resistance: Less than 5 ohm.
4. Use fall of potential method in accordance with section 8.2.1.5 of IEEE 81.
5. Testing device:
    a. Earth resistance tester.
        1) Heavy-duty, low-resistance type with direct-reading and direct-current ohmmeter as described in bulletin No. 25 and any one of bulletins Nos. 25J, 25J-2, and 25T, by James G. Biddle Company; the 3 point electronic Vibroground by Associated Research, Incorporated; or equal.
        2) Capable of measuring ground resistance to an accuracy of 0.5 ohms or better.
6. Test performance:
    a. Initial distance between remote current electrode (C) and grounding system under test (X): At least six times longest diagonal dimension of grounding system.
    b. Distance between electrode C and electrode X if grounding electrode system consists of one or two ground rods: At least 100 feet or as directed by COR.
    c. Beginning at electrode X, drive potential-reference electrode (P) into ground at a number of test points on a straight line between electrode X and electrode C.
    d. Distance between test points: Approximately 5 percent of actual distance between electrodes X and C.
    e. Continuously log apparent resistance readings for each test point and plot curve of resistance versus distance to ensure that the electrode C location is giving acceptable results as indicated in IEEE 81.
    f. Measure and record test points until reaching electrode C or as directed by COR. If plot of resistance vs. distance curve indicates remote current electrode is in area of influence of grounding system, increase distance between electrode C and grounding system, and measure and record a new set of test data.
    g. Allow 40 calendar days after receipt of the grounding system resistance test reports for the Government to determine the location and size of any additional grounding is required.
    h. Retest the grounding system resistance in accordance with these paragraphs if additional grounding is added.

END OF SECTION

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SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C80.1-15	Electric Rigid Steel Conduit (ERSC)
2.	ANSI/SCTE 77-10	Underground Enclosure Integrity

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-12	National Electrical Safety Code (NESC)

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FB1-14	Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing (EMT), and Cable

D. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

E. Underwriters Laboratories (UL)

1.	UL 360-13	Liquid-tight Flexible Steel Conduit

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 05 33-1, Approval Drawings and Data:

1. Manufacturer’s drawings and catalog data.

1.04 DESIGN REQUIREMENTS

A. Determine size of junction and pull boxes, fabricated sheet steel boxes, and precast hand holes in accordance with NPFA 70, unless shown otherwise.

B. Determine size of wiring trough in accordance with NFPA 70, unless shown otherwise.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Rigid Metal Conduit (RMC):

1. ANSI C80.1.
2. Factory painted red coating when required by specifications or shown.

B. Plastic Coated Rigid Steel (PCRS): Conduit conforms to ANSI C80.1, UL6, and NEMA RN-1.

C. Liquidtight Flexible Metal Conduit (LFMC):

1. Interlocked steel construction with PVC jacket.
2. Ultra-violet resistant.
3. Color: Black.
4. Conform to NFPA 70 and UL 360.
5. Fittings conform to NEMA FB1.

D. Wiring Trough:

1. Material: 16 gauge or 14 gauge galvanized steel.
2. Enclosure:
   a. NEMA Type 3R in accordance with NEMA 250.
   b. Drip shield top and no knockouts.
3. Slip-on removable cover fastened with captive screws along bottom edge and provided with provisions for padlocking.
4. Embossed mounting holes on back of enclosure.
5. Finish: Manufacturer's standard gray coating inside and outside of enclosure.

2.02 OUTLET BODIES, DEVICE BOXES, JUNCTION AND PULL BOXES

A. Outlet Bodies and Fittings:

1. Material: Cast iron or malleable iron.
2. Covers: Cast or sheet metal.

B. Cast Devices Boxes: Type FD and GRF manufactured by Cooper Crouse-Hinds; or equal, having the following essential characteristics:

1. Rectangular or round, deep-wiring device outlet boxes with threaded hub connections for rigid steel conduit.
2. Material: Iron alloy.
3. Weatherproof, raintight and dust-tight.
4. Number of gangs: As required.
5. Provide plugs for unused openings.
6. Extension rings: Iron alloy with corrosion-resistant finish.

C. Boxes for Dry Wall Construction:

1. Standard galvanized sheet steel switch and outlet boxes.
2. Switch boxes:
   a. Depth: 2-1/8 inches, minimum.
   b. Number of gangs: As required.
   c. Furnish with raised device covers (plaster rings).

D. Fabricated Sheet Steel Boxes:

1. Used as junction and pull boxes.
2. Sheet steel thickness: No. 14 United States Standard gauge, minimum.
3. Boxes installed indoors to be NEMA 250 type 12. Boxes installed outdoors to be NEMA 250 type 4.
4. Hinged cover with oil-resistant gasket.
5. Finish: Manufacturer's standard gray coating.

E. Large, Fabricated Sheet Steel, Free Standing, Type 4 Enclosures:

1. Large free standing pull box, NEMA 250, Type 4.
2. Sheet steel: 12 gauge, minimum.
3. Seams: Continuously welded and ground smooth.
4. Coating: Polyester powder coating over phosphatized surface, inside and out, ANSI 61 gray.
5. Internal mounting channels welded horizontally to sides at top, bottom, and center.
6. Stainless steel door clamps and heavy gauge continuous hinge with stainless steel pin.
7. Includes lifting eyes, document pocket, and oil resistant door gasket.

8. Size in accordance with NFPA 70 or as indicated on drawings.

2.03 PRECAST HANDHOLE

A. Type: Precast polymer concrete with open bottom and Tier 15 rating.

B. Cover:

1. Bolt down type with gasket and stainless steel bolts.
2. Have embossed logo “ELECTRIC” on the surface.
3. Have Tier level rating embossed on the surface.

C. Provide embedded pulling eyes with ratings suitable for the installation. Locate pulling eyes on wall opposite each conduit entrance.

D. Conform to test provisions of ANSI/SCTE 77.

2.04 CONDUIT FITTINGS

A. Expansion-deflection Couplings:

1. Furnish for movement in any direction.
2. Watertight, raintight, concretetight.
3. Deflection and expansion: 3/4 inch, minimum.
4. Angular misalignment: 30 degrees, minimum.

B. Watertight Conduit Hubs:

1. Myers hub manufactured by Cooper Industries, Crouse-Hinds Division, Syracuse, NY, catalog series ST-, STA- and SSTG-; catalog series HUB- and HUBG- manufactured by Appleton, Rosemont, IL; catalog series CHM- manufactured by O-Z Gedney, Rosemont, IL; or equal with the following essential characteristics:
    a. Suitable for terminating rigid steel electrical conduit through the walls of enclosures.
    b. Recessed O-ring for raintight connection.
    c. In accordance with NEMA FB1.
    d. Galvanized malleable iron.
    e. Insulated throat.

2.05 ACCESSORIES

A. Fittings required to complete electrical conduit systems. Includes, caps, connectors, couplings, unions, nipples, reducers, elbows, pipe plugs, bondnuts, and any other fittings.

B. Devices required to fasten, clamp, attach, and support conduit in place. Includes supports and clamps complete with bolts, washers, and nuts.

C. Locknuts and Bushings:

1. Locknuts: Steel. Die cast locknuts are not acceptable.

2. Bushings: Insulated and pressure cast or malleable iron. Grounding bushing to be lay-in saddle type.

D. Conduit Riser Grips:

1. Suitable to support vertical cable runs in rigid steel conduit:

2. Single weave, closed or split mesh type.

3. Mesh material: Tin-coated bronze strands.

E. Conduit Tags: Round brass or stainless steel.

F. Polyethylene Warning Tape:

1. Type: Heavy-duty polyethylene, detectable underground warning tape.

2. Width: 6 inches.

3. Color: Red.

4. Copy: Continuously imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" or equivalent wording.

5. Suitable for direct burial.

G. Thread Lubricant: Lithium, graphite, or zinc based material designed to inhibit corrosion and to lubricate metal-to-metal joints.

H. Electrical duct seal for sealing ends of raceways.

I. Protective Sealant: Water repellant, and resistant to peeling and cracking.

PART 3 EXECUTION

3.01 INSTALLATION

A. Conduit Type: As listed below unless shown otherwise.

1. RMC: Exposed conduit, unless shown otherwise.

2. PCRS: For direct buried conduit inside of the fenced Pre-manufactured Pump Stations' yards and transitions through concrete slabs.

B. Install as shown and in accordance with NFPA 70 and IEEE C2.

C. Determine routing of exposed, buried, and embedded conduit when not shown.

D. Determine exact location of embedded conduit stub-ups based on equipment being furnished.

E. Bends:

1. Make smooth, gradual bends to permit pulling insulated conductors without undue stress or damage to conductors or conduit.
2. Ensure bends are free from kinks, indentations, or flattened surfaces.
3. Make metal conduit bends onsite with radii in accordance with NFPA 70.
4. Bend conduit cold to prevent damage to protective coating.

F. When threading conduit, use cutting tools sized for the conduit being threaded (threading tools for RMC and PCRS are different sizes). Remove burrs and sharp corners at ends of metal conduit.

G. Coat male threads of rigid metal conduit joints with suitable graphite or zinc sealing material before making joints.

H. Tighten conduit joints securely to ensure electrical continuity and to prevent entrance of moisture or foreign material.

I. Install with necessary fittings and supports.

J. Make transitions between RMC and PCRS conduits with suitable fittings designed for the applications. Fittings for PCRS conduit shall also be plastic coated.

K. Tighten conduit to electrical equipment mounted on tubular metal structures securely and support rigidly in place by conduit clamps, hex head nuts, and threaded 3/8 inch stud fasteners driven by powder-actuated tools.

L. Install expansion couplings where exposed or embedded conduits cross expansion or contraction joints. Install expansion couplings and expansion-deflection couplings in accordance with manufacturer's instructions.

M. Conduit for Fire Protection System:

1. Factory painted red conduit and accessories.
2. Conduit shall be dedicated to the fire protection system. Do not install wiring for the fire alarm system in conduits, junction boxes, or outlet boxes with conductors of other systems.
3. See Section 28 31 00 - Fire Detection and Alarm for additional information.
4. Tighten conduits with strap wrench or other means which do not damage painted surfaces. Repair damaged surfaces in accordance with Section 09 96 20 - Coatings.

N. Exposed Conduit Runs:

1. Straight and parallel with each other and with centerlines of room or structure.
2. Support conduit rigidly in place and in accordance with NFPA 70. Do not weld conduit to conduit supports or structural steel.

O. Conduit Beneath Concrete Slab Floors:

1. Make 90 degree bend and extend vertically through concrete slab floor. Ensure conduit risers are vertically plumb.
2. Make adequate provisions to protect the plastic coating from physical damage during backfill operations.

P. Conduit Embedded in Concrete:

1. Conduit to be rigid steel (RMC) type.
2. Conduit not to displace more than 3 percent of the gross area of the cross-section of the slab. Calculate cross sectional area as 12 inches times slab thickness.
3. Conduit outside diameter to be no larger than 1/3 of the overall thickness of the slab in which they are embedded.
4. Conduit to be spaced at least 3 diameters or widths on center.
5. Conduit to occupy the middle third of the cross sectional depth of the slab in which they are embedded, where possible.
6. Protect ends of conduit with coupling and plug to prevent entrance of concrete, sand, or other foreign material.
7. Tie conduit from reinforcing bars or otherwise support to prevent sagging while concrete is being placed.
8. Conduit stub-ups:
    a. Minimum length above finished floor: 4 inches, not including coupling.
    b. Terminate conduit with coupling and plug until ready to connect remaining conduit sections. Replace plug with bushing or Chase-type nipple before installing insulated conductors.
    c. Approximately 1 foot of the horizontal embedded conduit and entire vertical stub-up to be plastic-coated rigid steel conduit.
9. Seal conduit boxes with rubber gasketed blank cover. Clean concrete from inside of conduit boxes immediately after forms are removed.
10. Swab conduit within 24 hours after removal of forms with clean dry rags until conduit is thoroughly cleaned and dried.
11. Terminate ends of conduit that do not terminate at boxes with couplings and pipe plugs or insulating bushings and caps.

Q. Direct-Buried Conduit:

1. Depth: 24 inches, minimum unless shown otherwise.
2. Install 2 inches of sand around conduit.
3. Install detectable warning tape 18 inches above buried conduit.
4. Backfill and compact trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

R. Liquid tight Flexible Metal Conduit:

1. Use flexible conduit for connections to equipment that is subject to vibration, where flexibility is required, or where shown.
2. Maximum length of a flexible conduit section is not to exceed 24 inches.

S. Hand Holes:

1. Install in locations shown and in accordance with manufacturer's instructions and recommendations.
2. Place a minimum of 6 inches of pea gravel or crushed rock in bottom of excavation before installing hand hole.
3. Install such that top of hand hole is at finished grade level.
4. Install Pre-manufactured Pump Station hand holes at least 2 feet, but no more than 4 feet away from side of the Pre-manufactured Pump Station.
5. Backfill and compact around hand hole in accordance with Section 31 23 10 - Earthwork and as directed by COR.

T. Conduit Terminations:

1. Make conduit terminations to indoor boxes, cabinets, and panel boards in accordance with standard drawing 104-D-254.
2. Make conduit terminations to outdoor boxes with watertight conduit hubs. Use of locknuts, bushings, or bushed nipples at outdoor conduit terminations is not acceptable.
3. Install bushings or Chase-type nipples on ends of conduit to protect insulation of insulated conductors from abrasion.
4. Install locknuts and bond nuts to provide tight ground connections between conduit and boxes, panel boards, and cabinets.
5. Make terminations of conduit beneath substation switchgear, motor control equipment, motor control centers, and floor mounted cabinets with grounding bushings. Connect grounding bushing to equipment ground bus with a 4 AWG bare-copper conductor.

6. Seal ends of conduit terminations with electrical duct seal to prevent air circulation and entrance of vermin through conduits into boxes, panel boards, or cabinets. Install duct seal to a minimum depth of 1 inch.

U. Conduit Tags:

1. Provide metal conduit tags for conduit terminations.
2. Stamp or engrave tag with conduit number as shown on "As-Built" cable and conduit schedule.
3. Permanently attach tag to conduit with wire and metal crimp-type connector.

END OF SECTION

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SECTION 26 05 90
WIRING CHECKOUT AND TESTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the Price Schedule for Complete Electrical System.

1.02 DEFINITIONS

A. Qualified Person: In accordance with Article 100 of NFPA 70.

1.03 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)

1.04 PERFORMANCE REQUIREMENTS

A. Tests:

1. Demonstrate proper interaction between equipment through cabling interconnections and verify these interconnections are accurately documented.
2. In addition to tests required by Section 26 05 10 - Conductors and Cables.

B. Furnish materials, including test instruments, required for checkout and testing.

C. Make wiring changes and drawing revisions to ensure there are no discrepancies between check prints, and internal equipment wiring and external cabling.

D. Replace defective equipment and make device setting adjustments as required for operation of electrical systems in accordance with specifications and manufacturer's instructions.

E. If required during testing, remove and replace wire connections.

F. Make wiring changes, wire tag revisions, and other repairs or revisions during the testing session when the discrepancies are discovered.

G. Perform wiring checkout and operational and functional tests in presence of the COR.

1.05 QUALIFICATIONS

A. Testing Personnel:

1. Competent and qualified person to perform wiring checkout, and operational and functional testing.
2. Have thorough knowledge of the electrical equipment, installation, and drawings.
3. Qualified to operate equipment being tested.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Notify COR in writing 10 days in advance of each testing session.

B. Provide the following at time wiring checkouts and tests are performed.

1. Two complete sets of full-size (D-size) electrical schematic and wiring diagram check prints for equipment being tested.
   a. One set to be used and maintained by the COR.
   b. One set to be maintained by Contractor and used to produce final drawings.

C. Perform wiring checkout and tests in accordance with the following.

1. Wiring checkout:
   a. Use electrical schematic and wiring diagram check prints to perform internal wiring check of equipment.
   b. Use electrical schematic and wiring diagram check prints to perform wiring check of external cabling.
   c. Perform a complete wire-by-wire, contact-by-contact, terminal-by-terminal (point-to-point) check of circuit logic.
   d. Verify agreement with approved wiring diagrams. Revise to reflect circuit logic corrections made during checkout.
   e. Verify agreement with approved schematic diagrams. Revise to reflect circuit logic corrections made during checkout.
   f. Verify contact configuration and contact numbering.
   g. Verify continuity of wiring.

h. Verify proper wire tagging at ends of conductors and cables.

i. Check conductors for insulation damage. Perform additional insulation resistance test of damaged conductors.

2. Operational and functional testing:

a. Perform after completion of wiring checkout of equipment being tested.

b. If required, adjust and calibrate protective devices in accordance with specifications, and manufacturer's instructions and recommendations.

c. Check electrical systems and controls for proper sequence of operation, correct adjustments and settings, and agreement with schematic diagram.

END OF SECTION

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SECTION 26 13 26
MEDIUM-VOLTAGE METAL-CLAD SWITCHGEAR

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C37.46-10	High Voltage (>1000V) Expulsion and Current-Limiting Power Class Fuses and Fuse Disconnecting Switches

B. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 693-05	Recommended Practice for Seismic Design of Substations
2.	IEEE C2-12	National Electric Safety Code
3.	IEEE C37.04-99(2006)	Rating Structure for AC High Voltage Circuit Breakers
4.	IEEE C37.06-09	AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
5.	IEEE C37.09-99(2007)	Test Procedure for AC High Voltage Circuit Breakers
6.	IEEE C37.20.2-99(2005)	Metal-Clad Switchgear
7.	IEEE C57.13-08	Instrument Transformers
8.	IEEE C62.11-12	Metal-Oxide Surge Arresters for Alternating Current Power Circuits

C. National Equipment Manufacturers Association (NEMA)

1.	NEMA FU1-02(2007)	Low Voltage Cartridge Fuses
2.	NEMA LA1-09	Surge Arresters

3. NEMA SG4-09 Alternating-Current High-Voltage Circuit Breakers

D. InterNational Electrical Testing Association, Inc. (NETA)

1.	NETA ATS-13	Acceptance Testing Specifications for Electrical Equipment and Systems

E. National Fire Protection Association (NFPA)

1.	NFPA 70-11	National Electrical Code (NEC)

1.03 PROJECT CONDITIONS

A. Completely assembled and installed switchgear assembly shall operate as specified without derating under following conditions:

1. Elevation: 6,700 feet.
2. Temperature range: minus 35 degrees CC to 40 degrees C.
3. Seismic qualifications: Low Qualification level in accordance with IEEE 693.
4. Wind loading: Withstand wind up to 90 miles/hour.
5. Seismic and wind forces do not occur simultaneously.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 13 26-1, Approval Drawings and Data:

1. Manufacturer's technical catalog data marked with corresponding Bill of Materials (BOM) item number.
2. Layout drawings.
3. Equipment data:
   a. Total weight of switchgear assembly and additional impact load during opening operation of breaker.
   b. Weight of removable element of circuit breaker.
   c. Circuit breaker tripping and closing currents.
   d. Description of bus bar insulation system.
4. Equipment Nameplate list.
5. Device Nameplate list.
6. BOM.
7. Schematic diagrams.

8. Time-Current Characteristic Fuse Curves. Government will determine which fuse characteristic curve rating to be used based on curves submitted.

C. RSN 26 13 26-2, Wiring Diagrams:

D. RSN 26 13 26-3, Check Prints.

E. RSN 26 13 26-4, Factory Test Reports:

1. For design tests, certificates stating equipment has passed applicable referenced design tests are acceptable in lieu of submitting actual test reports.

F. RSN 26 13 26-5, Field Test Reports.

G. RSN 26 13 26-6, Final Drawings.

H. RSN 26 13 26-7, Operation and Maintenance Instruction Book.

1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with IEEE C37.20.2.

1.06 EXTRA MATERIALS

A. Furnish special tools and accessories required for installation, normal operation, and maintenance.

B. Furnish Spare Parts:

1. Identical to and interchangeable with equipment being furnished with switchgear assembly.
2. Circuit breaker moving contact and stationary contact assembly, complete for one pole. Vacuum bottle assembly complete for one pole.
3. One spare blank terminal block marking strip for each terminal block furnished.
4. One fuse of each type and size used.
5. One indicating light assembly of each color, size, type used.

PART 2 PRODUCTS

2.01 SWITCHGEAR ASSEMBLY

A. Conform to IEEE C37.20.2.

B. Type: Outdoor, dead front, with energized parts behind grounded metal barriers.

C. Ratings:

1. Maximum voltage: 15 kV, rms.
2. Lightning impulse withstand: 95 kV, peak.
3. Continuous current: 1200 A, main bus.
4. Momentary current: Not less than close-and-latch capability of circuit breaker.
5. Short-time current: Not less than short-time withstand rating of circuit breaker.
6. Frequency: 60 hertz.

D. Construction Features:

1. Shield energized low-voltage terminals exposed by door opening with removable cover.
2. Equip high-voltage drawer or trunion-mounted devices with automatic grounding devices.
3. Determine number of switchgear sections from drawings, including required bus transition sections.
4. High-voltage cable entries: Conduits from below.
5. Low-voltage control and auxiliary power cable entry into switchgear assemblies: Conduits from below.

E. Bus: Copper.

F. Enclosures:

1. Outdoor, weatherproof, IEEE C37.20.2: Category A.
2. "Non-walk-in" type which provides front of each section with at least one inside door, or equivalent, and one outside weatherproof door.
3. Inside doors to provide access to equipment cavity and may be used for mounting control and metering devices.
4. Outside weatherproof doors:
    a. Provide access and protection to front of section.
    b. Do not mount electrical devices on outside door.
    c. Equip with top and bottom strikes, and center latch. Strikes and latch shall pull door securely against gasket and enclosure. Mechanism used to pull door against gasket and enclosure shall be adjustable.
    d. Door handle shall engage latch and strikes.
    e. Door handles shall be pad lockable.

5. Slope top of outdoor equipment away from front of enclosures.
6. Seal weatherproof doors and outdoor enclosure walls with neoprene gaskets.
7. Equip ventilation openings with filters.

2.02 CIRCUIT BREAKERS

A. Conform to IEEE C37.04, IEEE C37.06, and NEMA SG4.

B. Type:
1. Vacuum with motor-compressed spring stored-energy mechanism.
2. Three-pole, single-throw, back-connected, latch-in, removable-element type.
3. Trip Free in all positions.

C. Ratings:
1. Maximum voltage: 15 kV, rms.
2. Nominal system voltage: 4.16 kV, rms.
3. Full wave withstand (BIL): 95 kV, peak.
4. Continuous current: 1200 A, rms.
5. Short-circuit/Short time current: 20,000 A, rms.
6. Interrupting time: 83 milliseconds (5 cycles).

D. Construction Features and Accessories:
1. Locate manual closer and opener on front panel of removable element.
2. Closing Speed of Contacts: Independent of control voltage and operator.
3. Visual indications:
   a. On front of breaker panel.
   b. Circuit breaker contact position.
   c. Spring charge condition.
   d. Operation counter.
4. Mechanical interlocks to prevent insertion or removal of circuit breaker removable elements while circuit breaker is in closed position.
5. Mechanical interlocks to prevent circuit breaker from closing unless primary disconnecting devices are in fully closed contact.
6. Internal wiring shall be NEC Type SIS, size 14 AWG min., and terminators shall be insulated ring-tongue type utilizing lock washers.

7. Self-coupling, separable, adjustable ground plate.
8. Mechanism Operated Contact (MOC) switch interface shall completely close and latch breaker contacts without stalling and with no harm to the MOC switch.

E. Control and Operational Features:

1. Closing and tripping power: 120 Vac.
2. Stored energy mechanism motor operator power: 120 Vac.
3. Capacitive trip device.
4. Breaker closing will normally be by operator pendant-connected control switch operation.
5. Manual close and trip for emergency operation, test, and withdrawn positions.
6. During closing operation, stored energy springs shall be automatically charged for tripping.
7. Provide manual charging of stored energy mechanism for use during power outages or testing.
8. Auxiliary switches with not less than 5 spare "a" contacts and 5 spare "b" contacts.
9. Local operation of circuit breaker from control circuit while breaker is in test position.
10. Initiate breaker tripping by operator control switch or protective relays.
11. Latch breaker closed so loss of station power or control power does not cause breaker tripping.
12. Removal of breaker element shall automatically trip breaker and release springs.
13. In installed breaker position, stored-energy mechanism shall automatically charge following a trip operation.

2.03 CURRENT TRANSFORMERS

A. Conform to IEEE C57.13, IEEE C37.04, and NEMA SG4.

B. Bushing or window type.

C. Multi-ratio. Ratios as indicated on drawings.

D. Accuracy Class: As indicated on drawings.

2.04 SURGE ARRESTERS

A. Conform to IEEE C62.11 and NEMA LA1.

B. Type: Metal-oxide.

C. Construction: Polymer housing.

D. Station class.

E. Protective characteristics as specified in Table 26 13 26A - Surge Arrester Protective Characteristics.

Table 26 13 26A - Surge Arrester Protective Characteristics

TOV, 1 sec.	MCOV, kV rms; not less than:	Maximum Equivalent Front-of - Wave, kV crest	Maximum Discharge Voltage, kV crest Using 8/20 Current Wave @			Maximum Switching Surge, kV crest
			5kA	20kA	40kA	
5.2 kV	4.4 kV	23.9 kV	TBD	TBD	TBD	13.5 kV

2.05 POTENTIAL TRANSFORMERS

A. In accordance with IEEE C57.13, C37.04, and NEMA SG4.

B. Ratings and Connection: As shown on drawings.

C. Drawout type.

D. Fuse:

1. In accordance with ANSI C37.46.
2. Current-limiting type.
3. Sized by PT manufacturer.
4. Interrupting rating: TBD (rms, symmetrical).

2.06 PROTECTIVE RELAYS

A. Provide on each feeder and utility source.

B. BE1-11f Feeder Protective Relay as manufactured by Basler Electric Company, Highland, IL; or equal, having following essential characteristics:

1. Multifunction, digital relay that monitors 3 phase, alternating-current and voltage.
2. Output relays: Trip relay, alarm relay. Output relays to be programmable.
3. Self-diagnostics failure function: Continually monitor its own functions and trip or alarm in case of failure.
4. Protective functions:
    a. Phase instantaneous overcurrent (50).
    b. Phase inverse time overcurrent (51).
    c. Under/Overvoltage Protection (27/59).
    d. Modbus RTU.
    e. 120 Vac Control Input.
    f. 5-ampere current Input.
    g. 120 Vac Voltage Input.
    h. Programmable for Maintenance Switch use.
    i. Furnish Maintenance Switch circuit for each feeder breaker overcurrent circuit.

2.07 ACCESSORY DEVICES

A. Compatible with associated electrical, mechanical, and thermal ratings of circuit breakers.

B. Provide device to permit removing and handling breaker element by one person.

C. UL listed, where applicable.

D. Suitable length of control cable, with plug and receptacle, to permit test of removable breaker element while in withdrawn position, from control circuit.

E. Control Switches:

1. Pistol-grip handle switches:
    a. 600 volts alternating current or direct current.
    b. 20 amperes continuous current.
2. Contacts: Silver plated and of self-wiping action type.

F. Hand Held Pendant Pushbutton Station:

1. OPEN and CLOSE pushbuttons.
2. Minimum 25 foot umbilical cord.

G. Remote Racking Device:

1. Allows for open/close operation and in/out racking at a safe distance.
2. Torque switch mechanism to stop racking motor.
3. Powered by plug connection to 120 Vac receptacle.
4. Hand held pendant racking control station.
    a. Minimum 25 foot umbilical cord.
    b. Open, Close, In, Out pushbuttons. Enable pushbutton for two-hand operation.
    c. Permissive circuit provisions.

H. Engraved Nameplates and Warning Signs:

1. Signs, size, engraving, and material: As indicated on standard drawing 40-D-6234.
2. Provide nameplates and warning signs for following:
    a. Overall switchgear assembly: Manufacturer’s nameplate.
        1) Place manufacturer's name, trademark, or other descriptive marking on all electrical equipment.
        2) Provide other markings: Voltage, current, wattage, or other ratings as specified.
    b. Each section of switchgear assembly: Designations as indicated on drawings or as follows:
        1) Mount nameplates for each device on a door.
        2) Nameplates for each device mounted within switchgear enclosure. In lieu of furnishing nameplates, Contractor may fulfill this requirement by identifying each device with device name or standard NEMA designation by a typed or computer generated permanent marking on or adjacent to device.
        3) High-voltage compartment. - Warning sign mounted on access door or barrier to each high-voltage compartment. Sign shall carry notation "DANGER - High-voltage compartment".
3. No hand lettering.

I. Enclosure Wire:

1. NEC type SIS wire.
2. No. 14 AWG copper conductor minimum with the current transformer wiring No. 10 AWG minimum.
3. Class K stranded.
4. 600 volts.

J. Fuses and Fuseholders:

1. Voltage rating: 600 volts.
2. UL listed.
3. Fuses:
    a. In accordance with NEMA FU1.
    b. Current-limiting type.
    c. Determine current ratings.
    d. Suitable for 'finger-safe' type fuse holders.
4. Fuseholders:
    a. Modular 'finger-safe' type.
    b. Current rating: Not less than fuse size.
    c. Furnish with nameplate identifying protected circuit.
    d. Mount in easily accessible location within control cabinet.

K. Space Heaters:

1. Provide as necessary to prevent condensation.
2. Suitable for 120 Vac service.
3. Thermostatically controlled and be adjustable.
4. Provide with protective covers.

L. Terminal Blocks:

1. Rated 600 volts, 30 amperes.
2. Molded-block type to accommodate ring lugs one half of an inch wide (outer diameter) at terminal screws.
3. Furnish with binding-head or washer-head screws having serrated or grooved contact surfaces or lockwashers.
4. Molded insulating barriers between terminals.
5. Shorting-type for current transformer wiring.

6. Removable covers and marking strips.
7. Provide 20 percent spare terminals on each terminal block for connections to external circuits.
8. Provide marking strips with conductor designations typed or computer generated. No hand lettering.

M. Terminal Connectors:

1. Pressure-crimp-type ring connectors:
   a. Tin-plated copper, serrated inner barrel.
2. Pressure-crimp-type pin connectors:
   a. Tin-platted copper.
   b. For use only on device terminals not suitable for ring connectors.
3. Insulation: 600 volts, nylon or vinyl.

N. Wire Markers:

1. Type: Self-laminating-vinyl or heat-shrink.
2. Color: White.
3. Lettering: Machine. Do not print wire markers by hand.

2.08 FABRICATION

A. General:

1. Completely wire switchgear. Tag cables going between switchgear sections.
2. Twist hinge wiring around axis of wire instead of bending laterally.
3. Firmly clamp wiring on hinged panels near hinged side of panels and terminate on adjacent blocks on stationary part of switchgear.
4. Equip switchgear with wiring to terminal blocks for connection to control and relaying circuits.
5. Coordinate location of openings for conduits from below.
6. Mount relays so vibration caused by door closing or breaker operation will not cause false operation.

B. Protective Relay:

1. Panel-mount on the internal door of the applicable switchgear section.
2. Wire to instrument transformers through relay test switches.

C. Ground Bus:

1. Install ground bus in accordance with IEEE C37.20.2. Electrically bond to enclosure.
2. Ground bus shall be accessible from front of cubicle.
3. Provide lugs or terminals on ground bus suitable for connection to ground system with No. 4 AWG bare copper conductors.

D. Terminal Blocks:

1. Arrange terminal blocks to allow external cabling to be supported and to allow easy connection of incoming and outgoing cables.
2. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 6 inches separation minimum. Access to front of terminal blocks shall be unobstructed.
3. Provide 1 spare 12-terminal block per breaker section.
4. Machine letter designations on terminal block marking strips. Do not use hand lettering.
5. Identify vertical columns of terminal blocks with a single letter such as "A", "B", "C". Vertical columns may contain more than 12 termination points.
6. Terminate current transformer secondary wiring on short-circuiting type terminal blocks.

E. Wiring And Wiring Connections:

1. Make all connections at device terminals or terminal blocks. Maximum two wires at terminations. Wire splices are not acceptable.
2. Support and secure wire bundles with cable tie mounting bases. Secure cable tie mounting base with two No. 8 screws. Mounting cable tie bases with only adhesive will not be allowed.
3. Install ring tongue pressure-crimp-type connectors for terminations at terminal blocks and electrical devices.
4. Do not terminate wire without terminal connector.

F. Wire Markers:

1. Install wire markers on conductor end.
2. Print conductor designation on first line.
3. Print conductor destination and terminal number on second line.

G. Nameplates:

1. Attach nameplates with pan head self-tapping screws. Do not use adhesives to attach nameplates.

2.09 FINISH

A. Switchgear Assembly: In accordance with IEEE C37.20.2 and utilizing manufacturer's standard methods and materials for complying with IEEE, except as follows:

1. Interior: Manufacturer's standard 'white' finish.
2. Materials for paint system: Must be certified 'lead- and chromate-free', including painting systems and equipment.

B. Metal-clad Circuit Breaker: Manufacturer's standard finish.

2.10 CONTRACTOR SOURCE QUALITY TESTING

A. Inspection and Witnessing:

1. Government may, at its option inspect equipment and witness factory tests.
2. Notify COR, in writing, at least 14 days in advance of factory testing.

B. Circuit Breaker:

1. Factory Tests:
   a. Design tests in accordance with IEEE C37.09 on a circuit breaker of same type, style, and model furnished.
   b. Production tests in accordance with IEEE C37.09.

C. Switchgear Lineup(s):

1. Factory Tests: Production tests in accordance with IEEE C37.20.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with applicable requirements of IEEE C37.20.2, IEEE C2, NFPA 70, and this section.

B. As indicated on drawings.

C. Install Switchgear on a Galvanized Steel Channel Base:

1. Make channel base continuous around perimeter of equipment in accordance with drawings.

2. Provide channel base with holes for grout and anchors in accordance with drawings.
3. Set and level channel base on floor. Do not use shims to level the channel base.
4. Bolt and grout channel base in place in accordance with Section 03 63 00 - Epoxy Grout.
5. Bolt switchgear equipment in place on channel base after grout has cured.
6. Furnish anchoring, supporting, and mounting materials required to install equipment.

D. Ground and bond switchgear to building ground system in accordance with Section 26 05 20 - Grounding and Bonding.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Wiring checkout in accordance with Section 26 05 90 - Wiring Checkout and Tests.

B. Field acceptance testing in accordance with NETA ATS and IEEE C37.20.2.

END OF SECTION

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SECTION 26 22 12
DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 22 12-1, Approval Data:

1. Manufacturer's technical data.
2. Equipment layout drawings.
3. Nameplate drawing.

C. RSN 26 22 12-2, Operation and Maintenance Instruction Book.

1.04 REGULATORY REQUIREMENTS

A. Be UL listed and beat the UL label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 MEDIUM VOLTAGE DRY-TYPE TRANSFORMER

A. Type: General purpose, self-cooled, dry-type.

B. Enclosure: Ventilated, drip-proof. Fabricated of heavy gauge, sheet steel construction.

C. Completed coil and core bolted to enclosure base but isolated by means of rubber vibration-absorbing mounts.

D. Provide electrostatic shield for attenuation of voltage spikes, line noise, and transients.

E. Winding Conductors: Copper.

F. Insulation: A 220 degree C system.

G. Winding Temperature Rise: 150 degrees C above a 40 degrees C ambient.

H. Primary Voltage: 4160 volts, 3 phase, 60 hertz.

I. Secondary Voltage: 480Y/277 volts, 3 phase, 60 hertz.

J. kVA Rating: As shown on drawings.

K. Primary Taps: Four 2.50 percent full-capacity below rated voltage and two 2.50 percent full capacity above rated voltage.

L. Mounting: Floor.

2.02 LOW VOLTAGE DRY-TYPE TRANSFORMER

A. Type: General purpose, self-cooled, dry-type.

B. Enclosure: Ventilated, NEMA Type 2 drip-proof. Fabricated of heavy gauge, sheet steel construction.

C. Completed coil and core bolted to enclosure base but isolated by means of rubber vibration-absorbing mounts.

D. Provide electrostatic shield for attenuation of voltage spikes, line noise, and transients.

E. Winding Conductors: Copper.

F. Insulation: A 220 degree C system.

G. Winding Temperature Rise: 150 degrees C above a 40 degrees C ambient.

H. Primary Voltage: 480 volts, 3 phase, 60 hertz.

I. Secondary Voltage: 208Y/120 volts, 3 phase, 60 hertz.

J. kVA Rating: As shown on drawings.

K. Primary Taps: Four 2.50 percent full-capacity below rated voltage and two 2.50 percent full capacity above rated voltage.

L. Mounting: Floor.

2.03 NAMEPLATES

A. Material: Type A as described on standard drawing 40-D-6234.

B. Provide nameplate for each transformer.

2.04 FINISHES

A. Manufacturer's standard gray finish for intended installation location.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Transformers on Galvanized Steel Channel Bases:

1. Make channel base continuous around perimeter of equipment in accordance with drawings.
2. Provide channel base with holes for grout and anchors in accordance with drawings.
3. Set and level channel base on floor. Do not use shims to level the channel base.
4. Bolt and grout channel base in place in accordance with Section 03 63 00 - Epoxy Grout.
5. Bolt motor control equipment in place on channel base after grout has cured.
6. Furnish anchoring, supporting, and mounting materials required to install equipment.

B. Install in accordance with manufacturer's instructions and recommendations.

C. Minimum separation of at least 12 inches from combustible materials,

D. Make conduit and wiring connections.

E. Transformer is a separately derived alternating-current system as defined in NFPA 70. Ground and bond transformers in accordance with NFPA 70 and as shown.

F. Provide require safety labels.

G. Provide engraved nameplate on transformer.

3.02 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 41
DISTRIBUTION PANELBOARDS

PART 1 GENERAL

1.01 MEASUREMENT AN D PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA PB1-11	Panelboards

B. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

C. Underwriters Laboratories (UL)

1.	UL 67-09	Panelboards
2.	UL 489-13	Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 24 41-1, Approval Data:

1. Manufacturer’s Technical Data.

C. RSN 26 24 41-2, Approval Layouts:

1. Equipment Layout Drawing.

D. RSN 26 24 41-3, Test Data.

1.04 REGULATORY REQUIREMENTS

A. UL listed and labeled.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

A. Voltage and System: 208/120 volts, 3 phase, 4 wire, 60 hertz.

B. Input Type:

1. Panelboard DCB: Main Circuit Breaker (MCB): As shown.

C. Main Bus Rating: 225 amperes, minimum.

D. Enclosure Type 12: In accordance with NEMA 250 with hinged door.

E. Solid copper neutral bus.

F. Bus Material: Copper.

G. Mounting: Surface-mounted.

H. Accessories:

1. Ground bus:
    a. Copper.
    b. Sufficient length for attaching equipment ground conductors.
2. Circuit directory:
    a. Show breaker number and connected load as shown on drawings.
    b. Provide panelboard schedule on drawings unless as-built conditions require directory to be revised.
    c. Use computer generated lettering in capital letter for directory entries.
    d. Directory to provide the following information:
        1) Panel name.
        2) AIC Rating.
        3) Feeding circuit number and panel name.
        4) Volts, Amps, Phase, Wire, Date printed.

I. Nameplate:

1. As indicated on standard drawing 40-D-6234.

2. Provide nameplate for each Panelboard.

3. Engraving example: "Panelboard DCB".

J. Conform to NEMA PB1, UL 67, and NFPA 70.

K. Finish: Manufacturer's standard gray finish for intended installation location.

2.02 MOLDED CASE CIRCUIT BREAKER

A. Thermal-magnetic type with inverse-time trip characteristics on overload and instantaneous trip on short circuit.

B. Voltage: 208/120 volts, as required.

C. Single or multi-pole as indicated on panelboard schedules.

D. Frequency: 60 hertz.

E. Interrupting Rating: 14,000 symmetrical RMS amperes, minimum.

F. Arc quenchers.

G. Quick-make and quick-break toggle mechanisms.

H. Trip-free operating handle.

I. Circuit breakers shall be lockable where required by other systems such as the Fire Protection System. See Section 28 31 00 - Fire Detection and Alarm. A lockable breaker is accomplished by using a circuit breaker lock that is listed for use with the circuit breaker and that allows the breaker to trip, but does not allow tampering with the breaker.

J. Single operating handle. Use of handle ties on multiple-pole circuit breakers is not acceptable.

K. Equip with padlock attachments for locking breakers in "OFF" position.

L. Conform to UL 489.

2.03 FABRICATION

A. Mount ground bus at bottom of panelboard enclosure. Bond bus to enclosure.

B. Mount circuit directory on inside of door.

C. Provide 20 percent spare circuit breakers.

D. Cover blank spaces with removable covers.

E. Circuit Directory:

1. Use computer generated lettering for directory entries. Hand written directory entries are not acceptable.
2. Show breaker number and connected load as indicated in their relative physical location.
3. Provide panelboard schedule on drawings unless as-built conditions require directory to be revised.
4. Mount directory in transparent plastic front on inside surface of access doors for each board.
5. Fabricate circuit directory frame such that directory need not be folded when placed in frame, and such that information on directory is clearly visible and legible.
6. Directory to provide the following information:
   a. Panel name.
   b. AIC Rating.
   c. Supply circuit number and panel name.
   d. Volts, Amps, Phase, Wire, Date printed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide anchoring, supporting, and mounting materials for a complete installation.

B. Install in accordance with manufacturer's instructions and recommendations.

C. Mount panelboard so that no operating handle is less than 24 inches or more than 72 inches above finished floor.

D. Set panelboard plumb and level.

E. Make conduit and wiring connections.

F. Provide require safety labels.

G. Provide engraved nameplate on panelboard.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR in writing 10 days before testing.

B. Operate panelboard enclosure key in the presence of Government.

C. Furnish test equipment, labor, and personnel to perform the following tests. Perform panelboard continuity and insulation tests after the installation has been completed and before the panelboard is energized.

1. Continuity tests using a dc device with buzzer.

2. Insulation test using a 500 volt minimum insulation-resistance test set.

   a. Record readings after 1 minute and until the reading are constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

3. Record test data and include the identification of panelboard and megohms readings verses time.

END OF SECTION

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SECTION 26 27 40
WIRING DEVICES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost.

1. Include in the price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA WD1-99(2010)	General Color Requirements for Wiring Devices
2.	NEMA WD6-02(2008)	Specific Purpose Plugs and Receptacles

B. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electric Code (NEC)

C. Underwriters Laboratories Inc. (UL)

1.	UL 20-10	General Use Snap Switches
2.	UL 94-13	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 27 40-1, Approval Data:

1. Manufacturer’s data.

PART 2 PRODUCTS

2.01 OCCUPANCY SENSOR LIGHT SWITCH

A. Catalog No.: OSSMT-MDW, Manual-On Occupancy Sensor manufactured by Leviton, Website: www.leviton.com; or equal, having the following essential characteristics:

1. Switch shall be capable of manual-on and automatic-off operation via passive infrared (PIR) and ultrasonic (U/S) detection technology to monitor occupancy space.

2. If this unit does not detect movement after a preset period of time, it will respond by switching its assigned load off.
3. The device shall switch at the zero crossing point of the AC power curve to ensure maximum relay contact life and compatibility with electronic ballasts.
4. The manual-on occupancy sensor shall be equipped with a push-button to provide manual on/off switching.
5. The device shall feature adjustable delayed-off time as well as provide sensitivity adjustment and integral sliding blinders to customize the horizontal field of view.
6. Field of view shall be 180 degrees with maximum coverage of 2,400 square feet.
7. Sensing distance shall be a minimum of 40 feet in front and 30 feet to the sides.
8. Four optional manual adjustments for delayed-off time setting: 30 seconds, 10 minutes, 20 minutes, and 30 minutes.
9. Make adjustment options after removing the control panel cover.
10. The device shall be capable of providing optional manual-on/automatic-off operation. If motion is detected within 40 seconds after the load has been turned off due to the absence of motion, the lights will turn back on. If the 40 seconds expires, the lights (load) shall be turned on manually.
11. The device shall be capable of controlling the load in single pole applications as indicated.
12. Frequency: 60 hertz.
13. Voltage: 277 VAC.
14. Load rating: 2700 volt-amps (VA) at 277 voltage for fluorescent loads.
15. Color: White.
16. Conform to NEMA WD 1 and be UL listed.

2.02 TOGGLE LIGHT SWITCH

A. Catalog No.: 1221-SW, 1223-SW, and 1224-SW, AC Switches manufactured by Leviton, Website: www.leviton.com,; or equal, having the following essential characteristics:

1. Industrial grade.
2. Toggle switch.
3. Current: 20 amperes.
4. Single pole, 3 way, or 4 way operation as indicated.
5. Contacts: Silver-cadmium 0.031 thick.
6. Operating temperature: minus 40 degrees C to 65 degrees C.
7. Flame resistance to V-0 rating per UL 94.

8. Frequency: 60 hertz.
9. Voltage: 120/277 VAC.
10. Color: White.
11. Terminals: Capable of No. 10 wiring.
12. Conform to NEMA WD1 and NEMA WD6.
13. UL listed, meeting the requirements of UL 20.

2.03 GFCI RECEPTACLES

A. Specification grade, heavy duty, duplex plug with integral ground fault circuit interrupter.

B. NEMA Configuration: 5-20R.

C. Voltage and frequency: 120 volts, 60 hertz.

D. Current: 20 amperes.

E. Body: Impact resistant plastic.

F. Terminals: Screw type for line wiring and grounding.

G. Pushbuttons: Test and reset.

H. Conform to NEMA WD1 and NEMA WD6.

2.04 COVER PLATES

A. Standard Switch and Receptacle:

1. Type: Impact resistant plastic with white cover plate or 302 stainless steel as indicated.
2. Material Thickness: 0.032 inches.
3. Switch cover plates shall have number of gangs as indicated.

B. Weatherproof Switch Coverplates:

1. Type: Die cast with heavy rubber gasket.
2. Material: Copper free aluminum.
3. Suitable for mounting on type FS cast box.
4. Manufacturers: Crouse Hinds, Syracuse NY, catalog No. DS 185; or equal.

C. Weatherproof Receptacle Coverplates:

1. Type: Die cast with heavy rubber gasket.
2. Material: Copper free aluminum.

3. Suitable for mounting on type FS cast box.

4. Cover shall be 'in-use' type cover meeting requirements of NFPA 70.

2.05 FINISHES

A. Manufacturer's standard finishes except as follows:

1. Light Switches and all Receptacles: White.

2. Standard Cover Plates: White.

PART 3 EXECUTION

3.01 INSTALLATION

A. Bond wiring devices to equipment grounding conductor.

B. Provide wiring devices as indicated.

C. Install switches with OFF position down.

D. Install duplex receptacles in single gang back boxes. Install quad receptacles as 2 duplex receptacles in 1 double gang back box with 1 quad receptacle faceplate.

E. Install receptacles with grounding pole on top.

F. Set occupancy sensor switches to a 10 minute time delay for shut off.

G. Install fork pressure-crimp-type connectors for terminations in accordance with Section 26 05 10 - Conductors and Cables. Do not use stranded conductors for connection to wiring devices. Do not use push-in terminals for wiring connections.

END OF SECTION

SECTION 26 42 10

BURIED GALVANIC ANODE CATHODIC PROTECTION AND CORROSION MONITORING SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Buried Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems:

1. Payment: Lump sum price offered in the Price Schedule.

a. Includes coatings.

1.02 DEFINITIONS

A. Cathodic Protection:

1. Sacrificial Protection: Reduction of corrosion of a metal in an electrolyte by electrically coupling it to a more anodic metal. This form of cathodic protection is also called galvanic anode cathodic protection.

B. Line Pipe: Section 33 11 10 - Pipeline General Requirements. May be referred to in this section as “Metal Line Pipe”.

C. Valves and Equipment for Line Pipe Installations: Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

D. Valves and Fittings: Section 35 12 15 - Valves and Equipment.

E. Steel Pipe: Section 35 21 95 - Steel Pipe.

F. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, and structure-to-water potentials.

2. The potential of structure in electrolyte as compared to potential of a reference electrode making contact with same electrolyte.

3. Static structure-to-electrolyte potential: Structure-to-electrolyte potential determined without any external current (e.g. prior to energizing a cathodic protection system, and with no galvanic couple, pH cell, interference currents, or the like present), or after such a current source has been disconnected for an extended time. Also referred to as native structure-to-electrolyte potential.

4. Uncorrected structure-to-electrolyte potential: Structure-to-electrolyte potential determined with cathodic protection system energized and cathodic protection current flowing. This potential is sometimes called protective potential and may contain significant IR drop error.

5. Polarized structure-to-electrolyte potential: Structure-to-electrolyte potential determined after cathodic protection system has been energized, but immediately after cathodic protection current is interrupted. Also referred to as "instant off" structure-to-electrolyte potential.

6. Polarization: Change from static or native potential as a result of current flow across electrode/electrolyte interface. Also considered difference between polarized and native potentials.

G. Structure: Steel Pipe and Fittings and Valves and Equipment for Line Pipe or other metalwork being protected and monitored.

H. Electrolyte: An electrically conductive solution, such as soil or water. The terms for these specific conductive solutions may be substituted for the word "electrolyte" in these definitions.

I. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying structure and acting to physically and electrically isolate metal from electrolyte.

J. Cable: Metallic conductors other than protected structures and anodes.

K. Portable Voltmeter: Portable instrument for measuring voltage drops across electrical components or potential (voltage) differences between a structure and a stable reference electrode:

1. Minimum input impedance: of 10 megohm.

2. Should be capable of measuring DC voltages between plus or minus 0.1 volts and plus or minus 100 volts.

3. When measuring structure potentials using a digital instrument, connect the positive terminal of voltmeter to structure and common (negative) terminal to reference electrode. Read magnitude and polarity of voltage directly as shown on instrument display.

4. When measuring structure potentials using an analog instrument with a needle that swings only in 1 direction, reverse connections and interpretation of polarity by the user is required.

L. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement; used for measuring relative potentials of other electrodes (e.g., protected structures). Sometimes referred to as a reference half-cell. A copper/copper sulfate reference electrode (CSE) is often used.

M. Test Station and Anode Junction Box: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B3-12	Soft or Annealed Copper Wire
2.	ASTM B843-13	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE SP0169-13	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2.	NACE TM0497-12	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
3.	Peabody A.W., (2001)	Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE.

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1,000 V Maximum)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 26 42 10-1, Certification and Data:

1. Copy of Cathodic Protection Specialists' NACE International certification for personnel performing or directing installation and testing of corrosion monitoring system.
2. Preconstruction drawings: Intended location of test stations and junction boxes.
3. Manufacturer's data including catalog data sheets when available, including:
    a. Galvanic anodes.
    b. Cables.
    c. Metallurgical bonding system.
    d. Dielectric coating system for bonds.
    e. Test stations.
    f. Anode junction boxes.
    g. Shunts.
    h. Variable resistors.

i. Isolation joint flange kits.

j. $Cu/CuSO_4$ permanent reference electrode(s) (metallic pipe option).

4. Interference Mitigation Method:

a. Proposed mitigation method for cathodic interference submitted for approval by foreign pipeline owner and Reclamation.

C. RSN 26 42 10-2, Final Data:

1. As-built information and drawings, including:

a. Locations of test stations, junction boxes, anodes, electrical continuity bonds, and cable runs.

1) Use unique identifier and GPS coordinates.

2) Include type of test station. Refer to drawings 1695-D-60107 and 1695-D-60108.

b. List of anode cable identifications in test stations and junction boxes.

2. Testing data:

a. Test equipment and methods utilized.

b. Placement of reference electrode during each test.

c. Results of tests conducted.

1.05 SYSTEM DESCRIPTION

A. Provide cathodic protection and corrosion monitoring systems for the following features:

1. Galvanic cathodic protection systems for Steel Line Pipe, Valves and Equipment for Line Pipe Installations, Steel Pipe and Fittings, Casings, and other associated metalwork.

B. Provide corrosion-engineering services to provide and test the galvanic anode cathodic protection system.

1. Include electrical continuity bonds, test stations, junction boxes, anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.

2. Materials, installation and testing shall be consistent with sound corrosion engineering principles and practice in accordance with NACE SP0169, NACE TM0497, and Peabody.

C. Cathodic protection systems will have capacity to:

1. Minimum service life of 20 years for components.

2. Maintain on locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:

a. A polarized structure-to-electrolyte potential of at least negative 0.850 volts on the structure having a high quality bonded dielectric coating.

b. Alternately, at the discretion of the Government, negative 0.100 volts of polarization if negative 0.850 volt criterion cannot be obtained due to extenuating circumstances (e.g., on bare or poorly coated structures or localized locations with high soil resistivity).

c. A polarized potential at any point on a dielectrically coated structure not exceeding negative 1.100 volts in all instances.

D. Placement and current output of anodes:

1. Place to provide adequate distribution of cathodic protection current, as indicated by potential readings.

1.06 DESIGN REQUIREMENTS

A. Manufacturer's Standards: Comply with manufacturer's recommendations and standards unless otherwise specified.

B. NACE SP0169 and NACE TM0497 applies to issues not specifically addressed by this section.

PART 2 PRODUCTS

2.01 CABLES

A. Manufactured no more than 24 months prior to notice to proceed.

B. Cathodic Protection:

1. Single-conductor: Stranded, plain, annealed copper cable.

2. Cable Insulation:

a. Rated for 600 volts and direct burial or immersion.

b. High molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inch.

3. Unspliced lengths to permit installation from terminus to terminus (e.g., anode to test station) free of splices and without stress.

4. Gauge:

a. No. 6 AWG or larger for electrical continuity joint (jumper) bonds (black insulation).

b. No. 6 AWG or larger for metallic Line Pipe structure (bond) cables (black insulation).

c. No. 12 AWG or larger for Steel pipe, Fittings, and Casings structure (bond) cables (black insulation).

d. No. 12 AWG or larger for determining of structure-to-electrolyte potentials (black insulation).

e. No. 8 AWG or larger for galvanic anodes for metallic Line Pipe (red insulation if available).

f. No. 12 AWG or larger for galvanic anodes for Steel Pipe, Fittings, and Casings (red insulation if available).

2.02 ELECTRICAL CONTINUITY JOINT BONDS

A. Insulated copper cable in accordance with cable requirements above.

2.03 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by ThermOweld, 4102 South 74th East Ave., Tulsa, OK 74145; or equal, having the following essential characteristics:

1. Designed for:

a. Cathodic protection systems.

b. Metallic substrate materials.

2. Exothermic reaction produces molten copper, which produces a permanent, high conductivity connection.

3. Uses a special alloy to provide minimum heat effect on substrate material.

4. Current carrying capacity equal or better than that of conductor.

2.04 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Dielectric material: Royston Handy Cap, manufactured by Royston Laboratories, Inc., 128 First St., Pittsburgh, PA, 15238; or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.

2. Applied with primer coat, as needed.

3. Approved dielectric coating material.

4. Suitable for intended environment.

2.05 GALVANIC ANODES

A. Steel Line Pipe:

1. Galvanic anodes: 60S4 UltraMag High Potential Magnesium Anode manufactured by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248; or equal, with the following essential characteristics:

a. Minimum of 60 pounds of magnesium anode material per anode.

b. High potential magnesium anode material specifically designed for cathodic protection systems.

c. Anode material meeting or exceeding requirements of ASTM B843 and having minimum potential of negative 1.700 volts referenced to a CSE.

d. Contain a mild steel core that extends entire length of anode. Mild steel core shall be centered within anode material and exposed on 1 end of anode for factory made anode-to-cable connection.

B. Steel pipe, Fittings, and Casings:

1. Galvanic anodes: 20D2 UltraMag High Potential Magnesium Anode manufactured by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248; or equal, with the following essential characteristics:

a. Minimum of 20 pounds of magnesium anode material per anode.

b. High potential magnesium anode material specifically designed for cathodic protection systems.

c. Anode material meeting or exceeding requirements of ASTM B843 and having minimum potential of negative 1.700 volts referenced to a CSE.

d. Contain a mild steel core that extends entire length of anode. Mild steel core shall be centered within anode material and exposed on 1 end of anode for factory made anode-to-cable connection.

C. Factory anode-to-cable connection, exposed mild steel core, and exposed copper cable potted in epoxy.

D. Silver solder connection between the anode cable and mild steel core.

E. Anode cable in accordance with cable requirements of this section.

F. Anode pre-packaged in a chemical backfill specifically intended for type of buried anode used.

1. Chemical backfill: Approximately 75 percent ground hydrated gypsum, 20 percent powdered bentonite, and 5 percent anhydrous sodium sulfate.

G. Anode packaged in a plastic or heavy paper bag of sufficient thickness to protect electrode, backfill, and cloth bag during normal shipping and handling.

H. Store prepackaged anodes off ground and protect against weather, condensation, and mechanical damage.

2.06 TEST STATION ENCLOSURE

A. Test stations: TESTOX Series 100 or Series 700, manufactured by Gerome Electric Supply Co., 336 E. Main St., Uniontown, PA 15401; or equal, having the following essential characteristics:

1. Above-ground, cast aluminum, pipe-mounted type.
2. Specifically constructed for cathodic protection system installations.
3. Protected as required for permanency.
4. Secured to pipe with setscrew or threaded.
5. Sufficient number of terminals, 5 terminals minimum, with associated hardware for the number and size of cables and required accessories.
6. Equip with 0.01 ohm calibrated shunt for each anode such that the current output of each anode can be determined.
7. Equip with variable resistors for each anode such that current output of each anode can be adjusted.
8. Test station cables in accordance with cable requirements of this section.

2.07 ANODE JUNCTION BOX ENCLOSURE

A. Enclosed within a NEMA 250, Type 3-R, lockable cabinet constructed of No. 16 gauge or thicker galvanized steel or fiberglass that is weatherproof, lockable, and vented for heat dissipation.

B. Specifically constructed for cathodic protection system installations.

C. Protected as required for permanency.

D. Sufficient number of terminals with associated hardware for number and size of cables and required accessories.

E. Equip with 0.01 ohm calibrated shunt for each anode such that current output of each anode can be determined.

F. Equip with variable resistors for each anode such that current output of each anode can be adjusted.

G. Engraved 1/4 inch minimum NEMA grade C phenolic panel.

H. Solderless, pressure-type terminals.

I. Identified terminals.

J. Equip with combination bracket for pole or wall mounting.

K. Anode junction box cables in accordance with cable requirements of this section.

2.08 TEST STATION PIPE AND BARRIER POST

A. Steel Pipe:

1. In accordance with Section 05 50 00 - Metal Fabrications.
2. Pipe size indicated on drawing 1695-D-60108.

B. Barrier Posts:

1. In accordance with Section 05 50 00 - Metal Fabrications.
2. Pipe size indicated on drawing 1695-D-60108.

C. Coating:

1. Test station support post coated or galvanized in accordance with Section 09 96 20 - Coatings.
2. Barrier Post coated NTUA blue in accordance with Section 09 96 20 - Coatings.

D. Concrete:

1. In accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.09 SAND BACKFILL

A. Sand Backfill: ASTM C33, fine aggregate.

2.10 WARNING TAPE

A. Polyethylene warning tape for anode cables:

1. Minimum 3 inches wide.
2. Red or yellow with black lettering.
3. Suitable for direct burial.
4. “Caution: Cathodic Protection Cable Buried Below” printed on full length on tape.

2.11 PERMANENT REFERENCE ELECTRODE

A. Copper/Copper Sulfate permanent reference electrode: Permacell Plus, manufactured by CorrPro Canada, 103, 221 - 18th Street SE, Calgary, AB, T2E UJ5; or equal, having the following essential characteristics:

1. Double membrane, ceramic cell in a geomembrane package.
2. Electrode cable in accordance with cable requirements of this section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation details indicated on drawings 1695-D-60107, 1695-D-60108, and 1695-D-60109.

B. Installation and testing shall be performed or directed by a Cathodic Protection Specialist.

C. Electrically isolate pipe and fittings from other metal such as foreign structures and rebar in concrete, and concrete encased manifold.

D. Do not leave dielectric materials, other than non-metallic carrier pipe, that might cause shielding of cathodic protection current (e.g., plastic debris) in excavation with structure.

E. Electrical Continuity Joint (Jumper) Bonds (when required):

1. Provide metallurgical bonds at mechanical type joints (e.g., non-welded joints) between ferrous parts to be included in a particular cathodic protection system as indicated in this section or as necessary to ensure electrical continuity.
2. Minimum of 2 cables per bond joint for Steel Line Pipe.
3. Minimum of 2 cables per bond joint for Steel Pipe and fittings on non-metallic pipe.
4. Bond cable installed with sufficient slack to prevent stress or tugging.
    a. Allow for minimum 1/2 inch of joint movement.
5. Jumper Bond Locations:
    a. Between non-welded ferrous pipe sections and ferrous pipe and fittings.
    b. Between restraints and fittings for non-metallic pipe.

F. Cable:

1. Inspect for insulation defects prior to backfilling.
    a. Replace cable if insulation is damaged.
2. Install without kinks, stresses, and/or splices.
3. Buried applications:
    a. For horizontal segments of cable, in accordance with drawing 1695-D-60108 and Section 31 23 02 - Compacting Earth Materials:
        1) Minimum burial depth: 30 inches.
            a) Bury cables a minimum of 42 inches in agricultural fields.
        2) Surround cable with minimum 6 inches of sand backfill.
        3) Place warning tape approximately 12 inches above cable for entire length of cable segments.

b. Run cable through coated rigid steel conduit once cable emerges from ground.

4. Connect to test station and anode junction box terminals with crimped, ring-tongue connectors.

5. Identify origin of cables terminating in an enclosure:

a. Cable identification as to the distinct originating structure or anode in accordance with drawing 1695-D-60109.

b. Printed letters on a shrinkable label attached to cables clearly visible within enclosure.

c. Encase printed labels in clear heat shrink tubing.

G. Structure connections:

1. 1 test cable and 1 bond cable per structure at each test station.

2. Connect cables to structures by exothermic metallurgical bond as shown in drawing 1695-D-60109.

a. Make exothermic metallurgical bond in accordance with bonding supply manufacturer's instructions.

b. Bonds shall not damage linings inside pipes or fittings.

c. Test metallurgical bond integrity by striking side of weld nugget with a 16 ounce hammer, in presence of the COR.

d. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.

1) Allow dielectric material to cure before repairing damaged structure coating or lining.

a) Repair dielectric coatings/linings in accordance with Section 09 96 20 - Coatings.

H. Galvanic Anodes:

1. Install horizontally or vertically as follows and as directed by the COR:

a. Steel Line Pipe Location:

1) Install 2 anode beds.

a) Sixteen anodes per bed as shown in drawing 1695-D-60107.

i. Eight anodes on each side of the anode junction box.

2) One anode bed at each end of pipe section.

3) Minimum 40 feet from nearest part of structures to be protected.

4) Minimum 20 feet from one another.

5) Depth: 4 feet to top of anodes.

b. Steel Pipe, Fittings, and Casings Location:

1) Install minimum of 1 anode on metalwork unless otherwise noted.

a) Two anodes required for Steel Pipe and Casings.

b) Restrained joints shall not be protected or bonded unless within 60 feet of a taper, air valve, blowoff, sectionalizing valve, or other metallic fitting or small section of metallic Line Pipe.

2) Minimum 30 feet from nearest part of structures to be protected.

3) Minimum 10 feet from one another.

4) Minimum 1 anode length from non-metallic structures.

5) Bond together metalwork within 100 feet of each other.

6) Depth:

a) At or below invert of pipe structure being protected,

b) Minimum 7 feet below final grade.

2. Remove outer water resistant covering on pre-packaged anodes before installation. Do not damage wettable covering containing backfill and magnesium.

3. Do not support anodes by their cables.

4. Do not wet pre-packaged anodes until in ground, surrounded with compacted earth, and covered by at least 1 foot of compacted backfill.

5. Do not connect anodes to structures at test stations; energizing systems only at time of testing.

6. Connect individual galvanic anodes to structures through individual calibrated 0.01 ohm shunts within the test station or anode junction box for current measurement (1 shunt for each anode).

7. Connect individual anodes to structure through variable resistors within test station or anode junction box to allow for adjusting output current from individual anodes (if necessary).

I. Test Stations and Anode Junction Boxes:

1. Locations:

a. Specifically at structure locations.

1) Corrosion monitoring test stations:

a) 1200 foot intervals along metallic Line Pipe section.

b) Foreign pipeline crossings along metallic Line Pipe section.

2) Galvanic anode cathodic protection test stations at protected pipe fittings and associated structures.

3) Anode junction box at each end of metallic Line Pipe.

b. Locate: Test stations and anode junction boxes to make them readily accessible.

c. Do not locate test stations and anode junction boxes inside agricultural fields.

d. Locate where test stations and anode junction boxes will not likely be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location subject to approval of COR.

e. Locate as close to each current carrying structure connection as possible and convenient.

2. Details for test stations and anode junction boxes are shown in drawing 1695-D-60107 and 1695-D-60108.

3. Permanently, uniquely, and clearly identify each test station.

4. Terminate cables for a given location within same test station enclosure. Identify cables as to distinct originating structure.

5. Test Stations and anode junction boxes should contain 3 cables, at a minimum:

a. Test Stations:

1) No. 12 AWG current carrying bond cable from the protected structure.

2) No. 12 AWG current carrying cable from anodes.

3) No. 12 AWG test cable from the protected structure for determining structure-to-soil potentials.

b. Anode Junction Boxes:

1) No. 6 AWG current carrying bond cable from the protected structure.

2) No. 8 AWG current carrying cable from anodes.

3) No. 6 AWG or larger for determining of structure-to-electrolyte potentials.

6. Protect test stations and junction boxes using steel bollards in accordance with drawing 1695-D-60108.

a. Secure test station and junction box support pipe to steel bollard with metal straps or pipe clamps.

J. Foreign Pipeline Crossings:

1. Test stations are only required if both Reclamation line and foreign line are metallic and an impressed current system is installed on one or both pipes.

2. Test station shall include two cables from each pipe and a permanent reference electrode.
    a. Obtain permission from the foreign pipe owner 30 days prior to attaching cables on foreign line.
        1) Cables shall be attached to foreign pipeline by pipeline owner or by contractor at the discretion of the foreign line owner.
    b. Permanent reference electrode installed in accordance with manufacturer's instructions.
        1) Place permanent $Cu/CuSO_4$ reference electrode between the foreign pipe and the Reclamation pipe.
        2) Place reference electrode approximately 12 inches from the Reclamation pipe.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Include energizing, adjusting, and testing the cathodic protection systems.

B. Perform in the presence of COR.

C. Inform COR of date, time, and tests at least 14 working days prior to testing.

D. Equipment:
1. Portable Voltmeter: Minimum input impedance of 10 megohms and capable of measuring DC voltages between plus or minus 0.1 millivolt to plus or minus 100 volts.
2. Portable CSE reference electrode.

E. Record and report readings with final test data submittal.

F. Conduct testing in least 2 testing cycles:
1. Check isolation flanges before backfilling to ensure adequate electrical isolation using appropriate equipment.
2. First Testing Cycle:
    a. Verify that each test station and anode junction box is properly labeled.
    b. Prior to energizing system:
        1) Test structure electrical continuity.
        2) Test station and anode junction box integrity.
            a) Determine voltage difference between cables within each test station and anode junction box enclosure.
        3) Measure static structure-to-soil potentials of buried metalwork.

a) At each individual test station and anode junction box location.

b) Portable reference electrode placed as close to buried metalwork as possible for structure-to-soil potential measurements.

c) Saturate ground with water to reduce reference cell contact resistance.

c. After energizing the system.

1) Determine protective (uncorrected) and polarized structure-to-soil potentials in accordance with the capacity requirements of this Section.

a) At each individual test station and anode junction box location.

b) Place portable reference electrode as close to buried metalwork as possible for structure-to-soil potential measurements.

c) Saturate ground with water to reduce reference cell contact resistance.

2) Determine current output of each individual anode in test stations and anode junction boxes.

3) Adjust variable resistor setting for each anode to obtain required balance of current output.

4) Test for cathodic interference.

a) Notify foreign pipeline owner 30 days prior to interference testing.

3. Second and Subsequent Testing Cycles:

a. Time between testing cycles shall be 30 to 60 days.

b. Cathodic protection system shall not be adjusted between testing cycles.

c. Repeat testing required after energizing the system during the first testing cycle.

d. If testing cycle data indicates that cathodic protection system requires adjustment to meet requirements, adjust cathodic protection system and conduct subsequent testing cycles within 30 to 60 days.

4. Troubleshoot and correct problems determined by the COR.

G. Submit proposed method for cathodic interference mitigation to Reclamation and foreign pipeline owner for approval.

H. Submit final data after last testing cycle when performance criteria have been met and no further adjustments are needed.

I. After reviewing the submittal, the Government may require additional testing cycles, adjustments, and re-submittal to determine if the cathodic protection system conforms to requirements.

END OF SECTION

SECTION 26 42 11

SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM FOR WELDED TANKS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Submerged Galvanic Anode Cathodic Protection System For Welded Tanks:

1. Payment: Lump sum price offered in Price Schedule.

a. Includes coatings.

1.02 DEFINITIONS

A. Cathodic Protection:

1. Sacrificial Protection: Reduction of corrosion of a metal in an electrolyte by electrically coupling it to a more anodic metal. This form of cathodic protection is also called galvanic anode cathodic protection.

B. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, and structure-to-water potentials.
2. Potential of structure in electrolyte as compared to potential of a reference electrode making contact with same electrolyte.
3. Static structure-to-electrolyte potential: Structure-to-electrolyte potential determined without external current (e.g. prior to energizing a cathodic protection system, and with no galvanic couple, pH cell, interference currents, or the like present), or after such a current source has been disconnected for an extended time. Also referred to as native structure-to-electrolyte potential.
4. Uncorrected structure-to-electrolyte potential: The structure-to-electrolyte potential determined with the cathodic protection system energized and cathodic protection current flowing. This potential is sometimes called the protective potential and may contain significant IR drop error.
5. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after the cathodic protection system has been energized, but immediately after the cathodic protection current is interrupted. Also referred to as “instant off” structure-to-electrolyte potential.
6. Polarization: Change from the static or native potential as a result of current flow across the electrode/electrolyte interface. Also considered the difference between polarized and native potentials.

C. Structure: Submerged surface of a steel tank or other metalwork being protected and monitored.

D. Electrolyte: An electrically conductive solution, such as soil or water. The terms for these specific conductive solutions may be substituted for the word “electrolyte” in these definitions.

E. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying structure and acting to physically and electrically isolate the metal from the electrolyte.

F. Cable: Metallic conductors other than the protected structures and the anodes.

G. Portable Voltmeter: Portable instrument for measuring voltage drops across electrical components or potential (voltage) differences between a structure and a stable reference electrode:

1. Should have a minimum input impedance of 10 megohm.
2. Should be capable of measuring DC voltages between plus or minus 0.1 volts and plus or minus 100 volts.
3. When measuring structure potentials using a digital instrument, connect the positive terminal of the voltmeter to the structure and the common (negative) terminal to the reference electrode. Read the magnitude and polarity of the voltage directly as shown on the instrument display.
4. When measuring structure potentials using an analog instrument with a needle that swings only in one direction, reverse connections and interpretation of the polarity by the user is required.

H. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement; used for measuring the relative potentials of other electrodes (e.g. protected structures). Sometimes referred to as a reference half-cell. A copper/copper sulfate reference electrode (CSE) is often used.

I. Anode Junction Box: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from the structure.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B843-13	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE SP0169-13	Control of External Corrosion on Underground or Submerged Metallic Piping Systems

2.	NACE SP0196-11	Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks
3.	NACE TM0497-12	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
4.	Peabody A.W., (2001)	Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.04 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B843-13	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE SP0169-13	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2.	NACE SP0196-11	Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks
3.	NACE TM0497-12	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
4.	Peabody A.W., (2001)	Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE

C. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals if welded tanks are installed.

B. RSN 26 42 11-1, Certification and Data:

1. Copy of Cathodic Protection Specialists' NACE International certification for personnel performing or directing installation and testing of corrosion monitoring system.

2. Manufacturer’s data including catalog data sheets when available, including:

a. Galvanic anodes.

b. Cables.

c. Metallurgical bonding system.

d. Dielectric coating system for bonds.

e. Dielectric anode covering at anode hold points.

f. Anode junction box.

g. Shunts.

h. Variable resistors.

i. Coated wire rope.

j. Cable conduit.

k. Permanent reference electrodes.

C. RSN 26 42 11-2, Final Data:

1. As-built information and drawings, including:

a. Locations of anodes in relation to anode junction box identification and restraints.

b. List of anode cable identifications in junction box.

2. Testing data:

a. Test equipment and methods utilized.

b. Placement of reference electrode during each test.

c. Results of tests conducted.

1.06 SYSTEM DESCRIPTION

A. Provide cathodic protection and corrosion monitoring systems for above ground welded steel tanks.

B. Provide corrosion engineering services to provide and test galvanic anode cathodic protection system.

1. Include anodes and accessory equipment and features as directed in this section or as otherwise indicated.

2. Materials, installation and testing in accordance with NACE SP0169, NACE SP0196, NACE TM0497, and Peabody.

C. Cathodic protection systems:

1. Minimum service life of 20 years for system and components.

2. Maintain on locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:

a. A polarized structure-to-electrolyte potential of at least negative 0.850 volts on the structure having a high quality bonded dielectric coating.

b. Alternately, at discretion of Reclamation, negative 0.100 volts of polarization if negative 0.850 volt criterion cannot be obtained.

c. A polarized potential at any point on a dielectrically coated structure not exceeding negative 1.100 volts in all instances.

D. Placement of anodes:

1. Provide adequate distribution of cathodic protection current.

2. Submerged:

a. Maintain sufficient anode material below minimum normal operating water level.

b. Not place stress on anode cables which will be suitable for direct immersion.

1.07 DESIGN REQUIREMENTS

A. Manufacturer's Standards: Comply with manufacturer's recommendations and standards unless otherwise specified.

B. NACE SP0169, NACE SP0196, and NACE TM0497 apply to issues not addressed by this section.

PART 2 PRODUCTS

2.01 CABLES

A. Manufactured no more than 24 months prior to Notice To Proceed.

B. Cathodic Protection:

1. Single-conductor: Stranded, plain, annealed copper cable.

2. Cable insulation:

a. Rated for 600 volts and direct immersion.

b. Black, with a high molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inches.

3. Unspliced lengths to permit installation from terminus to terminus, e.g. anode to test station, free of splices and without stress.

C. Gauge:

1. No. 12 AWG or larger for structure cable (black insulation).

2. No. 12 AWG or larger for determining structure-to-electrolyte potentials (black insulation).

3. No. 12 AWG or larger for galvanic anodes (red insulation if available).

4. No. 14 AWG or larger for permanent reference electrodes (yellow insulation).

2.02 EXOTHERMIC METALLURGICAL BONDS

A. Designed for cathodic protection systems and for metallic substrate materials.

B. Exothermic reaction produces molten copper, which produces a permanent, high conductivity connection.

C. Uses a special alloy to provide minimum heat effect on substrate material.

D. Current carrying capacity equal or better than that of the conductor.

2.03 GALVANIC ANODES

A. Galvanic anodes: Extruded rod ProMag Standard Potential Magnesium Anode manufactured by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248; or equal, with the following essential characteristics:

B. Standard potential magnesium extruded rod anode with the following essential characteristics:

1. Standard potential magnesium anode material specifically designed for cathodic protection systems and the intended environment.

2. Magnesium rod anode material:

a. 1.315 inch diameter.

b. Four 11 foot long anodes for Regulating Tank No. 1.

1) Minimum 11.75 pounds per anode.

c. Five 25 foot long anodes for Regulating Tank No. 2.

1) Minimum 26.7 pounds per anode.

3. Anode material meeting or exceeding the requirements of ASTM B843 and having a minimum potential of negative 1.5 volts referenced to a CSE.

4. Contain a mild steel core that extends entire length of anode. The mild steel core shall be centered within anode material and exposed on one end of the anode for the factory made anode-to-cable connection.

C. Factory anode-to-cable connection, exposed mild steel core, and exposed copper cable potted in epoxy.

D. Silver-solder connection between the anode cable and mild steel core.

E. Anode cable in accordance with cable requirements of this section.

2.04 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Coat exposed weld nugget, exposed cable, or structure metal using Bitumastic 50 (Carboline) or equal.

B. Refer to Section 09 96 20 - Coatings.

2.05 ANODE JUNCTION BOX

A. Enclosed within a NEMA 250, Type 3-R, lockable cabinet constructed of No. 16-gauge or thicker galvanized steel or fiberglass that is weatherproof, lockable, and vented for heat dissipation.

B. Specifically constructed for cathodic protection system installations.

C. Protected as required for permanency.

D. Sufficient number of terminals (5 terminals minimum) with associated hardware for number and size of cables.

E. Equip with 0.01 ohm calibrated shunt for each anode.

F. Equip with 25 ohm, 12 watt variable resistors for each anode such that the current flow of each anode can be adjusted as required within 125 percent of one another, without overheating the variable resistor.

G. Engraved 1/4 inch minimum NEMA grade C phenolic panel.

H. Solderless, pressure-type terminals.

I. Identified terminals.

J. Equip with combination bracket for pole or wall mounting.

2.06 ELECTRICAL CONDUIT

A. Coated rigid steel conduit for anode and permanent reference electrode cables.

2.07 PERMANENT REFERENCE ELECTRODE

A. Copper/Copper Sulfate permanent reference electrode for use in fresh water service: STAPERM Model CU-2-FW, manufactured by GMC Electrical, Inc., 2027 E. Ontario CA, 91761; or equal, having the following characteristics:

1. Rugged 1 inch plastic housing.
2. Plus or minus 5 mV with 3.0 microamp load.
3. No. 14 AWG stranded copper cable with yellow HMWPE insulation of suitable length to extend from the reference electrode location to the junction box without splicing.

PART 3 EXECUTION

3.01 INSTALLATION OF GALVANIC ANODE CATHODIC PROTECTION SYSTEMS

A. Installation details indicated on drawings 1695-D-60103, 1695-D-60104, 1695-D-60105, 1695-D-60106, and 1695-D-60109.

B. Installation and testing shall be performed or directed by a Cathodic Protection Specialist certified by NACE International.

C. Cable:

1. Inspect for insulation defects prior to backfilling.
    a. Replace cables if insulation is damaged.
2. Install without kinks, stresses, and/or splices.
3. Run cable through coated rigid steel conduit once cable emerges from tank interior.
4. Protect cables inside tanks from damage and stresses.
5. Connect to junction box terminals with crimped, ring-tongue connectors.
6. Identify origin of cables terminating in an enclosure:
    a. Cable identification as to the distinct anode in accordance with drawing 1695-D-60109.
    b. Printed letters on a shrinkable label attached to cables clearly visible within enclosure.
    c. Encase printed labels in clear heat shrink tubing.

D. Structure cables:

1. Two structure cables at anode junction box.

2. Connect cable to tank by exothermic metallurgical bond as shown in drawing 1695-D-10609.
    a. Make exothermic metallurgical bond in accordance with bonding supply manufacturer's instructions.
    b. Bonds shall not damage linings inside tank.
    c. Test metallurgical bond integrity by striking side of weld nugget with a 16 ounce hammer, in presence of the COR.
    d. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.
        1) Allow dielectric material to cure before repair of damaged structure coating or lining.
            a) Repair dielectric coatings/linings in accordance with Section 09 96 20 - Coatings.

E. Galvanic Anodes:
1. Regulating Tank No. 1:
    a. Install anodes vertically in a ring/box configuration consisting of 4 anodes.
        1) Space anodes equidistant from each other in ring/box configuration.
        2) Place anodes approximately 4 feet 5 inches from tank wall.
    b. Anodes hung from 3/16 inch diameter coated stainless steel wire support ropes at top and bottom of anodes such that bottoms of anodes are located approximately 4 feet 5 inches from bottom of tank.
    c. Anode installation details shown in drawing 1695-D-60103.
2. Regulating Tank No. 2:
    a. Install anodes vertically in a ring/box configuration consisting of 5 anodes.
        1) Space anodes equidistant from each other in ring/pentagon configuration.
        2) Place anodes approximately 5 feet 5 inches from tank wall.
    b. Anodes hung from 3/16 inch diameter coated stainless steel wire support ropes at top and bottom of anodes such that bottoms of anodes are located approximately 5 feet 5 inches from bottom of tank.
    c. Anode installation details shown in drawing 1695-D-60104 and 1695-D-60105.
3. Where wire support ropes hold anodes, wrap anodes with a double thickness of dielectric barrier material to a width of 3 to 4 inches as shown on drawing 1695-D-60106.

4. Wire ropes attached to tank sidewalls using welded brackets shown on drawing 1695-D-60106.

5. Anode cables:

   a. Run anode cables to roof of tanks and out single port to junction box.

   b. Run cables through a coated rigid steel conduit outside of tank to junction box.

   c. Protect cables from damage inside tanks.

   d. Do not connect anodes to structures at junction boxes; energizing systems only at time of testing.

   e. Connect individual galvanic anodes to structure through individual calibrated shunts within junction box for current measurement.

   f. Connect individual galvanic anodes to structure through variable resistors within junction box to allow for equalizing current from individual anodes.

F. Permanent Reference Electrodes:

1. Install 2 permanent copper/copper sulfate reference electrodes in water storage tank.

2. Installation:

   a. Reference electrodes placed on opposite sides of tank.

   b. Reference electrodes installed on bottom anode-to-tank wall support rope with dielectric tape and non-metallic cable ties.

   c. Protect reference electrode cable from damage inside tank.

   d. Run reference electrode cables to roof of tanks and out single port with anode cables to junction box.

   e. Terminate reference electrode cables in junction box.

G. Junction Box:

1. Locations:

   a. Against or mounted to outside tank wall.

   b. Minimum 4 feet from ground level.

2. Contain the following cables:

   a. Current carrying cable from the protected structure.

   b. Current carrying cable from each anode terminating in junction box.

   c. Cable from the protected structure for determining structure-to-water potentials.

   d. Reference electrode cables for water storage tank.

3. Installation details shown on drawing 1695-D-60106.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Include energizing, adjusting, and testing cathodic protection systems.

B. Performed in the presence of COR.

C. Inform COR of date, time, and tests to be performed at least 5 working days prior to testing.

D. Testing equipment:

1. Portable Voltmeter: Minimum input impedance of 10 megohms and capable of measuring DC voltages between plus or minus 0.1 millivolt to plus or minus 100 volts.

2. Portable CSE reference electrode.

E. Record and report readings with final test data submittal.

F. Testing shall be conducted in least 2 testing cycles:

1. First testing cycle:

a. Prior to energizing the system.

1) Junction box integrity.

a) Determine voltage difference between structure cables within junction box enclosure.

2) Measure potential difference between permanent copper/copper sulfate reference electrodes and portable copper/copper sulfate reference electrode.

a) Potential: 0.00 plus or minus 10 mV.

3) Measure potential difference between permanent copper/copper sulfate reference electrodes in each tank.

a) Potential: 0.00 plus or minus 10 mV.

4) Measure static structure-to-water potentials of the submerged wall and floor.

a) Place portable reference electrode as close to submerged surface as possible for structure-to-water potential measurements.

b) Measure at following locations on the tank surface (dependent on accessibility):

i. Bottom.

ii. Middle.

iii. Just below surface level.

iv. Various locations around tank.

v. Bottom center.

c) Using each permanent reference electrode in the water storage tank.

b. After energizing the system.

1) Determination of protective (uncorrected) and polarized structure-to-water potentials in accordance with capacity requirements of this Section.

a) Place portable reference electrode as close to the submerged metalwork as possible for structure-to-water potential measurements.

b) Measure at following locations on the tank surface (dependent on accessibility):

i. Bottom.

ii. Middle.

iii. Just below surface level.

iv. Various locations around tank.

v. Bottom center.

2) Determination of current output of each individual anode in junction box.

3) Adjustment of variable resistor setting for each anode as required to obtain required balance of current output and potential requirements.

2. Second and subsequent testing cycles:

a. Time between testing cycles shall be 30 to 60 days.

b. Cathodic protection system shall not be adjusted between testing cycles.

c. Repeat testing required after energizing the system during the first testing cycle.

d. If testing cycle data indicates cathodic protection system requires adjustment to meet requirements, adjust cathodic protection system and conduct subsequent testing cycles within 30 to 60 days.

G. Submit final data after last testing cycle when performance criteria have been met and no further adjustments are needed.

H. After reviewing submittal, the Government may require additional testing cycles, adjustments, and re-submittal to determine if cathodic protection system conforms to requirements.

END OF SECTION

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SECTION 26 42 12

BOLTED TANK SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Bolted Tank Submerged Galvanic Anode Cathodic Protection System:

1. Payment: Lump sum price offered in the Price Schedule.

a. Includes coatings.

1.02 DEFINITIONS

A. See Section 26 42 11 - Submerged Galvanic Anode Cathodic Protection System for Welded Tanks.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B843-13	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE SP0169-13	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2.	NACE SP0196-11	Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks
3.	NACE TM0497-12	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
4.	Peabody A.W., (2001)	Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals if bolted tanks are installed.

B. RSN 26 42 12-1, Certification, Design, and Manufacturer's Data:

1. Copy of Cathodic Protection Specialists' NACE International certification for personnel performing or directing design, installation, and testing of corrosion monitoring system.
2. Cathodic Protection System Design including:
    a. Design calculations.
    b. Preconstruction drawings detailing anode placement and electrical connections.
3. Manufacturer's data including catalog data sheets when available, including:
    a. Galvanic anodes.
    b. Cables.
    c. Metallurgical bonding system.
    d. Dielectric coating system for bonds.
    e. Associated installation materials.

C. RSN 26 42 12-2, Final Data:

1. As-built information and drawings, including anode locations.
2. Testing data:
    a. Test equipment and methods utilized.
    b. Placement of reference electrode during each test.
    c. Results of tests conducted.

1.05 SYSTEM DESCRIPTION

A. Provide cathodic protection and corrosion monitoring systems for:

1. Above ground steel tank.

B. Provide corrosion-engineering services to design, provide, and test galvanic anode cathodic protection system.

1. Include anodes and accessory equipment and features as directed in this section or as otherwise indicated.
2. Designs, materials, installation and testing in accordance with NACE SP0169, NACE SP0196, NACE TM0497, and Peabody.

C. Cathodic protection systems:

1. Minimum service life of 20 years for system and components.
2. Maintain on locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:

a. A polarized structure-to-electrolyte potential of at least negative 0.850 volts on the structure having a high quality bonded dielectric coating.

b. Alternately, at discretion of Government, negative 0.100 volts of polarization if negative 0.850 volt criterion cannot be obtained.

c. A polarized potential at any point on a dielectrically coated structure not exceeding negative 1.100 volts in all instances.

D. Placement of anodes:

1. Provide adequate distribution of cathodic protection current.

2. Submerged:

a. Maintain sufficient anode material below minimum normal operating water level.

b. Not place stress on anode cables, which will be suitable for direct immersion.

1.06 DESIGN REQUIREMENTS

A. Manufacturer's Standards: Comply with manufacturer's recommendations and standards unless otherwise specified.

B. NACE SP0169, NACE SP0196, and NACE TM0497 applies to issues not addressed by this section.

PART 2 PRODUCTS

2.01 GENERAL

A. Minimum cathodic protection service life: 20 years for system and components.

2.02 CABLES

A. Manufactured no more than 24 months prior to Notice To Proceed.

B. Cathodic Protection:

1. Single-conductor: Stranded, plain, annealed copper cable.

2. Cable insulation:

a. Rated for 600 volts and direct immersion.

b. Black, with a high molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inch.

3. Unspliced lengths to permit installation from terminus to terminus free of splices and without stress.

C. Gauge: No. 12 AWG or larger for galvanic anodes, red insulation if available.

2.03 EXOTHERMIC METALLURGICAL BONDS

A. Designed for cathodic protection systems and for metallic substrate materials.

B. Exothermic reaction which produces a permanent, high conductivity connection.

C. Uses a special alloy to provide minimum heat effect on substrate material.

D. Current carrying capacity equal or better than that of the conductor.

2.04 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Coat exposed weld nugget, exposed cable, or structure metal using Bitumastic 50 (Carboline) or equal.

B. Refer to Section 09 96 20 - Coatings.

PART 3 EXECUTION

3.01 INSTALLATION OF GALVANIC ANODE CATHODIC PROTECTION SYSTEMS

A. Installation and testing shall be performed or directed by a Cathodic Protection Specialist certified by NACE International.

B. Cable:

1. Inspect for insulation defects prior to backfilling.
    a. Replace cables if insulation is damaged.
2. Install without kinks, stresses, and/or splices.
3. Protect cables inside tanks from damage and stresses.

C. Make exothermic metallurgical bond in accordance with bonding supply manufacturer's instructions.

1. Bonds shall not damage linings inside tank.
2. Test metallurgical bond integrity by striking side of weld nugget with a 16 ounce hammer, in presence of the COR.
3. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.
    a. Allow dielectric material to cure before repair of damaged structure coating or lining.

1) Repair dielectric coatings/linings in accordance with Section 09 96 20 - Coatings.

D. Galvanic Anodes:

1. Located such as to provide adequate potential distribution to tank surface to meet polarization criteria requirements.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Include energizing, adjusting, and testing cathodic protection systems.

B. Performed in the presence of COR.

C. Inform COR of date, time, and tests to be performed at least 5 working days prior to testing.

D. Testing equipment:

1. Portable Voltmeter: Minimum input impedance of 10 megohms and capable of measuring DC voltages between plus or minus 0.1 millivolt to plus or minus 100 volts.

2. Portable Cu/CuSO4 reference electrode.

3. Temporary test coupons placed at various locations inside the tank if anodes connected directly to structure (dependent on accessibility).

E. Record and report readings with final test data submittal.

F. Conduct testing in least 2 testing cycles utilizing temporary test coupons:

1. First testing cycle:

a. Prior to energizing the system.

1) Measure static structure-to-water potentials.

a) Place portable reference electrode as close to submerged surface or coupons as possible for structure-to-water potential measurements.

b) Measure at following locations on the tank surface or test coupons (dependent on accessibility):

i. Bottom.

ii. Middle.

iii. Just below surface level.

iv. Various locations around tank.

v. Bottom center.

b. After energizing the system.

1) Determination of protective (uncorrected) and polarized structure-to-water potentials in accordance with capacity requirements of this Section.

a) Place portable reference electrode as close to the submerged surface or coupons as possible for structure-to-water potential measurements.

b) Measure at following locations on the tank surface or coupons (dependent on accessibility):

i. Bottom.

ii. Middle.

iii. Just below surface level.

iv. Various locations around tank.

v. Bottom center.

2. Second and subsequent testing cycles:

a. Time between testing cycles shall be 30 to 60 days.

b. Cathodic protection system shall not be adjusted between testing cycles.

c. Repeat testing required after energizing the system during the first testing cycle.

d. If testing cycle data indicates cathodic protection system requires adjustment to meet requirements, adjust cathodic protection system and conduct subsequent testing cycles within 30 to 60 days.

G. Submit final data after last testing cycle when performance criteria have been met and no further adjustments are needed.

H. After reviewing submittal, the Government may require additional testing cycles, adjustments, and re-submittal to determine if cathodic protection system conforms to requirements.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Complete Electrical System.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 51 00-1, Approval Data:

1. Manufacturer's data.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories Inc. (UL) listed.

B. Provide mounting hardware.

2.02 TYPE A LUMINAIRE

A. Catalog No. IBL 12L WD SD125 LP840 DLC DWH, I-BEAM LED High Bay Suspended manufactured by Lithonia Lighting, Website: http://www.lithonia.com or equal, having following essential characteristics:

1. Lamp Type: Light Emitting Diode (LED) luminaire.
2. Voltage: 120-277 volt.
3. L95 Value: 60,000 hour, minimum.
4. Lumen Maintenance Factor: 96 percent at 50,000 hours, minimum.
5. Color temperature: LED 4000K.
6. CRI: 70, minimum.
7. Efficiency: 93 percent, minimum.
8. Length: 45 inches, Width: 15.75 inches.
9. Mounting: Suspension with adjustable, straight cord, aircraft cable up to 48 inches in length.
10. Finish: White polyester powder coat paint.
11. Warranty: 5 year, minimum.

2.03 TYPE B LUMINAIRE

A. Catalog No. HBL 064GL 35 NW-UNV-N-WT, manufactured by Philips, Website: http://www.lightingproducts.philips.com or equal, having the following essential characteristics:

1. Lamp Type: Light Emitting Diode (LED) luminaire.
2. LED Count: 60, minimum.
3. Voltage: 120-277 volt.
4. L70 Value: 60,000 hour, minimum.
5. Color temperature: LED 4000K.
6. CRI: 70, minimum.
7. Driver: 350 mA drive current.
8. Finish: White, epoxy primer with powder topcoat. Resistant to corrosion, ultraviolet degradation, and abrasion.
9. Housing: Die-cast extruded aluminum.
10. Mounting: Suspension with adjustable, straight cord, aircraft cable up to 48 inches in length.
11. Internal Driver Access: Below luminaire.
12. Warranty: 5 year on luminaire and finish, minimum.

2.04 FABRICATION

A. Luminaires requiring special modifications shall be modified and wired by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install luminaires and accessories as indicated and in accordance with manufacturer's instructions.

B. Install specified lamps in luminaires.

C. Aim and adjust luminaires as indicated.

D. Install fittings and accessories required for complete installation.

E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

F. Make connections to branch circuits. Use insulated conductors with insulation suitable for temperature conditions within luminaire.

G. Bond luminaires to branch circuit equipment grounding conductor.

H. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

I. Remove dirt and debris from enclosures.

J. Clean photometric control surfaces as recommended by manufacturer.

K. Clean finishes and touch up damage.

L. Clean luminaires and install new lamps for broken or burned out lamps.

END OF SECTION

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SECTION 26 52 00
EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)
2. NFPA 101-15 Life Safety Code

B. Underwriters Laboratories (UL)

1. UL 924-12 Emergency Lighting and Power Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 52 00-1, Approval Data:

1. Manufacturer’s data.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories Inc. (UL) listed.

B. Provide mounting hardware.

C. Luminaires requiring special modifications shall be modified and wired by manufacturer.

2.02 TYPE E1 LUMINAIRE

A. Catalog No. AA8-SD-1BRWH, AA Series Emergency Lighting Units manufactured by Cooper Lighting, Website: www.cooperlighting.com,; or equal, having following essential characteristics:

1. Self-contained emergency lighting unit with adjustable lamps.

2. Three dimensional swivel assembly for lamps.
3. 2, PAR 36, sealed beam lamps.
4. Housing: Die-formed steel with white corrosion-resistant polyester powder coat paint.
5. 120/277-volt AC selectable input.
6. Solid state battery charger. UL 924 listed.
7. Low voltage disconnect (80 percent of battery nominal), brownout protection, and short-circuit protection.
8. Solid-state transfer for switching on/off the AC circuit during outages.
9. Test switch and power indicator light for maintenance purposes.
10. Maintenance free, sealed nickel cadmium battery rated for 90 minutes minimum.
11. Operating temperature range 0 degrees C to 50 degrees C.
12. Warranty: 1 year for unit and 15 years prorated for the battery.

2.03 TYPE E2 LUMINAIRE

A. Catalog No. LQC-X-R-ELN, Quantum Exit Sign by Lithonia Lighting, Website: www.lithonia.com,; or equal, having the following essential characteristics:

1. Light Emitting Diode (LED) exit sign.
2. Red LED illumination.
3. Single or double face as indicated.
4. Chevrons as indicated.
5. Wall mounted on end or back as indicated.
6. 120/277 volt AC selectable input.
7. Solid-state voltage charger.
8. Test switch/power indicator light.
9. Maintenance free, sealed nickel cadmium battery rated for 90 minutes minimum.
10. 6 inch letters. Meets UL 924 for viewing distance.
11. Housing: Die-cast aluminum, brushed aluminum faceplate.
12. Warranty: 5 year, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions, NFPA 70, and NFPA 101.

B. Aim and adjust emergency lighting units per applicable codes.

C. Install fittings and accessories required for complete installation.

D. Install surface mounted emergency lighting units and exit signs plumb and adjust to align with building lines and each other. Secure to prevent movement.

E. Make connections to branch circuits as indicated on the drawings. Use insulated conductors with insulation suitable for temperature conditions within emergency lighting units.

F. Operate each emergency lighting unit and exit sign after installation and connection. Inspect for proper connection and operation.

G. Remove dirt and debris from enclosures.

H. Clean finishes and touch up damage to match surrounding finish.

I. Clean emergency lighting units and exit signs and install new lamps for broken or burned out lamps.

END OF SECTION

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SECTION 26 56 00
EXTERIOR LIGHTING

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for Complete Electrical System.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 56 00-1, Approval Data:

1. Manufacturer's data.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories (UL) listed.

B. Provide mounting hardware.

C. Luminaires requiring special modifications shall be modified and wired by manufacturer.

2.02 TYPE AA LUMINAIRE

A. Catalog No.: SEC-EDG-4MB-WM-04-D-UL-BZ-350-40K, The Edge LED Security Wall Pack manufactured by Cree, Website: http://www.cree.com/lighting,; or equal, having the following essential characteristics:

1. Light Emitting Diode (LED) luminaire.
2. L70 value of 150,000 hours minimum.
3. Color temperature: LED 4000K.
4. 40 LEDs per luminaire.
5. 350 mA drive current.
6. 120 or 277 volts as indicated
7. BUG rating of 1, 0, 1 respectively.
8. Finish: bronze.
9. International Dark Sky Association Compliance.
10. Die-cast extruded aluminum housing.

11. Resistant finish preventing corrosion, ultraviolet, and abrasion.
12. Wall mounted.
13. UL Wet listed.
14. Operating temperature range: minus40 degrees C to 40 degrees C.
15. Warranty: 5 year, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install luminaries as indicated on drawings and in accordance with manufacturer's instructions.

B. Install fittings and accessories required for complete installation.

C. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

D. Remove dirt and debris from enclosures.

E. Clean photometric control surfaces as recommended by manufacturer.

F. Clean finishes and touch up damage to match surrounding finish.

G. Clean luminaires and install new lamps for broken or burned out lamps.

H. Control exterior luminaires by lighting control panel listed in Section 26 24 41 - Distribution Panelboards.

END OF SECTION

SECTION 27 15 00
COMMUNICATIONS CABLING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for SCADA System.

1.02 REFERENCE STANDARDS

A. Building Industry Consulting Service International (BICSI)

1.	BICSI-TDMM-13th Edition	Telecommunications Distribution Methods Manual (TDMM)

B. Insulated Cable Engineer Association (ICEA)

1.	ICEA S-90-661-12	Category 3, 5, and 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems

C. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE C2-12	National Electric Safety Code (NESC)

D. National Electrical Contractors Association (NECA)

1.	NECA/BICSI 568-06	Installing Building Telecommunications Cabling

E. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)

F. Telecommunications Industry Association (TIA)

1.	TIA J-STD-607-12	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
2.	TIA-568-C.1-09	Commercial Building Telecommunications Cabling Standard
3.	TIA-568-C.2-09	Balanced Twisted-Pair Telecommunications Cabling and Components Standards

G. TIA-1152-09 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling Underwriters Laboratories (UL)

1. UL 444-08 Communications Cables

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 27 15 00-1, Approval Data:

1. Manufacturer's data.

C. RSN 27 15 00-2, Approval Data:

1. Post-installation test reports.

2. Test Reports to include:

a. Electronic PDF and paper copy of each trace made during testing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store fiber optic cable in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 FIBER BYPASS UNIT

A. Provide an optical fiber bypass unit.

B. Physical Features:

1. Fiber ports: 2 channel 100BaseFX, single-mode 1310nm, ST connector, minimum.

2. Power: redundant 24 VDC inputs.

3. Low power consumption.

4. Optical Switching Time: 10 ms, maximum.

5. Enclosure: Metal case.

2.02 SINGLE-MODE FIBER OPTIC CABLE

A. All Dielectric Fiber Optic Cable:

1. Cable type: Single-Mode.

a. Major cable components:

b. Inner and outer polyethylene jackets.

c. Inner and outer polyethylene jackets ripcords.

d. Inner jacket, filled buffer tubes, and central member wrapped with water-swellable tape or filled with a non-hygroscopic jell.

e. Optical fibers: 12.

f. Water-swellable yarn.

g. Dielectric strength member.

h. Dielectric central member.

2. Outer Jacket:

a. Medium density polyethylene.

b. Outer jacket label:

1) Interval: regular for entire cable length in unbroken pattern.

2) Content:

a) Manufacturer’s Name.

b) Manufacturer’s cable designation.

c) Words "fiber optic cable".

3. Strength members: With expansion and contraction characteristics similar to glass fibers.

4. Buffer tubes:

a. Protect each fiber in a buffer tube of loose-tube type construction.

b. Color coded.

5. Optical fibers:

a. Attenuation of 1310/1383/1550 nanometer wavelength light: Less than 0.5/0.5/0.4 decibels per kilometer.

b. Attenuation: Directly proportional to cable length for an arbitrary cable length section after steady-state conditions are reached.

c. Color coded.

6. Cable core: Symmetrically stranded buffer tubes around dielectric central member.

7. Cable tensile strength:

a. Long term (installed): 135 pounds.

b. Short term (during installation): 600 pounds.

8. Operating temperature range: Minus 0 to 150°F.

9. Age: 24 months old, maximum.

2.03 LOW SMOKE ZERO HALOGEN (LSZH) CONDUIT

A. Heavy walled duct.

B. Size shall be suitable for fiber optic cable.

C. Nonmetalic type, extruded, flexible low smoke zero halogen type.

D. Suitable for direct burial.

E. Does not retain coiled shape when removed from roll.

F. Minimum bending radius of less than or equal to 14 times outside diameter of conduit.

2.04 POLYETHYLENE WARNING TAPE

A. Width: 6 inches.

B. Color: Yellow.

C. Copy: Continuously imprinted with "CAUTION BURIED CABLE BELOW".

D. Suitable for direct burial.

2.05 TERMINATION/SPLICE PANEL

A. Type:

1. Rack-mounted in pumping plant network equipment enclosure.
2. Wall mount or panel mount at remote I/O location in the SCADA Equipment Cabinets.

B. Metal housing with splice tray holder, splice tray, adaptor plates, and radius limiters.

C. Splice trays:

1. Same manufacturer as termination/splice enclosure.
2. Fusion splice organizer to retain each splice and its shrink tubing.
3. Manufactured for loose tube type fiber optic cable.

D. Adaptor plates:

1. Same manufacturer as termination/splice enclosure.
2. Mount at minimum 4 fibers.
3. Use ST connectors.
4. Each ST with 3 meters of single-mode fiber optic cable.

2.06 FIBER OPTIC PATCH CABLES

A. Type fiber: single-mode.

B. Length: As required.

C. Connectors:

1. ST on end connected to splice panel.
2. As required to connect to fiber optic equipment.

D. Loss per connector: Less than 0.5 dB.

2.07 MEDIA CONVERTER

A. Ethernet to Single-mode fiber.

B. ST connectors.

C. RJ-45 connector.

D. Operating temperature: minus 40 degrees F to 120 degrees F, minimum.

2.08 COAXIAL CABLE

A. Type: Radio Communication.

B. RG Type: 58/U.

C. Impedance: 50 Ohms.

D. Copper center conductor.

E. Copper braided shield with 95 percent braid coverage.

F. Jacket: Low Smoke Polyvinyl Chloride (PVC).

G. For use in radio circuits.

2.09 CAT 6 CABLE

A. Category 6 per ICEA S-90-661, UL 444, and TIA-568-C.2.

1. Four twisted pair, minimum size 24 AWG conductors.
2. Imprint cable with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating and length marking at regular intervals.
3. Provide communications rated cabling for the installation purpose it is installed (plenum, riser, general purpose) in accordance with NFPA 70.

4. Cables installed in conduit between floors shall be UL listed and labeled for wet locations.

2.10 FACEPLATES AND CONNECTORS

A. Terminate unshielded twisted pair (UTP) cables in accordance with TIA-568-C.1 and TIA-568-C.2 with T-568A color configuration.

B. Use registered jack (RJ) 45 modular connector.

C. Provide each location with 2 port RJ-45 faceplates unless otherwise noted on drawings.

D. Faceplate color: White.

2.11 ACCESSORIES

A. Conductor markers:

1. White.
2. Self-laminating vinyl type or heat-shrink type.
3. Marked both end of conductors with port number and room location of connected switch/punch down block.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with BICSI-TDMM, NECA/BICSI 568, TIA-568-C.2, NFPA 70, IEEE C2, and UL standards as applicable.

B. Install per manufacturer's instructions and do not exceed manufacturers' cable pull tensions for copper cables.

C. Fiber Optic:

1. Clamp cable entry with fiber type cable clamp.
2. Leave spare fibers in each termination/splice panel.
3. Leave 10 feet fiber to make connection to adaptor plate pigtail.
4. Retain fibers at each cable end equal in length to longest single fiber.

D. Install conduit per Section 26 05 33 - Raceway and Boxes and back boxes for RJ-45 connectors in accordance with Section 26 27 40 - Wiring Devices.

E. Install continuous conductors between termination points. Conductor splices are not acceptable.

F. Do not install power and communication cable in same conduit.

G. Do not damage or chafe outer jacket material.

H. No cable shall contain unterminated elements.

I. Do not splice network cables.

J. Do not untwist Category 6 cables more than 1/2 inch from point of termination to maintain cable geometry.

K. Conduit installation:

1. Do not pull cable into conduits until conduit runs have been cleaned and are free from obstructions and sharp corners.
2. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
3. Install cable to prevent cuts or abrasions in insulation or protective covering, or kinks in cable.
4. Do not cut or abrade cable insulation (outer jacket).
5. Do not kink cable.
6. Do not bend cable tighter than recommended bending radius, 15 to 20 diameters for fiber optic cable.
7. Block cable opening in sleeves under equipment or passing through blockouts, with silicone-foam, fire-retardant type material in accordance with NFPA 70.
8. Lubricant:
    a. Use only as aid to pulling.
    b. Soapstone or other suitable material not injurious to cable sheath and recommended by cable manufacturer.

L. Provide grounding and bonding in accordance with TIA J-STD-607.

M. Terminate networking cables in T568A configuration per TIA-568-C.2.

N. Control Cable and Wire Identification:

1. Provide computer generated or labeling machine lettering.
2. Provide labels for control cables and individual conductors of the control cable.
3. Individual control cable conductors: Designation shown on approved wiring diagrams. Designation to include wire number followed by wire destination.

O. Provide labels for instrumentation cables.

3.02 FIBER OPTIC CABLE INSTALLATION SITE REQUIREMENTS

A. In accordance with drawings.

B. Pull fiber optic cable from power pole into handhole pull box and into the SCADA Equipment Cabinet within the pumping plants. Coordinate with COR for designated power pole.

C. Install conduit from power pole to pull box eye as specified on drawings 1695-D-60098.

1. Install cable minimum of 30 inches below surface. Coordinate with COR for cable route and department.

D. Run fiber in the conduit down from existing utility pole splice closure into the utility pull box.

E. Install precast handhole pull box inside the pumping plants security parameter and in accordance with Section 26 05 33 - Raceways and Boxes with the embossed logo "FIBER" on the surface instead of "ELECTRIC". Coordinate with COR for placement.

F. Install fiber in electrical conduit to pumping plants as specified on drawing 1695-D-60098.

G. Run fiber into Pumping Plant No. 1 and Pumping Plant No. 2:

1. Furnish and install fiber bypass unit, termination splice panel, and fiber-optic media converter inside the SCADA Equipment Cabinet.
2. Connect incoming fiber cables and connect to termination/splice panel.
3. Provide patch cords to connect dielectric fiber cable to fiber optic equipment.
4. Install PoE media converters as specified in Section 27 30 01 - Telephone System, inside the pumping plant buildings fire panel enclosure.
5. Install fiber optic to PoE media converters as specified in Section 27 30 01 - Telephone System.
6. Connect fiber cables and connect to media converter.

H. Installation at the remote I/O sites:

1. Provide fiber bypass unit, termination splice panel, and fiber-optic media converter inside the SCADA Equipment Cabinet at a location designated by COR.
2. Connect fiber-optic cables and connect to termination splice panel.
3. Provide patch cords to connect fiber-optic cable to fiber-optic equipment.

I. Do not splice fiber optic cables outside of termination/splice panels or splice closures.

J. Coil 5 feet of fiber cable inside each termination/splice panel.

3.03 SPLICING

A. Method: Arc-fusion.

B. Splices per set of fusion tips: 50.

C. Splice loss: 0.1 dB, average bi-directional.

3.04 FIBER OPTIC CABLE TESTING

A. Test fiber optic cable:

1. Prior to installation.
2. After installation.

B. Government will witness tests:

1. Notify COR at least 20 days in advance of date and time of testing.
2. Test at a time which is mutually agreeable to Contractor and COR.

C. Test each fiber from the Utility splice panels to the fiber optic bypass units using an Optical Time Domain Reflectometer (OTDR):

1. Purpose and intent of testing:
    a. Determine if installed cable is free from defects.
    b. Compare measured attenuation with cable manufacturer's specified attenuation of 0.4dB per kilometer for 1300 nanometer light.
    c. Compare measured bi-directional splice loss with specified splice loss of 0.1dB per splice.
    d. Compare measured connector loss with specified connector loss of 0.5dB.
    e. Verify cable length.
2. OTDR requirements:
    a. Fiber type: Single-Mode.
    b. Dynamic Range: 25 dB, minimum.
    c. Operating temperature: 30 to 90 degrees F.
    d. Resolution: Selectable 0.1 to 10 m.
    e. Pulse width: Selectable. One for all tests.
    f. Reflectance accuracy: plus or minus Plus or minus 2dB.
    g. Loss accuracy (Linearity): 0.02dB/dB.
3. Obtain an OTDR waveform for each fiber to:
    a. Determine actual cable length.
    b. Determine attenuation and splice loss.
    c. Identify and locate splices and step discontinuities/possible fiber breaks.

D. Prepare test reports:

1. Generate a PDF copy and paper copy of each trace made during testing for inclusion in the report:
    a. OTDR waveform for each fiber showing "A" and "B" range marks.
        1) Do not move or change location of either mark.
2. Include an Analysis Summary Results Table for each fiber:
    a. Indicate numerical values associated with each event.
    b. Do not use question marks, dashes, or blanks.
3. Include following information for each trace:
    a. Trace name.
    b. Operator’s name.
    c. Date and time.
    d. Fiber type being tested.
    e. Bundle color.
    f. Fiber color.
    g. Fiber number.
    h. Launch reel length.
    i. OTDR resolution.
    j. Pulse width.
    k. Wavelength.
    l. Index of refraction.
    m. Averaging number.
    n. Receiver bandwidth.
    o. Sampling point count.
    p. End to end loss, dB.
    q. Reflectance, dB.
    r. Fiber Break, dB.
    s. Backscatter.
4. Traces to be viewable and reproducible on a PC using Windows 7 or newer.

E. The Government will review test reports and determine if fiber cable is suitable for its intended purpose.
    1. If defects are found (splices, connectors, discontinuities, etc.), repair or replace the cable or fittings at no additional cost to the Government.

3.05 CONTRACTOR COAX AND CAT6 FIELD QUALITY TESTING

A. Test equipment shall conform to TIA-1152.

B. Inspect coaxial connector integrity.

C. Inspect network cabling terminations for T568A color configuration.

D. Remove failed cables from project site upon attenuation test failure.

E. Perform testing for each outlet:

F. Performance test:

1. Perform Category 5e link tests in accordance with TIA-568-C.1 and TIA-568-C.2.
2. Include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

END OF SECTION

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SECTION 27 20 01
RADIO EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in Price Schedule for SCADA System.

1.02 ABBREVIATIONS

A. RTU - Remote Terminal Unit.

B. PLC - Programmable Logic Controller.

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-12 National Electric Safety Code (NESC)

B. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 27 20 01-1, Approval Drawings and Data:

1. Drawings in government format.
    a. Layout Drawings.
    b. Schematic Drawings.
    c. Wiring Drawings.
2. Bill of Materials.
3. Manufacturer’s product data.

C. RSN 27 20 01-2, Operations and Maintenance Manual:

1. Final drawings including “as-built” changes.
2. Final Software Documentation.
3. Spare parts list.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store radio equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.06 PERFORMANCE REQUIREMENTS

A. Communications between Reach 22B facilities and Cutter WTP/Reach 21 facilities shall be unlicensed General Electric MDS 900 MHz radios.

B. Radio communication modems shall be at the following facilities and telemetry sites:

1. Pumping Plant No. 1 (PP1).
2. Pumping Plant No. 2 (PP2).
3. NAPI Turnout.
4. Regulating Tank No. 2.

C. The MDS Radio Modems shall communicate with the SCADA PLCs via Ethernet Modbus TCP serial bus.

D. Determine the size and ratings of the following:

1. Fuses.
2. Surge Suppression Devices.
3. Radio system power requirements for sizing SCADA cabinet power supplies.

E. This section outline the general requirements of the radio system; however, it shall be the Contractor's responsibility to complete the details of the design.

1.07 EXTRA MATERIALS

A. Spare Parts:

1. Furnish:
    a. Spare Radio Modem and Antenna: 1.
    b. Fuses: 20 percent or a minimum of 3 each (whichever is greater) of each size, type, and rating.
    c. Surge suppression device: 20 percent or a minimum of 2 each, whichever is greater, of each size, type, and rating.

B. Recommended spare parts list applicable to equipment furnished under this section. Include name of each part, component, module, or printed circuit card; item part number, manufacturer's name and address, quantity recommended, and approximate price (current at time list is prepared) of each item.

PART 2 PRODUCTS

2.01 SCADA SYSTEM

A. See Section 25 00 01 - Control and Monitoring.

2.02 RADIO MODEMS

A. General Electric MDS 900 MHz radios.

B. Type: Unlicensed 900 MHz FHSS (Frequency Hopping Spread Spectrum).

C. Frequency Band: 902-928 MHz ISM.

D. Data:

1. Interface: Ethernet/RJ-45.
2. Usable throughput: up to 512 kbps.
3. Antenna connection: TNC connector (female).

E. MDS Cyber Security Suit.

F. Transmitter power output: 1 Watt, minimum.

G. Power Supply: 10.5 to 30 VDC.

H. Operating Temperature Range: Minus 30 degrees C to 60 degrees C.

2.03 RADIO EQUIPMENT CABINET

A. Used on repeater sites only.

B. DDB, SB-24168W-ALI or similar.

C. NEMA 4 enclosure type.

D. Size: 24 inches by 16 inches by 10 inches (H x W x D).

E. Pole-mount, Heat Shields, vented.

F. Constructed of sheet metal no lighter than 12 gauge.

2.04 COMMUNICATION ANTENNA

A. Type: Yagi. Coordinate with COR for radio study variations.

B. Frequency Band: 902-928 MHz.

C. Designed for all-weather applications.

D. Elevated with mass/facility structure support or communication towers.

2.05 COMMUNICATION TOWER

A. Non-guide wire, concreter-lagged base or as required by regional codes.

B. Lattice of triangular cross-section, parallel-sided type.

C. Minimum 30 feet height.

D. Barrier Posts:

1. In accordance with Section 05 50 00 - Metal Fabrications.
2. Concrete: In accordance with Section 03 30 00 - Cast-in-Place Concrete.

E. Placement away from powerlines for safety and interference.

F. Coordinate with COR for radio study variations.

2.06 INSULATED CONDUCTORS

A. Insulated conductors used to wire the plant radio shall be in accordance with the requirements of Section 26 05 10 - Conductors and Cables and Section 27 15 00 - Communications Cabling.

2.07 SURGE SUPPRESSION

A. DC Blocked Protector.

B. Frequency Range: 902-928 MHz.

C. Surge: 50 kA, 8/20 microsecond waveform.

PART 3 EXECUTION

3.01 INSTALLATION

A. Radio Survey Report: Supplied by Government. Contact COR.

B. Coordinate with the COR to establish communication links from every Reach 22B radio site through to the Cutter WTP MDS radio system.

C. Coordinate with the COR to attain both the LOS Survey and Field Radio Study reports.

D. In accordance with manufacturer’s recommendations.

E. Furnish anchoring and mounting materials required to install antenna towers.

F. Provide mounting hardware and accessories to make a complete and operable radio system.

G. Install the pumping plant radio equipment inside the SCADA equipment cabinets located at each site.

H. Install the pumping plant antennas at a location on the roof of the building at each location which provides for the most complete radio coverage.

I. Install the water tank antennas at a location on the top of the tank at each location which provides for the most complete radio coverage.

1. Meet Federal, Tribal, State, and local standards for the use of building and tank structures for the attachment of antennas.

J. Supply communication towers as needed for repeater stations and the NAPI Turnout to achieve communications on the Reach 22B MDS Radio system.

1. Communication towers will be used to place the communication antennas a minimum of 30 feet above grade or higher defined by the Contractor final Field Radio Survey at MDS radio communication sites where no structures are available.

2. Meet Federal, State, and local standards for the construction, placement, safety, and use of communication towers.

3. Mount Repeater Radio Equipment Cabinet on the communications tower at a minimum of 10 feet above grade for tamper deterrence.

4. Mount NAPI Turnout Radio Equipment Cabinet in the flowmeter vault.

K. Coordinate with COR for placement of communication antennas.

L. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

M. Make grounding and bonding connections in accordance with Section 26 05 20 - Grounding and Bonding.

N. Control Cable and Wire Identification: In accordance with Section 27 15 00 - Communications Cabling.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 - Automation System Testing, Acceptance, and Training.

C. Perform radio system transmission testing per manufacturer's recommendation. Radio signal shall meet minimum manufacturers recommendations for the following:

1. Signal Strength.
2. Signal to noise ratio.
3. Data Throughput.

END OF SECTION

SECTION 27 30 01
TELEPHONE EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for SCADA System.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE 802.3-12 Ethernet

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 27 30 01-1, Approval Drawings and Data:

1. Bill of Materials.
2. Manufacturer’s product data.

C. RSN 27 30 01-2, Check Prints:

1. Drawings in government format.
    a. Layout Drawings.
    b. Schematic Diagrams.
    c. Wiring Diagrams.

D. RSN 27 30 01-3, Operations and Maintenance Manual:

1. Final drawings including “as-built” changes.
2. Final Software Documentation.
3. Spare parts list.

E. RSN 27 30 01-4, Field Operational Checkout Test Report.

1.04 DESIGN REQUIREMENTS

A. Coordinate with COR to provide VOIP telephone equipment that is fully integrated between the Reach 22B Pumping Plants, the Cutter WTP, and the NGWSP telephone system.

B. Functional testing of the telephone equipment.

C. Make telephone equipment fully operational.

D. Furnish a list of recommended equipment that may be used to expand the telephone equipment, including original manufacturer's equipment, and/or a list of other vendor's telephone equipment, where applicable.

E. The telephone equipment shall be able to support at least 3 phone connections at each Pumping Plant facility and expandable to at least 4 phones at each Pumping Plant.

F. Provide an exterior phone and protective NEMA 4 enclosure at main entrance of each Pumping Plant facility. This shall be a direct access line.

G. The telephone equipment shall be able to support at least one direct access line for fire alarm system.

H. Provide new cable of Category 6, Ethernet switches, wire, connectors, wall plates.

I. The telephone equipment shall comply with voice quality standards. Apply amplification or attenuation required to the signal to maintain consistency in volume and clarity between calls. Do not allow white noise to not interfere with the voice quality.

1.05 EXTRA MATERIALS

A. Spare parts:

1. Telephone set: 1.
2. PoE Switch: 1.

B. Pack spare parts in containers suitable for long term storage.

C. Label spare parts clearly designating the contents of equipment or components for which they are intended.

D. Provide additional equipment not specified in this section but necessary to make the telephone equipment complete and operational.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle and store radio equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 TELEPHONES

A. Pumping Plant Facilities (inside facility):

1. Powered over Ethernet (PoE).
2. Ethernet bridge 10/100.
3. LCD display.
4. Display indicates when new voice mail is waiting to be acknowledged or heard.
5. Speaker phone.
6. Enable call forwarding to an internal extension or external number.
7. Head set connection: RJ-11.
8. Noise canceling microphone.
9. Volume control handset.
10. Handset cord: Hytrel, 25 feet.

B. Pumping Plant Facilities (exterior main entrance):

1. See General Plant phone requirements above.
2. Wall mount, industrial exterior grade.
3. Enclosure: NEMA Type 4 for recessed exterior-mounted telephone.

2.02 POWER OVER ETHERNET SWITCH

A. Rack-mounted, industrial, managed Ethernet switch.

B. Physical Features:

1. Copper ports: Ten 10/100 BaseTX, RJ-45, PoE, minimum.
2. Fiber ports: Two 100 BaseFX, single-mode 1310 nm, ST connectors.
3. Up to 30 watts per PoE port.
4. Status indicators on each port.
5. Power: redundant 24 VDC inputs.
6. Enclosure: Metal case.

C. Network Features:

1. IEEE 802.3 compliance.
2. IEEE 802.3 af/at compliance.
3. Full/Half Duplex operation on all ports.

4. 100 Mbps throughput, minimum.

2.03 CAT 6 CABLE

A. In accordance with Section 27 15 00 - Communications Cabling.

2.04 NAMEPLATES AND DEVICE MARKINGS

A. Principal devices including chassis and modules that cannot be readily identified by markings or tags shall have identifiable nameplates.

B. Locate nameplates for convenient observation by operational and maintenance personnel.

C. Mark interconnecting conductor and plug-in assemblies.

D. Mount red warning nameplates inside access openings of equipment that contains hazardous voltages in excess of 50 volts. Mount warning nameplates as close as possible to hazards.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's recommendations.

B. Locate PoE Switch and other telephone network rack-mounted components inside the SCADA Equipment Cabinet, Network Cabinet at each Pumping Plant.

C. Locate interior telephone at a location conducive to aid in Operations and Maintenance operations and approved by the COR.

D. Provide mounting hardware and accessories to install the telephone sets.

E. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

F. Gradual and uniform pulling stresses only shall be permitted on cable.

G. Where lubricant is needed as an aid to the pulling of cable, use soapstone or other approved material not injurious to cable outer sheath.

H. Make grounding and bonding connections in accordance with Section 26 05 20 - Grounding and Bonding.

I. Make grounding connections to existing grounding systems.

J. Cable and Wire Identification: In accordance with Section 27 15 00 - Communications Cabling.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Telephone equipment operation and testing requires completion of the NGSWP telephone system.

B. Notify Government in writing at least 15 days prior to beginning of tests.

C. Government personnel will be available for assisting in the performance of tests.

D. Testing will be witnessed by Government personnel. Government personnel will actively oversee testing.

E. Material and equipment furnished under this contract shall be subjected to tests by the Contractor, and at the expense of the Contractor at the times and location specified.

F. Furnish necessary testing equipment and pay cost of tests.

G. Tests shall verify that equipment is functional, performance, and design requirements as set forth in this solicitation are met.

H. Perform Field Operational Checkout Test (FOC).

I. Demonstrate satisfactory voice quality of equipment provided as a part of this contract.

J. Telephone Equipment Test minimum requirements:

1. Exercise basic call-handling capabilities.
2. Demonstrate Graphical User Interface (GUI) programs, use of controls, dialogs, and forms, continuity of prompts and general navigation.
3. Manual Call Testing:
    a. Use each phone to place and receive calls to and from other phones.
    b. Verify calls in this test are completed successfully with high voice quality.
    c. Call in with a variety of phone types (i.e., cell phones, outside phone systems).
4. Multi-line Performance Test: Generate multiple simultaneous calls into the equipment and verify high voice quality.
5. Auto attendant features: Call transfer to designated voicemail or phone number.

K. Perform field wiring checkout and test in accordance with Section 27 15 00 - Communications Cabling.

L. Acceptance of equipment, or the waiving of tests thereof, does not relieve the Contractor of the responsibility of furnishing equipment and materials meeting this section.

END OF SECTION

SECTION 28 10 01
SECURITY AND SURVEILLANCE EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in Price Schedule for SCADA System.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-12 National Electric Safety Code (NESC)

B. National Electrical Manufacturers Association (NEMA)

1. NEMA 250-14 Enclosures for Electrical Equipment (1000 Volts Maximum)

C. National Fire Protection Association (NFPA)

1. NFPA 70-14 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 28 10 01-1, Approval Drawings and Data:

1. Data:
    a. Manufacturer’s product data.
    b. Electrical characteristics.
    c. Bill of materials.
2. Drawings in government format.
    a. Detailed installation drawings and instructions of system being provided.
    b. Device, conduit and circuit plan layouts.
    c. Schematic and wiring diagrams.

C. RSN 28 10 01-2, Test Procedure and Start Date.

D. RSN 28 10 01-3, Test Report:

1. Certification of performance and results of test.

E. RSN 28 10 01-4, Check Prints:

1. Schematic and wiring diagrams.

F. RSN 28 10 01-5, Final Drawings and Operations and Maintenance Manuals:

1. Final Drawings including “as-built” changes.
2. Operations and Maintenance Manuals.
3. List of recommended spare parts and components.
4. Final bill of materials.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PERFORMANCE REQUIREMENTS

A. Provide hardware to fully integrate security systems between the Reach Pumping Plants facilities and the Cutter WTP security system over the Reach 22B System network.

B. Reach 22B telemetry vaults at the Pumping Plants' sites, the NAPI Turnout, and other vaults with Remote I/O PLC access shall have dry contacts on both the high value cabinets such as the SCADA Equipment Cabinet, and the vault access points.

C. Security site controller shall provide addressable points to allow visibility by the SCADA Sub-master Station at the Cutter WTP.

D. Provide equipment not specified in this section but necessary to make the system complete and operational.

E. Provide software essential for the system to meet functional requirements.

F. Design the video surveillance system to accommodate the following:

1. Digital Video Recorder:
    a. Automatic control and recording of each camera in the system.
    b. Manual control of each camera in the system via keyboard, mouse and monitor from the Cutter WTP Master Station.
2. Cameras:
    a. Program limit stops to limit the pan range of the camera to the wall adjacent to the camera.
    b. Pre-manufactured Pump Station building interiors:
        1) Powers up upon entry indication into the building and pan to the opened door.

2) Other camera powers up upon authorized entry into the building and provide continuous scan of the building until alarm system is set.

3) Cameras power up upon unauthorized entry into the building and provide a continuous scan of the building until the alarm is cleared.

4) Camera begins a continuous scan of the entire room once initial preset is reached.

c. Pumping Plant yards:

1) Allow coverage of the entire treatment facility yard from camera(s) mounted on the Pre-manufactured Pump Station structure at opposite diagonal corners.

2) Continuously scan of the entire facility yard.

G. Design the security system to accommodate the following:

1. Balanced magnetic contact mounted on doors shall indicate which door opened.

2. Provide alarm zone detection designations to the surveillance system.

3. Provide input to PLC upon unauthorized intrusion.

4. Call phone number upon unauthorized entry as designated by Government: Furnish phone number at time of testing.

5. Audible Alarm:

a. Allow user selectable times.

b. Initial settings:

1) Alarm sounds after 30 seconds if keypad code is not entered.

2) Sound alarm for 30 seconds on and 30 seconds off for the first 2 minutes.

3) Sound alarm for 30 second on and 90 seconds off after 2 minutes.

PART 2 PRODUCTS

2.01 DIGITAL VIDEO RECORDER

A. Type: Rack mount for inside SCADA equipment cabinet rack system.

B. NTSC/PAL signal system compatible.

C. On-Site Storage Requirements:

1. 10 days at 10 frames per second, minimum.

D. Pan/Tilt/Zoom (PTZ) Control, with full remote control via TCP/IP network.

E. Ports:

1. 10/100BaseT Ethernet.
2. Video Inputs: 4, minimum.
3. Mouse and keyboard.
4. USB ports, 3, minimum.

F. Archive Devices:

1. For long term storage, greater than 30 days.
2. DVDRW.
3. USB.

G. Remote / Web-Client capable.

H. Features:

1. 720p.
2. De-interlace function.
3. H.264 compression.
4. HDMI.

2.02 PAN/TILT/ZOOM (PTZ) DOME CAMERAS

A. Type: Heavy Duty.

B. Construction:

1. Type: Pendant.
2. Back box: Aluminum.

C. Auto-focus.

D. Zoom: 18x optical minimum.

E. Resolution: 720p, minimum.

F. Power over Ethernet PoE capable.

G. Outdoor camera to include the following:

1. Enclosure: NEMA 4X.
2. Dome: Smoked polycarbonate.
3. Protective cage: stainless steel.
4. Day/Night mode.

5. Operating temperature: Minus 40 degrees F to 120 degrees F.
6. High Powered POE injector for heater element.
7. Corner mounting for 270 degree view around plant.

2.03 SITE CONTROLLERS

A. Millennium Site Control Unit Model 149-101117; as manufactured by Millennium Group, 9 Natick, MA 01760, (866) 455-5222, www.millennium-groupinc.com or equal with the following salient characteristics.

B. Placed in SCADA Equipment Cabinet in the Pre-manufactured Pump Station facilities. See drawing
1695-D-60097.

C. Communication:
1. TCP/IP Networking Protocol.
2. RS-485 Communications to Door Controllers.

D. Voltage Input: 9 to 14 VDC.

E. Input Power Protection: Polarity, Overvoltage, and Transient Surges.

F. Supervisory Communications Monitor Relay.

G. Priority Event Buffer: 2000 Site Events History, 24 hour backup.

H. Tamper Protection.

I. External Clock Sync.

2.04 DOOR CONTROLLERS

A. Millennium door control device Model 149-100958; as manufactured by Millennium Group, 9 Natick, MA 01760, (866) 455-5222, www.millennium-groupinc.com; or equal with the following salient characteristics.

B. Single Door Control: See Section 08 34 53 - Security Doors and Frames.

C. Reader/Controller Interface.
1. Supports Wiegand Card Reader Protocols.
2. Configurable from 0-50 bits.
3. Magstripe technologies:
   a. ABA/ISO Track 2.
   b. Configurable Data Bits.

c. Clock and Data Information.

4. Marlok Optical Key Protocol.

D. Communication: RS-485 to site controller.

E. Input voltage: 9 to 14 VDC.

F. Programmable Output Relays: 2.

1. Rating: 2A at 24VDC.

G. Alarms.

1. Monitors up to 7 inputs.
2. S/W Selectable Priority Events.
3. Up to 200 event history stored.
4. Minimum 24 hour backup.

2.05 CONTROLLER POWER SUPPLY

A. Placed in the security equipment cabinets to supply normal and backup power to the site and door controller boards in each facility.

B. Input: 120 VAC.

C. Outputs:

1. Regulated and filtered.
2. Voltage: 13.8 VDC.
3. Current: 5 amps.

D. Secondary line conditioner for RS-485 communications.

E. DC Output protection.

F. AC Failure and Tampering Monitoring.

2.06 WALL-MOUNT CABINET

A. NEMA Type 12.

B. Size: 14 inches wide by 18 inches high by 6 inches deep.

C. In proximity to the SCADA equipment cabinet at the respective facilities.

D. Finish: Manufacturer’s standard coating.

E. Downward louvers for equipment cooling.

F. Lockable.

2.07 CARDREADER AND KEYPAD

A. Dual authorization: Card reader and Access Code.

B. Dual Encryption Reader: 26 or 41 bit.

C. Wiegand-formatted Data.

D. Audiovisual Indication.

E. 12 VDC supply voltage.

F. Rugged, Weatherproof, Operating Temperature: Minus 35 degrees to 65 degrees C.

G. RS485 Communications to security site controller.

2.08 BALANCED MAGNETIC CONTACT

A. Designation: Balanced magnetic contact.

B. Separate magnet housing and contact.

C. Armored cable.

D. Voltage: 24 VDC.

E. All metal housing.

2.09 FAIL LOCK MORTISE

A. Integrated with keypad to unlock with card reader/access code.

B. Fail Secure (locked) design and fire alarm input,

C. Heavy duty industrial design.

D. Input: 24 VDC, 2 Amps.

2.10 MOTION DETECTOR

A. Type: Interior.

B. 120 degree Detection.

C. Selectable sensitivity.

D. Tamper switch.

E. Voltage: 10.8 to 13.2 VDC.

F. Current: 18 mA.

G. Temperature: Minus 10 degrees C to 40 degrees C.

H. Relative humidity: 99 percent.

2.11 AUDIBLE ALARM

A. Type:

1. Heavy duty.
2. Surface mount.

B. Decibels at 10 feet: 101 dB.

2.12 SURVEILLANCE SIGNS

A. Type: Aluminum construction.

B. Size: 10 inches by 14 inches, minimum.

C. Sign shall read “RESTRICTED AREA MONITORED BY VIDEO CAMERA”.

2.13 SURGE SUPPRESSION DEVICES

A. Type: Designed to protect outdoor cameras.

2.14 INSULATED CONDUCTORS

A. Insulated conductors used to wire the security and surveillance system shall be in accordance with the requirements of Section 27 15 00 - Communications Cabling.

PART 3 EXECUTION

3.01 INSTALLATION

A. Make connections to place the security and surveillance system into operation.

B. Contractor is responsible for the proper operation of security system components installed through functional and integration testing.

C. In accordance with manufacturer’s recommendations.

D. Pre-manufactured Pump Station facilities:

1. Install security equipment cabinet in proximity of SCADA Equipment Cabinet.

2. Install security hardware and support equipment in the Security Equipment cabinet. Include the Site Controller, Power Supply.

E. Mount door control device in conduit junction box above interior side of each door in accordance with Section 26 05 33 - Raceway and Boxes.

F. Install door contact and video camera cables in accordance with Section 26 05 33 - Raceway and Boxes.

G. Make grounding and bonding connections in accordance with Section 26 05 26 - Grounding and Bonding and NFPA 70.

H. Control Cable and Wire Identification: In accordance with Section 27 15 00 - Communications Cabling.

I. Mount exterior security keypad/cardreader within easy access to the entry doors.

J. Mount exterior security cameras on elevated standoffs on the corners of the Pre-manufactured Pump Station structures at diagonally opposite corners to get optical coverage of all sides of the structure.

K. Mount digital video recorder and support equipment inside the SCADA Equipment cabinets rack system.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

1. Government will witness test. Notify COR in writing at least 20 days prior to the beginning of the Security and Surveillance system testing.
2. The purpose of the test is to demonstrate the functionality, performance and stability of the hardware and software.
3. Test verifies that hardware and software meet the requirements of the section and drawings.

3.03 TRAINING

A. Provide, at the project site, competent instructors to instruct Government personnel in system operations, hardware and software; that relate to the security and surveillance system.

B. Number of attendees: Minimum of 2 trainees.

C. Training duration: 8 hours.

END OF SECTION

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SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for SCADA System.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1.	NFPA 70-14	National Electrical Code (NEC)
2.	NFPA 72-16	National Fire Alarm and Signaling Code
3.	NFPA 90A-15	Installation of Air Conditioning and Ventilating Systems
4.	NFPA 101-15	Life Safety Code
5.	NFPA 1221-16	Installation, Maintenance and Use of Emergency Services Communications Systems

B. Underwriters Laboratories (UL)

1.	UL 268-09	Smoke Detectors for Fire Alarm Systems
2.	UL 268A-08	Smoke Detectors for Duct Application
3.	UL 464-14	Audible Signal Appliances
4.	UL 1971-02	Signaling Devices for the Hearing Impaired

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 28 31 00-1, Approval Data:

1. Manufacturer’s data.
    a. Include manufacturer’s name, model numbers, ratings, power requirements, and complete wiring point-to-point diagrams.
2. Installation companies current National Institute for Certification in Engineering Technologies (NICET) (minimum Level II Fire Alarm Technology) certification.

C. RSN 28 31 00-2, Testing Procedure and Notification.

1. Include detailed procedures for operational testing of each fire detection and alarm component prepared and signed by a NICET Level III fire alarm technician for performance of an operational system test.

D. RSN 28 31 00-3, Test Reports.

E. RSN 28 31 00-4, Training Materials.

1. Lesson plans.
2. Operations and Maintenance procedures.
3. Training Data.

F. RSN 28 31 00-5, Operation and Maintenance Instruction Book:

1. Rate of frequency in days, months, or years for each device to be tested. Base rate of frequency on the manufacturer's recommendations and/or NFPA 72 testing requirements, whichever is more stringent.

1.04 SYSTEM DESCRIPTION

A. General:

1. Provide devices for a complete system manufactured by a single manufacturer or division thereof except for the early warning detector for the control room listed below.
2. Activation of the system into 'alarm mode' occurs by actuation of alarm initiating devices. System shall remain in 'alarm' until the initiating device is reset and the FACP is reset and restored to 'normal mode'.
3. Fire alarm system components requiring power, except for the control panel power supply, operates on 24 Volts DC.
4. Size each signal line circuit (SLC) to provide 40 percent expansion without hardware modifications to the panel.
5. A single ground or open on initiating device circuits or notification appliance circuits shall not cause system malfunction, loss of operating power or the ability to report an alarm.
6. The secondary power source provides at a minimum, 24 hours of backup power and the ability to sustain 15 minutes in alarm mode at the end of the backup period. Batteries require a derating factor of 40 percent.
7. See drawings for the sequence of operation of devices.
8. Substitution to devices listed below require a full battery calculation submittal showing the system meets the requirements listed above.
9. In addition to IP communication interfaces, fire alarm control panels (FACP and FACP2) communicate trouble and alarm status to the Programmable Logic

Controller (PLC) listed in Section 25 00 02 - Programmable Controller via programmable relays.

PART 2 PRODUCTS

2.01 PHOTOELECTRIC SMOKE DETECTOR

A. Catalog No. 2W-B; i^3 Series Photoelectric Smoke Detector by FireLite Alarms, Website: www.firelite.com, or equal, having the following essential characteristics:

1. Conventional photoelectric smoke detector.
2. Plug-in design for easy mounting.
3.
4. Capable of remote annunciation for cleaning via maintenance module.
5. Capable of local identification for: Normal standby, out of sensitivity, alarm, or freeze trouble conditions.
6. Mounting: Direct surface or electrical box.
7. Removable cover and chamber for simple field cleaning.
8. Drift compensation and smoothing algorithms to reduce nuisance alarms.
9. Built-in test switch.
10. Sensitivity: 2.5 percent per foot nominal.
11. Freeze trouble threshold at 5 degrees C.
12. Voltage: 24 VDC.
13. Operating Temperature Range: 0 degrees C to 49 degrees C.
14. UL listed meeting the requirements of UL 268A.

B. Catalog No. 2W-MOD2; Maintenance Module for Detector by FireLite Alarms, Website: www.firelite.com, or equal, having the following essential characteristics:

1. Two wire loop test module for photoelectric smoke detector.
2. Compatible with detector.
3. Allows the fire alarm suppression panel to receive a ‘maintenance’ signal that the detector needs cleaning.
4. Local identification for normal standby, trouble, alarm, out of sensitivity, freeze trouble, and wiring fault.

C. Catalog No.: DNRW; Weather resistant housing by FireLite Alarms, Website: www.firelite.com, or equal, having the following essential characteristics:

1. NEMA 4 rated housing. Watertight, UV resistant enclosure providing protection against falling dirt, rain, and windblown dust, splashing and hose directed water.

2. Housing shall be compatible with duct smoke detector.

2.02 HORN/STROBE NOTIFICATION DEVICE

A. Catalog Nos: P2R (indoor) and P2RK (outdoor); Selectable Output Notification Appliance by FireLite Alarms, Website: www.firelite.com, or equal, having the following essential characteristics:

1. Wall mounted clear strobe/horn.
2. Strobe light shall be a xenon flash tube.
3. Red housing.
4. Candela: 15 to 110 selectable. See drawings for specific locations.
5. Strobe rate: 1 flash per second.
6. The horn shall have 3 audibility options and an option to switch between a temporal 3 pattern and a non-temporal pattern.
7. Device to have multi-switch for changing between horn modes as well as candela levels.
8. Voltage: 24 VDC.
9. See drawings for specific location of indoor or outdoor device.
10. Operating Indoor Temperature Range: 0 degrees C to 49 degrees C.
11. Operating Outdoor Temperature Range: minus 40 degrees C to 66 degrees C.
12. Connect via synchronization module compatible with both notification device and fire alarm control panel.
13. Outdoor units shall be listed for use with weatherproof backbox.
14. UL 1971 and UL 464 listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install work as shown and specified herein, in accordance with NFPA 70, NFPA 72, NFPA 90A, NFPA 101, NFPA 1221, and in accordance with the manufacturer's diagrams and recommendations.

B. Provide end of line resistors as needed.

C. Provide a lockable, red marked, circuit breaker dedicated to power each fire alarm panel and external batteries dedicated to fire alarm systems; label the circuit breaker as indicated. See panelboard schedules for specific circuit location. A lockable breaker is accomplished by using a circuit breaker lock that is listed for use with the circuit breaker and that allows the breaker to trip, but does not allow tampering with the breaker.

D. Install conduit and conductor in accordance with Section 26 05 33 - Raceways and Boxes and Section 26 05 10 - Conductors and Cables.

E. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

F. Do not install wiring for the fire alarm in conduits, junction boxes, or outlet boxes with conductors of other systems.

G. Fire detection and alarm conduit and conduit accessories shall be dedicated to this system and factory painted red (except aspirating piping). Upon complete installation, touch up paint as needed.

H. Locate detectors at least:

1. 12 inches from lighting fixtures.
2. 3 feet from diffusers of air handling systems.

I. Mount notification appliances 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Operational Test:

1. Notify the COR, in writing, 10 days before performing fire detection and alarm testing. Testing will be witnessed by Government and Pump Station operators.
2. Demonstrate each detection device operates per manufacturer’s instructions with IP communicator disconnected.
3. Perform 1 test showing successful digital communicator operation in contacting the proper supervising personnel.

B. Test Report:

1. Submit test reports bound together showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.
2. Each test report shall document readings, test results and indicate the final position of controls. Include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.
3. Provide documentation, security codes, replacement devices, and other relevant material to Government.
4. Provide dates of testing and correctional items found during testing with remedies.
5. Supply contact information including address, telephone, website for local certified fire alarm technician.

6. Test report will be signed by Government witnessing operational test.

3.03 TRAINING

A. General:

1. Submit lesson plans, operating instructions, maintenance procedures, and training data, in manual format, for the training courses.

2. Furnish manuals prior to training outlining step-by-step procedures required for system startup, operation, and shutdown.

a. Include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

B. Topics:

1. Familiarize designated Government personnel with proper operation of the fire alarm system.

2. Cover items contained in the operating and maintenance instructions book.

3. Training on performance of expansions or modifications to the fire detection and alarm system.

4. Provide the designated Government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

C. Location: Conduct the course in the building where the system is installed or as designated by the COR.

D. Attendees: 8.

E. Duration: 8 hours.

END OF SECTION

SECTION 31 02 10
WATER FOR DUST ABATEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Water for Dust Abatement:

1. Measurement: Volume of water applied for dust abatement as directed by the COR.

   a. Only water used for dust abatement as directed by the COR will be included.

   b. Quantity will be measured in tanks or tank trucks of predetermined capacity or by means of water meters.

2. Payment: M (1,000) gallons price offered in the Price Schedule.

1.02 SUBMITTALS

A. RSN 31 02 10-1, Meter Calibration.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 APPLYING WATER FOR DUST ABATEMENT

A. Furnish calibrated water meter for use in measuring water usage.

B. Provide water in accordance with Section 01 51 00 - Temporary Utilities.

C. Provide means of conveying water to point of use and applying water.

D. Install water meter at source.

E. Use pressure spray or distributor bar to apply water evenly.

F. Do not use water for dust abatement on temporary equipment roads and completed backfill areas unless directed by COR.

G. Apply water for dust abatement as directed by the COR.

END OF SECTION

SECTION 31 02 30
DUST PALLIATIVE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Dust Palliative:

1. Measurement: ROW and areas approved by COR.
    a. Palliative applied in areas approved by COR will be included.
2. Payment: Linear feet price offered in the Price Schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 02 30-1, Proposed Application Area for Dust Palliative:

1. Include dust palliative composition, equipment and application.
2. Certification that dust palliative does not inhibit revegetation.

PART 2 PRODUCTS

2.01 DUST PALLIATIVE FOR RESEEDED AREAS

A. Dirtglue, as manufactured by Dirtglue Enterprises, www.dirtglue.com; or equal, with the following essential characteristics:

1. Biodegradeable.
2. Water based.
3. Will not inhibit revegetation.

2.02 WATER

A. Required for mixing and application.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:

1. Shape and grade surface.
2. Loosen surface with rock rake or blade grader to depth of 1 to 2 inches.
3. Water loose surface so it is visibly moist.
4. In areas without surfacing materials: Do not disturb subgrade, moisten only.

3.02 APPLICATION

A. Apply in areas approved by the COR immediately after clearing, grubbing and top soil stockpiling have been completed.

1. Apply palliative to cleared and grubbed areas not be disturbed by excavation, stockpiled top soil materials, roads, access ramps.
2. Other areas directed by the COR where application of water for dust abatement is ineffective as determined by COR.
3. Perform maintenance application to control dust as directed by the COR.

B. Equipment: Designed for uniform application on variable widths at predetermined rates.

C. Location: Access road, stockpiles and ROW as directed by COR.

D. Area: Surface width as necessary within designated ROW.

E. Limitations:

1. Not during rain.
2. Not if rain is anticipated within 4 hours following treatment.
3. Do not apply to frozen ground.

F. Application rate:

1. Reseeded area: As recommended by manufacturer.
2. If material runs off during application, make repeated passes at lesser rates.

G. Compaction:

1. By equipment travel.
2. Keep traffic off treated surface until dust palliative has penetrated and cured enough to prevent excessive pickup under traffic.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Clearing and Grubbing:

1. Payment: Lump sum price offered in the Price Schedule.

a. Includes clearing and grubbing for Bank Protection.

1.02 DEFINITIONS

A. Vegetation: Trees, shrubs, brush, stumps, exposed roots, down timber, branches, grass, and weeds.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Obtain clearances and permits before clearing and grubbing.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Obtain COR approval before clearing and grubbing.

3.02 CLEARING

A. Clear only areas to be stripped of topsoil.

B. Clear areas to be stripped of topsoil outside of slope lines.

C. Obtain COR approval before removing trees.

D. Remove vegetation, rubbish, and objectionable material as determined by COR.

1. Where tree cutting is required:

a. Usable trees:

1) Size: 3 inches diameter or larger.

2) Remove, limb, and leave on roadside for local residents to collect and use as firewood.

b. Smaller woody plants and limbs:

1) Size: 3 inches diameter or less.

2) Chip and spread on ROW during revegetation process.

3.03 DISPOSAL OF CLEARED MATERIAL

A. Dispose of material in accordance with Section 01 74 00 - Cleaning and Waste Management.

END OF SECTION

SECTION 31 14 10
STRIPPING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Stripping, Stockpiling, and Placement:

1. Payment: For the lump sum price offered in the Price Schedule.

a. Includes stripping for Bank Protection.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Obtain clearances and permits before clearing and grubbing.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Obtain COR approval before clearing and grubbing and stripping.

B. Strip portions inside ROW required for construction to expose unknown cultural resources directly after mobilization.

1. Refer to Section 01 57 90 - Preservation of Historical and Archeological Data if cultural resources are discovered.

C. COR may provide a biological monitor:

1. During initial disturbance of wetland and riparian areas to ensure proper tallying of impacted willow clumps and cottonwoods;

2. During post construction to oversee proper return and respreading of topsoil.

3.02 STRIPPING

A. Remove topsoil to a depth of 6 inches and to additional depths where directed by COR. If a true topsoil structure does not exist, consider the surface soils removed to be topsoil for the purpose of this section.

3.03 STOCKPILE

A. Transport and stockpile topsoil as necessary prior to final hauling and placing.

B. Do not compact topsoil in stockpile.

C. Cover stockpile with a non-permeable tarp or dust palliative as approved by COR.

3.04 PLACEMENT

A. Remove trash, weeds, stones larger than 3 inches, and large pieces of vegetative materials.

1. Tree removal in accordance with Section 31 11 00 - Clearing and Grubbing.

B. Place topsoil in areas of earthen surface disturbed by construction.

C. Place topsoil to a minimum thickness of 6 inches.

D. Limit equipment travel over topsoil to avoid compaction.

E. Seed in accordance with Section 32 92 20 - Seeding.

END OF SECTION

SECTION 31 23 02
COMPACTING EARTH MATERIALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost of compacting earth materials in prices offered in the Price Schedule for other items of work where earth materials are compacted and:

   a. Furnishing water and moistening materials.

   b. Contractor Quality Testing.

1.02 DEFINITIONS

A. Use definitions from ASTM D653.

B. Control Fraction: The portion of a soil sample consisting of particles smaller than a designated sieve size. The fraction is used to compare in-place unit weight with standard laboratory unit weight. The control sieve size depends on the laboratory test used to determine laboratory maximum density.

C. C-Value: The ratio expressed as a percentage of (1) in-place unit weight at fill moisture content to (2) the wet unit weight of a laboratory-compacted specimen prepared at fill moisture content as determined by the rapid method of construction control in accordance with ASTM D5080. The C-Value is a comparison of compactive effort of field compaction equipment to standard laboratory compactive effort.

D. D-value: The ratio expressed as a percentage of (1) in-place wet unit weight at fill moisture content to (2) laboratory maximum wet unit weight as determined from a compaction curve constructed at fill moisture content as determined by the rapid method of construction control ASTM D5080. The D-value is the equivalent of percent compaction in accordance with ASTM D698.

E. Percent Compaction: The ratio expressed as a percentage of the in place dry unit weight to the laboratory maximum dry unit weight in accordance with ASTM D7382.

F. Special compaction: Compaction close to structures or in spaces not accessible by standard width rollers.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM D422-63(2007) Particle-Size Analysis of Soils

2.	ASTM D653-14	Terminology Relating to Soil, Rock, and Contained Fluids
3.	ASTM D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
4.	ASTM D1140-14	Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve
5.	ASTM D1556/D1556M-15	Density and Unit Weight of Soil in Place by the Sand-Cone Method
6.	ASTM D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7.	ASTM D2487-11	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
8.	ASTM D2488-09a	Description and Identification of Soils (Visual-Manual Procedure)
9.	ASTM D4318-10	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
10.	ASTM D4718-87(2007)	Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
11.	ASTM D4914-08	Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
12.	ASTM D5030/D5030M-13a	Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit
13.	ASTM D5080-08	Rapid Determination of Percent Compaction
14.	ASTM D6938-10	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depths)
15.	ASTM D7382-08	Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

B. Bureau of Reclamation (USBR)

1. USBR Guidelines for Earthwork Construction Control Testing of Gravelly Soils, Earth Sciences and Research Laboratory, Technical Service Center, Bureau of Reclamation, Denver, Colorado, September 2008.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 23 02-1, Test Results:

1. Results of tests listed in Table 31 23 02A - Contractor Materials Testing Requirements and Frequency.
2. Include test date, time, location and person performing tests.

1.05 SITE CONDITIONS

A. Do not place and compact soil under following conditions:

1. Rain that creates puddles in clayey or silty materials.
2. Heat or wind or both that dries material below specified moisture conditions.
3. Ice, frost, or snow pockets are visible in soil being placed or in underlying materials.

B. Ambient air temperature below freezing may make placement and compaction operations difficult.

1. Minimize interruptions of operations.
2. Continuous operations may be required to eliminate freezing of materials.
3. Obtain COR approval, before performing operations when ambient air temperatures are below freezing.
4. Cease operations when placed materials are freezing or below freezing.

PART 2 PRODUCTS

2.01 CLASSIFICATION

A. When required, classify earth materials using the Unified Soil Classification System (USCS) according to ASTM D2487 or ASTM D2488.

1. Gradation tests for classification: ASTM D422 or ASTM D1140.
2. Atterberg limits testing for classification: ASTM D4318.

2.02 SOIL TYPES

A. Clean Fill:

1. Any soil except soils with classifications Peat (PT), Organic Silts and Organic Clays (OL and OH), or Elastic Silt (MH) per ASTM D2487.
2. Free of roots, stumps, limbs, vegetation, organic matter, and ice.

3. Does not contain construction debris, scrap materials, refuse, man-made wastes, or chemical or hydro-carbon contamination.

B. Do not use frozen soils.

C. Special Gradations and Plasticity.

1. In some cases, such as embankment materials, embedment for buried pipe, special gradations and/or plasticity characteristics may be required. These requirements are in the applicable Section.

2.03 DESIGNATION OF SOILS FOR COMPACTION

A. Requirements for lift thickness, method of compaction, and method of determining degree of compaction depends on whether soil is considered to be silty or clayey, cohesionless, or cohesionless containing some silt and clay.

B. Silty or Clayey Soils: Contains appreciable amounts of fines (more than 15 percent plastic fines or 30 percent non-plastic fines).

C. Cohesionless Soils: Contains few fines (less than 5 percent fines).

D. Cohesionless Soils Containing Some Clay and Silt:

1. Contains some clay and silt (between 5 percent fines and 15 percent plastic fines or 30 percent non-plastic fines).

2. Controlled by ASTM D7382.

2.04 MAXIMUM PARTICLE SIZE

A. Soil for compacted backfill:

1. Maximum particle size limitations described in appropriate Sections for backfill against structures and in pipe trenches.

2. Otherwise, no cobbles larger than one-half the lift thickness.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Comply with:

1. Section 31 11 00 - Clearing and Grubbing.

2. Section 31 14 10 - Stripping.

B. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified compaction.

C. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing layer of material to be compacted.

3.02 SOIL MOISTURE CONTENT

A. Moisten or aerate material, as necessary, to provide moisture content that will readily facilitate obtaining specified compaction. Add water to soil only in increments that will permit moisture content to be uniform and homogenous throughout each layer after mixing.

B. Silty and Clayey Soils and Cohesionless Soils Containing Some Silt and Clay:

1. 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 borrow 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 the clods.
    b. Use of disks, harrows, or rakes may be required to blend moisture in the borrow area.
2. Moisture content during compaction:
    a. Soils controlled by impact compaction.
        1) Not greater than 2 percentage points wet or not less than 4 percentage points dry of optimum moisture content.
    b. Soils controlled by the vibrating hammer.
        1) Within the water content range for effective compaction as determined by ASTM D7382.
3. Determine moisture as follows:
    a. Soils controlled by impact compaction.
        1) Variation from Optimum Moisture Content:
            a) Difference between optimum moisture and compaction moisture measured in accordance with ASTM D5080.
        2) Moisture Content Comparison:
            a) Optimum moisture content determined by ASTM D698.
    b. Soils controlled by vibrating hammer.
        1) Within the water content range for effective compaction as determined by ASTM D7382.
    c. Soils controlled by either impact compaction or vibrating hammer.
        1) Compare field compaction moisture content with moisture contents determined in accordance with:

a) ASTM D2216, or,

b) ASTM D6938. Correct moisture from the nuclear gage for gauge error for the specific soils tested and the moisture content of the total material may require adjustment for the control fraction (ASTM D4718).

C. Cohesionless Soils: Add water during compaction, as necessary, since these soils are free-draining.

3.03 PLACEMENT

A. Place soils to be compacted in horizontal layers.

B. If necessary, blend materials so that compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations, or other imperfections.

3.04 COMPACTION

A. Silty or Clayey Material:

1. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers, other suitable compaction equipment, or equipment travel.
    a. Uniformly distribute equipment passes.
    b. Compact in horizontal layers to compacted thickness of 6 inches or less.
2. Special compaction: Compact with hand held impact tampers, or small tamping equipment.
    a. Uniformly distribute effort.
    b. Compact in horizontal layers to compacted thickness of 4 inches.

B. Cohesionless Free-draining Material:

1. Compact with crawler-type tractors, vibrating drum rollers, surface plate vibrator, or similar equipment.
    a. Uniformly distribute equipment passes.
    b. Compact in horizontal layers to compacted thickness of 12 inches or less.
2. Special compaction: Compact with hand held impact tampers, vibrating plate tampers, or small tamping equipment.
    a. Uniformly distribute effort.
    b. Compact in horizontal layers to compacted thickness of 6 inches.

C. Cohesionless Soils Containing Some Silt and Clay: Compact in accordance with either procedure above.

D. Density:

1. Percent Compaction, minimum: 85 percent for embedment if screened native material is utilized.

2. Percent Compaction, minimum: 95 percent for embedment if select material is utilized.

3. Percent Compaction, minimum: 95 percent under roadways, pump stations, tanks, vaults and assemblies.

E. Demonstration:

1. Lift thicknesses may vary depending on equipment and methods. Before changing requirements in this Section, demonstrate that required density will be obtained.

3.05 MEASURE OF COMPACTION

A. Determine unit weight of soils in-place using one of the following methods:

1. Silty or Clayey and Cohesionless Soils:

a. ASTM D1556.

b. ASTM D4914.

c. ASTM D5030.

d. ASTM D6938.

B. Determine degree of soil compaction by one of the following:

1. Silty or clayey soils:

a. Percent Compaction:

1) Rapid Method: ASTM D5080.

2) Laboratory Compaction Test: Comparison of in-place dry unit weight of minus No. 4 sieve size control fraction to laboratory maximum dry unit weight as determined by ASTM D698, Method A.

3) Silty and clayey soils containing more than 5 percent gravel:

a) In-place unit weight of minus No. 4 size control fraction determined by screening oversize material, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D4718.

2. Cohesionless soils:

   a. Percent Compaction for sands:

      1) In-place dry unit weight of minus 3/4 inch control fraction compared to the maximum dry unit weight determined by ASTM D7382.

      2) In-place unit weight of minus 3/4 inch size control fraction determined by screening oversize material, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D4718.

   b. Percent compaction for gravels: 3 passes with a vibratory plate compactor as directed by COR.

3. Cohesionless Soils Containing Some Silt and Clay: Use whichever testing procedure result requires higher in-place dry density.

C. Adjustment:

1. For soils with 5 to 30 percent oversized particles: In-place dry unit weight of control fraction determined by screening oversize material, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D4718.

2. For soils containing greater than 30 percent oversized particles: Required Percent Compaction may be adjusted in accordance with appropriate curve on Figure 3 in USBR Guidelines for Earthwork Construction Control Testing of Gravelly Soils.

3.06 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting as required in Table 31 23 02A - Contractor Materials Testing Requirements and Frequency.

   a. Independent testing laboratory shall meet requirements specified in Section 01 46 20 - Testing Agency Services.

2. Notify the independent testing laboratory and Government 24 hours before compaction work begins and 24 hours before significant change in compaction operations (major change in equipment or procedure used).

3. Notify the independent testing laboratory and Government immediately of equipment change due to breakdown, or re-deployment.

4. Notify COR within 2 hours if testing does not meet specified requirements.

5. Testing Frequency:

a. At a minimum, perform test at frequencies specified in Table 31 23 02A - Contractor Materials Testing Requirements and Frequency.

b. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.

c. After a successful work operation pattern is established, testing frequency may be performed at the minimum guidelines.

d. Perform additional tests at sites considered questionable by the Government; such as suspected incomplete compaction, surfaces that may have become excessively wet or dry since compaction, compacted surfaces torn up by subsequent equipment travel, or other similar circumstances. Frequency of additional testing is at discretion of the Government.

Table 31 23 02A - Contractor Materials Testing and Frequency

PROCEDURE	TEST STANDARD	STANDARD TITLE	MINIMUM FREQUENCY OF TESTING
Soil Classification	ASTM D2487	Classification of Soils for Engineering Purposes	As necessary to classify material to meet specification requirements or to index material for determining density by nuclear method.
	ASTM D2488	Description and Identification of Soils	
Moisture Content	ASTM D2216	Laboratory Determination of Water (Moisture Content of Soil and Rock by Mass).	With in-place density or as required to index material for determining density by nuclear method.
Laboratory Compaction (Standard Effort)	ASTM D698, Procedure A.	Laboratory Compaction Characteristics of Soil Using Standard Effort	One test every 500 cubic yards Minimum 1 test per day per compacted backfill operation, regardless of amount of material placed.
Laboratory Compaction (Vibratory Hammer)	ASTM D7382	Standard Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer	One test every 500 cubic yards Minimum 1 test per day per compacted backfill operation, regardless of amount of material placed.

Table 31 23 02A - Contractor Materials Testing and Frequency

PROCEDURE	TEST STANDARD	STANDARD TITLE	MINIMUM FREQUENCY OF TESTING
Oversized Correction	ASTM D4718	Correction of Unit Weight and Water Content for Soils Containing Oversize Particles	When oversize material is between 5 to 30 percent
Rock Factor	USBR	USBR Guidelines for Earthwork Construction Control Testing of Gravelly Soils	When oversize material is greater than 30 percent
Sand Cone	ASTM D1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method	One test every 500 cubic yards Minimum 1 test per day per compacted backfill operation, regardless of amount of material placed
Rapid Construction Control	ASTM D5080	Rapid Determination of Percent Compaction	One test every 500 cubic yards Minimum 1 test per day per compacted backfill operation, regardless of amount of material placed.
Nuclear Method	ASTM D6938	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)	One test every 100 cubic yards Minimum 1 test per day per compacted backfill operation, regardless of amount of material placed. Minimum 1 test per foundation prior to concrete placement.

B. Contractor Support:

1. Provide timely access to areas for density testing and excavate and level an area in compacted material to provide a surface for testing.
   a. Test fills compacted by sheepsfoot rollers 1 or 2 lifts below surface.
2. Government may select location of testing.
3. When density is being measured by a sand-cone device in accordance with ASTM D1556, cease construction activity in immediate vicinity of testing.
4. Dig test pits as requested to examine compacted soil against structures or pipe.
5. Backfill test pits to original requirements.

6. Provide warning lights, flags, or other safety devices as needed by testing personnel.

7. Provide adequate lighting for performing test if required because of darkness.

3.07 FIELD QUALITY ASSURANCE

A. The Government may perform test as required to verify contractor quality testing. If the Government performs quality assurance testing, provide support as required for Contractor quality testing.

END OF SECTION

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SECTION 31 23 10
EARTHWORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Common Excavation:

1. Measurement: Made to excavation paylines shown on the drawings or to paylines directed by the COR.
    a. Regardless of quantities removed, measurement for payment will be made to the prescribed paylines.
    b. For safety or other reasons, the Government reserves the right to require the Contractor to excavate beyond the prescribed paylines.
    c. Measurement for payment for additional excavation will be made to limits directed by COR.
2. Payment: Cubic yard price offered in the Price Schedule.
    a. Includes cost of labor and materials for work necessary to maintain excavations in good order during construction; removing such temporary construction, where required, and disposing the excavated material.
    b. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation will be at Contractor's expense.
    c. Work items:
        1) Air Chamber Buildings No. 1 and No. 2 yard and drain piping.
        2) Regulating Tanks No. 1 and No. 2 yard piping and drainage features.
        3) Pumping Plant No. 1 and No. 2 drain piping.

B. Placing and Compacting Backfill:

1. Measurement: Made to structure lines and excavation paylines, and compacted backfill lines shown on the drawings.
2. Payment: Cubic yard price offered in the Price Schedule.
    a. Placing:
        1) Includes haul of material. Material from required excavation used for backfill will be paid for both as excavation when removed from original position and as backfill when placed.

2) Where additional material is obtained from approved borrow pits and used for backfill about structures, payment will be made for backfill only.

3) Refill of excavation performed outside the established paylines for excavation for structures will be at Contractor's expense.

b. Compacting. Includes:

1) Cost of furnishing water and moistening materials.

2) Compacting refill outside of excavation paylines will be at expense of Contractor.

3) Work items:

a) Air Chamber Buildings No. 1 and No. 2 yard and drain piping.

b) Regulating Tank No. 1 and No. 2 yard piping and drainage features.

c) Pumping Plants No. 1 and No. 2 drain piping.

C. Cost:

1. Include backfilling about fencepost footings in linear foot price offered in the Price Schedule for Chain Link Fence.

D. Cost:

1. Include compacting backfill about fencepost footings in linear foot price offered in the Price Schedule for Chain Link Fence.

E. Cost:

1. Include costs of excavation, backfill, and compacting backfill for buried electrical items in prices offered in the Price Schedule for Complete Electrical System.

1.02 DEFINITIONS

A. Additional Excavation: Excavation beyond specified lines as directed by the COR to remove unsuitable foundation material.

B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines.

C. Rock Excavation:

1. Material that cannot be ripped with a 400 horsepower or larger crawler tractor equipped with a ripper rated for hard rock.

2. Material that cannot be excavated with a 300 horsepower or larger hydraulic excavator, with rock teeth, in areas where it is not feasible for ripping with a crawler tractor.

D. Cover: Distance between the top surface of buried cables, conductors, or conduits and the finished grade.

1.03 PROJECT CONDITIONS

A. Soil and rock conditions are described in Section 53 10 00 - Geology.

PART 2 PRODUCTS

2.01 EXCAVATED MATERIALS

A. Excavate to yield as much suitable material for use in permanent construction required under these specifications as practicable.

B. Place excavated materials which are too wet for immediate compaction temporarily in stockpiles until moisture content is reduced sufficiently to permit them to be placed in embankments.

2.02 MATERIAL FOR COMPACTING BACKFILL

A. Type and amount of material used for backfill, and manner of depositing material shall be subject to approval.

B. Obtain backfill material from required excavations. If sufficient suitable material is not available from this source, obtain additional material from approved borrow pits.

1. The Government makes no guarantee that specified backfill materials are contained in or can be processed from materials excavated.

C. Do not place material in backfill when either the material or the surfaces on which it is to be placed are frozen.

D. Do not use material removed in stripping for backfill material.

E. Do not use expansive clays and shales for backfill material.

F. Backfill material to be compacted: Contain no stones larger than 3 inches in diameter, approved by the COR, and obtained from required excavation or approved borrow pits.

G. Maximum stone size placed in backfill material not to be compacted: 3 inches in diameter.

H. Backfill within 2 inches of buried electrical grounding cables, insulated cables, and conduit: Sand or equally fine earth material.

PART 3 EXECUTION

3.01 EXCAVATION, GENERAL

A. Excavate to elevations shown on the drawings or established by the COR.

B. The Government reserves the right, during progress of work, to vary slopes, grades, and dimensions of excavations from those specified.

C. The Government does not represent that excavation performed under these specifications can be made to or maintained at paylines shown on the drawings or described in these specifications.

D. Perform excavation in the dry.

E. Do not excavate in frozen materials without written approval.

F. Where excavating in backfill and embankment placed under these specifications, excavate in accordance with applicable provisions for excavation.

G. Blasting: Not allowed.

H. Preserve material below and beyond established lines of excavation in the soundest possible condition.

1. Damage to work due to the Contractor's operations shall be repaired by and at the expense of the Contractor.

2. Material beyond required or prescribed excavation lines which is loosened by the Contractor's operations shall be removed at the expense of the Contractor.

3.02 PREPARATION OF FOUNDATIONS

A. Prepare foundations at structure sites by methods which will provide firm foundations for structures.

1. Finish bottom and side slopes of excavation, upon or against which the structure is to be placed, to prescribed dimensions.

2. Moisten and compact prepared surfaces with suitable tools to form firm foundations upon or against which to place the structure.

B. Where unsuitable material is encountered in the foundation for a structure, the COR will direct performance of additional excavation to remove unsuitable material.

1. Refill additional excavation with compacted backfill in accordance with Section 31 23 02 - Compacting Earth Materials.

C. Notify COR at least 48 hours in advance.

3.03 OVEREXCAVATION

A. If foundation material is excavated beyond lines required to receive the structure, fill overexcavation with suitable materials and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

B. If foundation material is disturbed or loosened during excavation or otherwise, compact foundation in place or remove and replace it with suitable material and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.04 DISPOSAL OF EXCAVATED MATERIALS

A. Dispose of excavated materials which are unsuitable for or are in excess of embankment, backfill, or other earthwork requirements, as determined by the COR, as provided in Section 31 23 39 - Disposal of Excavated Materials.

3.05 PLACING BACKFILL

A. Place backfill to the lines and grades shown on the drawings, or as directed by the COR.

B. Place backfill carefully and spread in uniform layers so that all spaces about rocks and clods will be filled.

C. Backfill trenches to the finished lines of adjacent earthwork.

3.06 COMPACTING BACKFILL

A. Place, moisten, and compact materials in backfill as provided in Section 31 23 02 - Compacting Earth Materials.

3.07 PROTECTION

A. To provide adequate protection for compacted backfill about a structure, the Government reserves the right to direct the Contractor to place a sufficient amount of backfill or embankment material over compacted backfill within 72 hours after completion of compacting backfill.

3.08 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR within 48 hours of completion of excavation but before compaction. Do not compact until approved by COR.

END OF SECTION

SECTION 31 23 22
PIPE TRENCH EARTHWORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Common Excavation for Pipe Trenches:

1. Measurement: Made to paylines and lengths shown on drawings.

   a. Regardless of actual widths, bottoms, and side slopes excavated, measurement will be made to paylines shown on drawings and to original ground surface.

   b. Measurement for payment for additional excavation will be made to trench widths (W_p) shown on drawings and to depth directed by COR.

   c. Measurement for payment will be continuous through pipe fittings.

   d. Measurement for payment for excavation for concrete for pipe fittings that is outside the trench excavation paylines will be made to lines and dimensions shown on the drawings or to the neatlines of the concrete.

2. Payment: Cubic yard price offered in the Price Schedule.

   a. Includes cost of labor and materials for shoring, sheeting, bracing, timbering, safety sloping, and other temporary construction; of pumping and unwatering; of removing such temporary construction where required; stockpiling excavated material for backfill; and disposal of unused or wasted excavated materials.

   b. No direct payment will be made for excavation for pipe trenches for pipe outside the paylines shown on drawings. Include cost of excavation for pipe trenches required outside paylines in the prices offered in the Price Schedule for Common Excavation for Pipe Trenches.

   c. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

   d. Where excavation is performed in backfill, no payment will be made for the resulting excavation, backfill, and compacting backfill.

   e. Includes Bank Protection.

B. Rock Excavation for Pipe Trenches:

1. Measurement: Made to paylines shown on drawings and trench lengths of rock material excavated.

a. Regardless of actual widths, bottoms, and side slopes excavated, measurement will be made to the paylines shown on drawings and to the original ground or rock surface.

b. Measurement for payment for additional excavation will be made to W_p and trench bottom shown on drawings and to depth directed by COR.

c. Measurement for payment will be continuous through pipe fittings.

d. Measurement for payment for excavation for concrete for pipe fittings that is outside the trench excavation paylines will be made to lines and dimensions shown on the drawings or to the neatlines of the concrete.

2. Payment: Cubic yard price offered in the Price Schedule.

a. Includes cost of labor and materials for mechanical breaking, shoring, sheeting, bracing, timbering, safety sloping, and other temporary construction; of pumping and unwatering; of removing such temporary construction where required; stockpiling excavated material for backfill; and disposal of unused or wasted excavated materials.

b. No direct payment will be made for rock excavation for pipe trenches outside the W_p, depth and length listed above. Include cost of rock excavation for pipe trenches required outside payline prices offered in the Price Schedule for Rock Excavation for Pipe Trenches.

c. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

C. Backfill for Pipe Trenches:

1. Measurement:

a. Made to the excavation paylines for pipe trenches, to lengths shown on the drawings, or as directed less the volume of pipe based on the diameters (Dp) shown on drawings, regardless of actual diameters of pipe furnished.

b. Measurement for payment for backfill in pipe trenches for additional excavation of pipe trenches will be made to the trench widths (W_p) shown on drawings and to the depth directed by the COR.

c. Backfill material mounded or spread over the trench above the original ground surface will not be measured for payment as backfill in pipe trenches.

2. Payment: Cubic yard price offered in the Price Schedule.

a. Includes cost of work associated with the excavation or procuring, processing, and hauling of necessary material.

b. Material from required excavation used for backfill in pipe trenches will be paid for both as excavation when removed from original position and as backfill when placed.

c. Where backfill material is obtained from other sources, payment will be made for backfill only. Include the cost of excavating or procuring, hauling, and processing of such material in the unit price offered in the Price Schedule for backfill in pipe trenches.

d. No direct payment will be made for backfill in pipe trenches for pipe outside paylines shown on drawings. Include cost of backfill outside these paylines in the prices offered in the Price Schedule for Backfill for Pipe Trenches

e. No direct payment will be made for furnishing and placing coarse concrete aggregate around air valves, blowoffs, and turnout. Include cost in the price offered in the Price Schedule for backfill in pipe trenches.

f. No payment will be made for backfill required to fill overexcavation performed by the Contractor.

g. No payment will be made for the removal and reconstruction of defective and nonconforming backfill compacted to an insufficient density.

h. Includes Bank Protection.

D. Compacting Backfill in Pipe Trenches:

1. Measurement: Made in place to the paylines and lengths shown on drawings, and will be made only for the quantities actually compacted within the excavation paylines for pipe trenches.

a. The volume of pipe will be deducted based on the diameters (Dp) shown on drawings, regardless of the actual diameters of pipe furnished.

b. Measurement for payment for compacting backfill in pipe trenches for additional excavation of pipe trenches will be made to the trench widths (W_p) shown on drawings and to the depth directed by the COR.

2. Payment: Cubic yard price offered in the Price Schedule.

a. Includes cost of furnishing water and moistening the material.

b. No direct payment will be made to the Contractor for compacting backfill in pipe trenches for pipe outside the paylines shown on drawings. Include cost of compacting backfill required outside paylines in the prices offered in the Price Schedule for Compacting Backfill in Pipe Trenches.

c. Compacting backfill for overexcavation outside specified or directed excavation paylines will be at the expense of the Contractor.

d. Includes Bank Protection.

1.02 DEFINITIONS

A. Additional Excavation: Excavation beyond specified lines as directed by the COR to remove unsuitable foundation material.

B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines.

C. Rock Excavation:

1. Material that cannot be ripped with a 400 horsepower or larger crawler tractor equipped with a ripper rated for hard rock with a rock tooth.

2. Material that cannot be excavated with a 300 horsepower or larger hydraulic excavator, with rock teeth, in areas where it is not feasible for ripping with a crawler tractor.

D. Excess excavated materials: Materials which are not used or processed for use as backfill material and waste materials from such processing.

1.03 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO SSHB-02	Standard Specifications for Highway Bridges, 17th Edition

1.04 PROJECT CONDITIONS

A. Soil and rock conditions are described in Section 53 10 00 - Geology.

PART 2 PRODUCTS

2.01 MATERIALS FOR BACKFILL

A. Use materials removed in excavating for pipe trenches or from other sources arranged for by the Contractor.

1. The Government makes no guarantee that specified backfill materials are contained in or can be processed from materials excavated from pipe trenches.

B. Do not use expansive clays in compacted backfill.

C. Bedding and Embedment: Use one of the following as allowed on drawing 1695-D-60045:

1. Screen native material or select material: Conform to gradation limits as shown on tables on drawing 1695-D-60045 or,

2. Controlled low strength materials in accordance with Section 31 23 70 - Controlled Low Strength Materials (CLSM) may be used in lieu of select material. CLSM is required as shown on drawing 1695-D-60045.

D. Maximum backfill particle size within 1 foot of the outside of pipe: Conform to requirements of Table 31 23 22A - Maximum Backfill Particle Size.

Table 31 23 22A - Maximum Backfill Particle Size

Type of Pipe	Maximum Particle Size, inches
Fiberglass, PVC, metallic pipe with dielectric coating, or metallic pipe encased in polyethylene	3/4
Coal-tar enamel-coated and -wrapped or plastic tape-coated steel line pipe with an approved bonded coatings	1-1/2
Polyethylene Pipe: Diameter up to 4 inches Diameter 6 inch to 8 inch Diameter 10 inch to 16 inch Diameter greater than 16 inch	 1/2 3/4 1 1 1/2
Other pipe	3

E. Maximum backfill particle size beyond 1 foot of outside of pipe: 1/2 lift height.

F. Particle size of material placed in compacted backfill, maximum: 3 inches.

G. Particle size of material placed in uncompacted backfill, maximum: 5 inches.

H. Backfill placed where pipelines cross under open irrigation ditches and other watercourses: Silty or clayey material with a plasticity index of 8 or more.

PART 3 EXECUTION

3.01 GENERAL

A. Perform operations so that land can be restored to original conditions.

3.02 EXCAVATION

A. Do not excavate pipe or keep pipe trench open more than 300 feet ahead or 100 feet when groundwater is present of pipelaying, backfilling, or compacting backfill operations, unless approved by COR.

1. Backfill and Compacting Operations:

a. Shall not fall behind pipelaying and excavation operations,

b. Allow CLSM to obtain required strength in accordance with Section 31 23 70 - Controlled Low Strength Materials (CLSM).

c. At the end of each shift:

1) One hundred feet of pipe trench, maximum, is open ahead of pipelaying and,

2) Backfill is within 100 feet of pipelaying.

3) For trenches left open overnight,

a) Cap exposed end of the pipeline.

b) Fence open trench with temporary safety fence in accordance with Section 01 56 32 - Temporary Safety Fence.

2. If backfilling and compacting fall behind pipelaying operations, stop excavation and pipelaying operations. Do not proceed until directed by the COR.

B. Excavate pipe trenches for pipelines, delivery installations, and pipeline accessories to lines, grades, and dimensions shown on drawings.

C. Finish bottom of trench accurately to lines and grades shown on drawings.

D. Perform excavation in the dry.

E. Do not excavate in frozen materials without written approval of the COR.

F. Place wildlife escape ramps and crossovers every 1,320 feet.

1. Place escape ramps and crossovers every 500 feet where active grazing is taking place or in Wildlife Specially Designated Areas.

2. Crossovers:

a. Ten foot wide, minimum.

b. Not fenced.

3. Maintain existing livestock and wildlife trails as a crossover.

G. Slope end of open trench with 3:1 Slope at end of work day.

3.03 ADDITIONAL EXCAVATION

A. Perform additional excavation in trench bottom for pipe foundations as shown on drawings and other additional excavation beyond specified lines, as directed by the COR.

3.04 OVEREXCAVATION

A. When foundation material is overexcavated beyond specified or directed lines, fill the overexcavation with backfill materials and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

B. If foundation material is overexcavated by being disturbed or loosened during excavation, compact material in place or remove and replace with backfill material and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.05 STOCKPILING

A. Stockpile excavated materials which meet or will be processed to meet material requirements for backfill in pipe trenches until processed or used as backfill material.

3.06 BEDDING AND EMBEDMENT

A. Place to lines shown on drawings or as directed by the COR.

B. Place CLSM in accordance with Section 31 23 70 - Controlled Low Strength Material (CLSM) and as shown on drawings.

C. Use CLSM in open cut road crossings.

D. Use CLSM for utility crossings and extend 10 feet on each side of crossing.

E. Do not drop directly on pipe.

F. If bedding is used, place bedding material below bottom of pipe before pipe is laid. Grade bedding material parallel to bottom of pipe.

G. Place to widths and depths shown on drawings.

H. Place at same elevation on both sides of pipe to prevent unequal loading and displacement of pipe. Elevation difference on sides of pipe shall not exceed 6 inches.

3.07 BACKFILL PLACEMENT

A. Install warning tape over center of pipe at least 18 inches below ground and at least 18 inches above pipe.

B. Place backfill in pipe trenches to lines shown on drawings, or as directed by the COR.

C. Do not place material in backfill when either the material or the surfaces on which the backfill is to be placed are frozen.

D. Place backfill for overexcavation performed outside specified or directed paylines for excavation for pipe trenches in the same manner as specified for adjacent backfill or embedment.

E. Do not drop backfill directly on pipe.

F. Place backfill carefully and spread in uniform layers so that spaces about rocks and clods will be filled.

G. Place backfill in lifts:

1. Backfill to be compacted: In accordance with Section 31 23 02 - Compacting Earth Materials.

2. Maximum lift height of other backfill: 1 foot.

H. Place backfill to the same elevation on both sides of the pipe to prevent unequal loading and displacement of pipe. Elevation difference of backfill on sides of pipe shall not exceed 6 inches.

I. Backfill above compacted backfill may be placed as soon as compacting of backfill is completed.

1. Placing of this backfill shall be delayed at locations designated by the COR for compacted backfill sample collection for testing.

J. Place backfill over pipe as approved by the COR, if backfilling operations are interrupted for more than 24 hours.

3.08 COMPACTING BACKFILL

A. Compact backfill in pipe trenches in layers having about the same top elevation on both sides of the pipe to prevent unequal loading and displacement of the pipe.

B. Compact backfill as specified in Section 31 23 02 - Compacting Earth Materials.

C. Location of Compacted Backfill:

1. As shown on drawings.

2. For air valve and blowoff foundations.

3. On outside of horizontal curves for a minimum of restrained pipe length.

4. Where pipeline cross under roadways and driveways.

5. Where utility pipelines cross pipeline:

a. To horizontal centerline of pipeline crossing lateral pipeline and to dimensions and slopes.

6. At pipe bends, encasements, and collars including collar-type blocking.

7. Around valve boxes and pipe erected vertically for air valves.

8. Where additional excavation for pipe trenches is directed by COR to remove foundation material or other material, compact backfill within paylines for this work.

9. Backfill at tees with horizontal outlets as shown on drawings.

D. When tests indicate insufficient density of compacted backfill about pipe:

1. Remove backfill above compacted backfill.

2. Compact backfill until proper density is obtained

3. Replace backfill above compacted backfill

4. This work shall be at the Contractor's expense.

3.09 PROTECTION

A. Government reserves the right to direct the Contractor to place a sufficient amount of backfill material over compacted backfill within 72 hours after compacting of backfill has been completed.

B. Place uncompacted backfill to a minimum depth of 3 feet or compact backfill to a minimum depth of 2 feet above top of pipe before allowing construction equipment to travel over pipe.

1. After these minimum earth covers are in place, the maximum equipment loading allowed over the pipe shall be HS-20 loading (16,000 pound wheel load) in accordance with AASHTO SSHB.

2. If construction equipment that exerts a larger wheel load is proposed to be used, submit construction equipment loadings to the COR for analysis and determination of required backfill depths or other protective measures.

3.10 DISPOSAL

A. Dispose of excess excavated materials in accordance with Section 31 23 39 - Disposal of Excavated Materials.

END OF SECTION

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SECTION 31 23 39
DISPOSAL OF EXCAVATED MATERIALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices in the Price Schedule for Common Excavation for Pipe Trenches.

B. Cost:

1. Include in prices in the Price Schedule for Rock Excavation for Pipe Trenches.

C. Cost:

1. Include in prices in the Price Schedule for Common Excavation for Structures.

D. Cost:

1. Include in prices in the Price Schedule for Rock Excavation for Structures.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DISPOSAL OF EXCAVATED MATERIALS

A. Waste material from required excavation which is not suitable or required for backfill, embedment, bedding, or topsoil.

B. Waste areas for excavated materials, 6 inches or smaller, as directed by COR.

C. Dispose waste material within ROW, as directed by COR, unless prior approvals of cultural and environmental clearance have been obtained outside of ROW.

D. Do not place waste material in wetlands, within 12 feet of drainage channels, within 12 feet of edge of prescribed or actual cuts for laterals, wasteways, or drains.

E. Do not waste material by dumping from top of slope.

F. Grade material to reasonably even and uniform surfaces that blend with natural terrain and drainages.

1. Minimum slope: 2 percent.
2. Maximum slope: 4H:1V.

G. Seed surface in accordance with Section 32 92 20 - Seeding.

END OF SECTION

SECTION 31 23 70

CONTROLLED LOW STRENGTH MATERIALS (CLSM)

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Backfill for Pipe Trenches.

B. Cost:

1. Include in the price offered in the Price Schedule for 24 Inch Diameter Metal Culverts.

C. Cost:

1. Include in the price offered in the Price Schedule for Steel Pipe.

1.02 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 318-11	Building Code Requirements for Structural Concrete

B. ASTM International (ASTM)

1.	ASTM C94/C94M-14b	Ready-Mixed Concrete
2.	ASTM C114-13	Chemical Analysis of Hydraulic Cement
3.	ASTM C143/C143M-12	Slump of Hydraulic-Cement Concrete
4.	ASTM C150/C150M-12	Portland Cement
5.	ASTM C618-12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
6.	ASTM C1602/C1602M-12	Mixing Water Used in the Production of Hydraulic Cement Concrete
7.	ASTM D1558-10	Moisture Content Penetration Resistance of Fine Grained Soils
8.	ASTM D4318-10	Liquid Limit, Plastic Limit and Plasticity Index of Soils
9.	ASTM D4832-10	Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

10.	ASTM D6024-15	Ball Drop on Control Low Strength material (CLSM) to determine Suitability for Load Application

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 23 70-1, Approval Data For Clsm Produced Without Native Soil:

1. Mix Design: For each CLSM mix.
    a. Mixture proportions.
    b. Material sources.
        1) Name and manufacturer of each cementitious material.
        2) Name of aggregate sources.
        3) Product name and manufacturer of admixtures to be used in mix.
        4) Government reserves right to require submission of samples of CLSM materials for testing before or during use in concrete.
    c. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
        1) 10 to 30 passing 200 sieve.
        2) 30 to 50 passing 200 sieve.
    d. Physical properties:
        1) Trial mixtures:
            a) Results from trial batches made within past 6 months.
            b) Trial mix test results, three 6 inch diameter cylinders each at 7 days and 28 days.
            c) Average compressive strength of trial batch cylinders at specified design age.
    e. Resubmit mix design for change in material source or type.
    f. Cementitious materials manufacturer’s certifications and test reports within last 6 months.
    g. Aggregate test reports for gradation and plasticity, less than 6 months old.
    h. Method to determine moisture and consistency of materials to maintain specified strengths. Provide testing frequency.
2. NRMCA Certification of Production Facilities:
    a. Automatic digital recording of cementitious materials, aggregate, water, and chemical admixtures.

b. Verification that facility meets requirements for furnishing concrete in subfreezing weather.

c. ACI Personnel Certification(s):

1) Aggregate Testing Technician.

2) Concrete Field Testing Technician.

3) Concrete Strength Testing Technician.

3. Current calibration of scales, water meters, and admixture dispensers.

4. If Quality control test results show CLSM does not meet requirements, submit revised mix design.

C. RSN 31 23 70-2, Approval Data For Clsm Produced With Native Soil:

1. Submit Mix design for each material type.

a. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:

1) 10 to 30 percent passing 200 sieve.

2) 30 to 50 percent passing 200 sieve.

b. Physical properties:

1) Trial mixtures:

a) Results from trial batches made within past 6 months.

b) Trial mix test results, three 6 inch diameter cylinders each at 7 days and 28 days.

c) Average compressive strength of trial batch cylinders at specified design age.

c. Resubmit mix design for change in material source or type.

d. Cementitious materials manufacturer’s certifications and test reports within the last 6 months:

e. Material test reports for gradation and plasticity, less than 6 months old.

2. Soil processing and mixing equipment.

3. Foreman references.

4. Method to maintain specified strengths using native soils.

5. If quality control test results show CLSM does not meet specified requirements, submit revised mix design.

D. RSN 31 23 70-3, Quality Control Test Results:

1. Notify COR within 2 hours if testing does not meet specified requirements.

2. If Quality Control Test Results show CLSM does not meet specified requirements, submit a revised mix design.

1.04 DELIVERY, STORAGE, AND HANDLING

A. For CLSM delivered from ready mix plants, furnish complete and legible batch ticket with each batch of CLSM in accordance with ASTM C94. Deliver ticket to COR at jobsite during batch delivery.

1.05 QUALIFICATIONS

A. References for foreman in charge of CLSM placement, if CLSM is produced with native soils: 3 projects within last 3 years.

PART 2 PRODUCTS

2.01 BACKFILL FOR PIPE TRENCHES

A. See Section 31 23 22 - Pipe Trench Earthwork.

2.02 24 INCH DIAMETER METAL CULVERTS

A. See Section 33 42 30 - Corrugated Metal Pipe Culverts.

2.03 STEEL PIPE

A. See Section 35 21 95 - Steel Pipe.

2.04 CEMENTITIOUS MATERIALS

A. Cement and pozzolan shipments shall be accompanied by shipping documents containing:

1. Manufactures Certification that material meets requirements.
2. Type or class of material shipped.
3. Manufacturing locations and dates.
4. Lot (bin) number.
5. Date of shipment.
6. Quantity of material shipped.
7. Provide to COR.

B. Cementitious Materials Options:

1. Specified Portland cement plus 20 to 80 percent by weight of total cementitious (cement plus pozzolan) specified pozzolan, in accordance with ACI 318.

C. Portland Cement:

1. ASTM C150, Type V.
2. Meet equivalent alkalies requirements of ASTM C150, Table 2.
3. Meet false-set requirements of ASTM C150, Table 4.

D. Pozzolan:

1. ASTM C618, Class F, except,
   a. Sulfur trioxide for Class F, maximum: 4.0 percent.
   b. Loss on ignition, maximum: 2.5 percent.
   c. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C618. Use low-alkali cement for test.
   d. Does not decrease sulfate resistance of CLSM by use of pozzolan.
      1) Demonstrate pozzolan will have an "R" factor less than 2.5.
      2) R = (C-5)/F.
      3) C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.
      4) F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

2.05 WATER

A. ASTM C1602.

2.06 AGGREGATE OR SOIL

A. Aggregate:

1. ASTM C33.
2. Maximum particle size: 1-1/2 inches or 1/8 of open distance between pipe and trench wall, whichever is less.

B. Non-plastic Soil:

1. Non Plastic according to ASTM D4318.
2. Gradation:
   a. Passing U.S. Standard No. 200 sieve, by weight, maximum: 50 percent.
   b. Passing U.S. Standard No. 100 sieve, by weigh, maximum: 70 percent.
   c. Maximum particle size: 1/8 of open distance between pipe and trench wall or 3/8 inch, whichever is less.

3. Select or process soil so that particles remain in suspension, i.e., no segregation occurs, when CLSM is placed.

4. Clay balls:

a. Maximum percent, by weight of soil: 10 percent.

b. Maximum size: 3/8 inch.

2.07 MIX

A. Mixture of Aggregate or Soil, Cementitious Materials, Water, and Admixtures:

1. Cementitious material content: Percent by dry weight of aggregate or soil to obtain specified compressive strength.

2. Make trial mixes prior to placing CLSM to determine mixture adequacy.

a. Determine compressive strength in accordance with ASTM D4832.

b. Determine slump in accordance with ASTM C143.

B. Water Content: Not to exceed that required to provide a mix that will flow and can be pumped.

C. Seven day Compressive Strength, ASTM D4832: Not less than 50 pounds per square inch (lb/in2) and not more than 150 lb/in2.

D. Consistency:

1. Except, when a stiffer mix required to prevent CLSM from flowing down trenches on a steep slope:

a. Slump, ASTM C143: 8 to 10 inches.

2.08 CLSM TEMPERATURE

A. CLSM Temperature at Time of Placement: 50 degrees F to 85 degrees F (10 to 30 degrees C).

PART 3 EXECUTION

3.01 BATCHING EQUIPMENT

A. Design and Operation of Mixers: Discharged CLSM shall be uniform in composition and consistency throughout each batch.

1. Adjust amount of water and aggregates batched for CLSM to compensate for variations in moisture content or grading of aggregates as they enter mixer.

2. Inform COR prior to and after adjustments in batching equipment and control instrumentation.

3. Equip truck mixer with dial or digital water meter accurate to within 1 percent of total mix water located between water supply and mixer.
4. Provide revolution counter which indicates total number of revolutions of drum per batch.
    a. Visible from outside truck.
    b. Reset to zero for each batch.
5. Attach metal plate attached in a prominent place on the mixer listing:
    a. Manufacturer's recommended drum capacity.
    b. Mixing and agitating speeds in accordance with ASTM C94.
6. Initial Mixing: Not less than 70 revolutions and not more than 100 revolutions after ingredients are in the drum.
7. Mix 30 revolutions after addition of tempering water.
8. Mix 10 to 12 revolutions after a prolonged period of agitation.
9. Discharge CLSM before 300 drum revolutions.

B. Manufacture and deliver in accordance with ASTM C94.
1. In addition to requirements of ASTM C94, use water meter approved by COR to measure and record mix water for each batch.

C. Provide following information to COR:
1. Copy of current calibration of scales and water meters.
2. Mix water information.

3.02 TRIAL BATCH

A. Perform trial run with proposed equipment and material prior to placing CLSM.
1. Obtain Representative Sample of Material:
    a. If native soil materials are used, mix material from top of trench to proposed invert.
        1) Discard plastic material.
    b. Test material for gradation, plasticity.
2. Test CLSM for slump and compressive strength.
    a. Prepare and test three 6 by 12 inch cylinders for both 7 and 28 day according to ASTM D4832.

3.03 PREPARATION

A. Place pipe on soil pads or other approved compressible material such as extruded polystyrene foam insulation. Soil pads shall maintain horizontal and vertical alignment during backfilling operations.

1. Do not create point loads on the pipe.

a. Soil pads shall have a lower compressible strength than the surrounding CLSM.

3.04 PLACING

A. Notify COR at least 24 hours before batching CLSM. Include quantity of CLSM required for each daily placement. Unless inspection is waived, perform batching in the presence of a Government inspector.

B. Do not place CLSM during rain.

C. Do not mix or place CLSM when ambient temperature is below 40 degrees F. Except when, ambient temperature is 35 degrees F and rising and the daily high is predicted to be above 40 degrees F, CLSM may be placed, if approved by the COR.

D. Place CLSM to lines, grade, and dimensions shown on drawings.

1. Initially, place CLSM from 1 side of pipe. Where necessary, rod or vibrate CLSM so that CLSM flows under pipe and appears on other side.

2. Add CLSM to both sides of pipe and rod or vibrate until CLSM completely fills space between pipe and trench.

3. Do not disturb pipe trench or allow foreign material to become mixed with CLSM.

E. Restrain pipe to prevent flotation during placement of CLSM.

1. Do not point load pipe.

F. Do not place backfill material over CLSM until CLSM has reached initial set.

1. As determined by ASTM D6024 (ball drop test) or ASTM D1558 in the presence of the COR.

2. Do not place greater than 10 feet of backfill over the pipe until the CLSM has a compressive strength of 50 pounds per square inch or greater.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting.

a. Independent testing laboratory shall meet requirements specified in Section 01 46 20 - Testing Laboratory Services.

b. Government may inspect testing laboratory facilities. COR will notify testing facilities 72 hours before inspection. Periodic inspection may be required by COR.

2. If CLSM Contains Native Soils:

a. Obtain and test soil samples for gradation and plasticity once every 14 days at a minimum or if a change in soil is visually noted.

1) Test material 14 days ahead of placement from top of trench to proposed invert.

b. During CLSM batching, provide an inspector from testing laboratory to monitor soil characteristics and operations.

1) Modify material and or batching operations as recommended by testing laboratory.

2) Notify COR within 24 hours of modifications.

3. Obtain samples and test to determine compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.

a. Testing frequency:

1) At least once for each shift when placing CLSM.

2) Once every 100 cubic yards or,

3) If consistency of materials change.

b. Acceptance Criteria:

1) 7 day compressive strength, ASTM D4832:

a) Not less than 50 pounds per square inch and not more than 150 pounds per square inch.

b) 70 percent of test cylinders shall exceed 75 pounds per square inch.

c. Make adjustments to mixture to comply with strength requirements.

d. Stop work if specified requirements are not met.

3.06 FIELD QUALITY ASSURANCE

A. The Government will obtain samples and test for compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.

3.07 PROTECTION

A. When subsequent lifts of CLSM are to be placed, maintain surface of CLSM in a moist condition by use of tarps or water mist until subsequent lift of CLSM is placed.

B. If backfill will not be placed over CLSM within 8 hours, place 6 inch minimum cover of moist backfill over CLSM. Maintain moisture in 6 inch soil cover until additional backfill is placed.

C. If ambient temperature is forecast to be 50 degrees F or less within 8 hours of placing CLSM, place 12 inch minimum additional cover of loose backfill over 6 inch moist backfill cover before end of work day. Do not allow CLSM to freeze.

END OF SECTION

SECTION 31 31 30
SOIL-APPLIED HERBICIDE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Gravel Surfacing.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals:

B. RSN 31 31 30-1, Use Plan.

C. RSN 31 31 30-2, Applier Certification.

1.03 QUALIFICATIONS

A. Applicators: Certified by appropriate State or local agencies, as required.

1.04 REGULATORY REQUIREMENTS

A. Comply with label directions, and applicable USEPA, State, and local laws and regulations.

PART 2 PRODUCTS

2.01 HERBICIDES

A. Label: USEPA pesticide registration number.

B. Provide soil-applied herbicide conforming to one of the following:

1. Atrazine:

a. Composed of a finely divided, wettable powder containing a minimum of 80 percent chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine and related compounds.

b. Mix: Minimum of 2 gallons of water per pound of dry product.

2. Bromacil:

a. Composed of a finely divided, wettable powder containing a minimum of 80 percent bromo-3-sec-butyl-6-methyluracil.

b. Mix: Minimum of 2 gallons of water per pound of dry product.

3. Prometon:

a. Composed of a liquid emulsifiable solution containing a minimum of 25 percent 2-methoxy-4,6-bis isopropylamino-s-triazine.

b. Mix with water:

1) For small areas, add sufficient water to provide thorough and uniform coverage.

2) For large areas, add concentrate to 100 gallons of water per acre.

C. Commercial mixtures meeting requirements may be used.

PART 3 EXECUTION

3.01 APPLICATION

A. Apply herbicide to:

1. Service yards, to the limits shown on drawings for:

a. Pre-manufactured Pump Station No. 1.

b. Pre-manufactured Pump Station No. 21

c. Regulating Tank No. 2.

2. Select one herbicide from those specified.

3. Apply soil-applied herbicide at following rate:

a. Atrazine: Equivalent of 0.035 pound of dry product per 100 square feet (about 15 pounds per acre).

b. Bromacil: Equivalent of 0.035 pound of dry product per 100 square feet (about 15 pounds per acre).

c. Prometone: Equivalent of 0.017 gallon of herbicide concentrate per 100 square feet (about 7-1/2 gallons per acre).

B. Apply herbicide only with approval of the COR.

C. Apply uniformly.

D. During application, continuously agitate suspension.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cobble Channel Lining:

1. Measurement: Volume measured to outlines placed and to thickness shown on drawings or as directed by COR.
2. Payment: Cubic yard price offered in the Price Schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C33/C33M-13	Concrete Aggregates
2.	ASTM C88-13	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
3.	ASTM C97/C97M-15	Absorption and Bulk Specific Gravity of Dimension Stone
4.	ASTM C150/C150M-15	Portland Cement
5.	ASTM C260/C260M-10a	Air-Entraining Admixtures for Concrete
6.	ASTM C494/C494M-15	Chemical Admixtures for Concrete
7.	ASTM C1017/C1017M-13	Chemical Admixtures for Use in Producing Flowing Concrete
8.	ASTM C1602/C1602M-12	Mixing Water Used in the Production of Hydraulic Cement Concrete

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 37 00-1, Approval Data and Test Results:

1. Name and location of commercial rock source.
2. Gradation of rock.
3. Certified laboratory test results demonstrating rock meets specified material requirements.

PART 2 PRODUCTS

2.01 ROCK

A. Hard, dense, and durable.

1. Specific Gravity, ASTM C97, Minimum: 2.50.
2. Absorption, ASTM C97, Maximum: 2 percent.
3. Loss, Sulfate Soundness, ASTM C88, Maximum: 10 percent.

B. Shape: Maximum dimension not greater than 3 times minimum dimension.

C. Reasonably well graded within limits shown in Table 31 37 00A - Cobble Gradation.

Table 31 37 00A - Cobble Gradation

Diameter, inches	Percent Smaller than Given Size by Weight
D_{50} = 4 inches	
8	60 - 100
4	2 - 60
D_{50} = 6 inches	
12	70-100
9	50-70
6	35-50
2	2-10
D_{50} = 12 inches	
18	70-100
15	50-70

Table 31 37 00A - Cobble Gradation

Diameter, inches	Percent Smaller than Given Size by Weight
12	35-50
4	2-10

2.02 GROUT

A. Portland Cement:

1. ASTM C150, Type V.
2. Meet false-set requirements of ASTM C150 - Table 4.

B. Aggregate Materials:

1. Fine aggregate: ASTM C33.
2. Course aggregate: ASTM C33, Size No. 8.

C. Water: ASTM C1602, including optional requirements of Table 2.

D. Admixtures:

1. Air-Entraining Admixture:
   a. ASTM C260.
   b. Use a neutralized vinsol resin formulation for air-entraining admixture used with ASTM C494, Type F or G; and ASTM C1017, Type I or II chemical admixtures.
2. Allowable chemical admixtures:
   a. ASTM C494, Type F and G.
   b. ASTM C1017, Type I or II.
   c. Do not use chemical admixtures which contain more than 0.1 percent chloride, by weight.

E. Grout Mix:

1. Net water-cement ratio, maximum: 0.47, by weight.
2. Minimum cement content:
   a. 750 pounds per cubic yard of concrete.
   b. 710 pounds if a high-range water-reducing admixture is used.

3. Aggregate: 52 to 58 percent fine aggregate, by total volume of aggregate.
4. Slump:
    a. Design slump, maximum: 4 inches.
    b. Use high-range water-reducing, or plasticizing admixture to increase slump to assure grout penetration into voids.
5. Air entrainment: 6-1/2 to 8-1/2 percent.
6. Waste grout that has become too stiff that proper placing without retempering.

PART 3 EXECUTION

3.01 AREAS TO GROUTED COBBLE

A. Clear vegetation/debris from placement area.

B. Place to the outlines and thicknesses as shown on the drawings.

3.02 PLACING

A. Place so rocks are evenly distributed.

B. Dump and smooth by moving rocks into position so that material when in place is stable.

C. Begin placement at toe and proceed up slope.

D. Leave no unreasonably large unfilled spaces.

3.03 GROUT

A. Reasonably clean in place cobble prior to placement to ensure bonding of grout with cobble.

B. Wet cobble before placing grout.

C. Place grout in voids as directed by the COR.

D. Rod grout to assure penetration into voids.

E. Curing:
1. Apply curing compound to grouted surface to provide water-retaining film. Reapply as necessary to maintain a continuous, water-retaining film on surface for 28 days.
2. Mix compound and spray apply in 1 coat to provide a continuous, uniform film over surface.

END OF SECTION

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SECTION 32 15 10
GRAVEL SURFACING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Gravel Surfacing:

1. Measurement: Volume of in-place compacted material to outlines of area covered and to specified thickness.
2. Payment: Cubic yard price offered in the Price Schedule.
    a. Includes Herbicide.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM D1241-15	Materials for Soil-Aggregate Subbase, Base, and Surface Courses
2.	ASTM D4632-08(2013)	Grab Breaking Load and Elongation of Geotextiles
3.	ASTM D4751-12	Determining Apparent Opening Size of a Geotextile
4.	ASTM D6241-14	Static Puncture Strength of Geotextiles and Geotextile-related Products Using a 50-mm Probe

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 15 10-1, Gravel Certification:

1. Aggregate meets ASTM D1241 abrasion loss criteria.

C. RSN 32 15 10-2, Geofabric Installation:

1. Manufacturer’s recommendation.

D. RSN 32 15 10-3, Geofabric Certification:

1. Geofabric meets specified chemical, physical, and manufacturing requirements.

PART 2 PRODUCTS

2.01 HERBICIDE

A. See Section 31 31 30 - Soil-applied Herbicide.

2.02 GRAVEL

A. Gravel: ASTM D1241, Type I, Gradation C, surface-course materials, except,

1. Fine aggregate:

a. Minimum passing No. 200 sieve: 8 Percent.

b. Fraction passing No. 40 sieve:

1) Liquid limit, maximum: 35.

2) Plasticity index range: 4 to 9.

2.03 GEOFABRIC

A. 170N non-woven geotextile, manufactured by Mirafi, www.tencate.com; or equal, with the following essential characteristics:

1. Grab Tensile Strength (ASTM D4632): 180 pounds.
2. Elongation (ASTM D4632): 50 percent.
3. Puncture Strength (ASTM D6241): 400 pounds.
4. Apparent Opening Size (ASTM D4751): 70 US Sieve size.

PART 3 EXECUTION

3.01 PREPARATION

A. Grade and prepare subgrade free from depressions and soft spots.

B. Obtain COR approval of subgrade before placing surfacing.

3.02 PLACING GEOFABRIC

A. Place geofabric in accordance with manufacturer’s recommendations.

B. Do not tear geofabric during placing of gravel surfacing.

C. Placement:

1. Service Yards:

a. Pre-manufactured Pump Station No. 1.

b. Pre-manufactured Pump Station No. 2.

c. Regulating Tank No. 2.

2. In locations as shown on drawings.

3. Cobble Channel Linings: In locations as shown on drawings.

3.03 PLACING

A. Place gravel surfacing at following locations:

1. Service yards, to the limits shown on drawings for:

a. Pre-manufactured Pump Station No. 1.

b. Pre-manufactured Pump Station No. 2,

c. Regulating Tank No. 2.

2. Road Crossings: In locations as shown on drawings 1695-D-60027 through1695-D-60044.

3. Access Road: As shown on drawings 1695-D-60053.

B. Apply herbicide in accordance with Section 31 31 30 - Soil-applied Herbicide.

C. Place, moisten, and compact gravel surfacing in accordance with Section 31 23 02 - Compacting Earth Materials.

D. Dispose of excess and unsuitable materials in accordance with Section 31 23 39 - Disposal of Excavated Materials.

END OF SECTION

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SECTION 32 31 10
CHAIN LINK FENCE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Chain Link Fence:

1. Measurement: Length of chain link fence installed.
2. Payment: Linear foot price offered in the Price Schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A121-13	Metallic-Coated Carbon Steel Barbed Wire
2.	ASTM A392-11a	Zinc-Coated Steel Chain-Link Fence Fabric
3.	ASTM A824-01(2012)	Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
4.	ASTM C33/C33M-13	Concrete Aggregates
5.	ASTM F567-14a	Installation of Chain-Link Fence
6.	ASTM F626-14	Fence Fittings
7.	ASTM F900-11	Industrial and Commercial Swing Gates

B. Chain Link Fence Manufacturers Institute (CLFMI)

1.	CLFMI 2445-14	Product Manual

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 31 10-1, Certification:

1. Manufacturers' certification that fence materials, fittings, and accessories meet specified requirements.
2. Include manufacturers' names and product designations and specified product standards in the certification.

PART 2 PRODUCTS

2.01 CHAIN LINK FABRIC

A. Zinc-Coated Steel Fabric: ASTM A392.

1. Size of mesh: 2 inch.
2. Coat before weaving.
3. Diameter of coated wire: 0.148 inch (No. 9 gauge).
4. Coating weight: Class 1.

2.02 INTERMEDIATE POSTS

A. CLFMI 2445, Type I round pipe.

2.03 TERMINAL POSTS, BRACES, AND RAILS

A. CLFMI 2445, Type I round pipe.

2.04 TENSION WIRE

A. Zinc-coated Steel Marcelled Tension Wire: ASTM A824.

1. Coating: Type II, Class 4.

2.05 BARBED WIRE

A. Steel Barbed Wire: ASTM A121.

1. Coating: Type Z, Class 3.
2. Design Number: 12-2-4-14R.

2.06 FITTINGS

A. Post and Line Caps, Rail and Brace Ends, Braces, and Bands: ASTM F626, zinc-coated steel or zinc-coated cast iron.

B. Toprail Sleeves, Tension Bars, and Truss Rods: ASTM F626, zinc-coated steel.

C. Tie Wires, Clips, and Bands: ASTM F626.

1. Standard round wire ties.
    a. 9 gage steel.
    b. Zinc coating, minimum: 1.2 ounces per square foot.

D. Barbed wire arms: ASTM F626, Type I.

2.07 GATES

A. Gates: ASTM F900.

1. Double-swing type.
2. Directions of swing: 180 degrees outward opening.

B. Frame: CLFMI 2445, Type I round pipe.

1. Corners:
   a. Welded or heavy fittings.
   b. Rigid and watertight.

C. Fabric: Same type used in fence.

D. Accessories:

1. ASTM F900.
2. Gate hinges, latches, stops, and keepers: Zinc-coated steel or zinc-coated cast iron.

2.08 CONCRETE

A. Manufacture and delivery: In accordance with Section 03 30 00 - Cast-In-Place Concrete.

B. Fine and coarse aggregates: ASTM C33.

1. Coarse aggregate size, maximum: 3/4 inch.

C. Compressive strength at 28 days, minimum: 2,500 pounds per square inch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect chainlink fence and gates at locations shown on drawings.

B. Install chain link fences of heights shown on drawings.

C. Install fence and gates as shown on drawings, complete with fabric, posts, braces, rails, fittings, accessories, concrete footings, and other materials required for complete installation of the fence and gates.

D. Install chain link fence in accordance with ASTM F567 and CLFMI 2445, except as shown on the drawing or specified.

E. Terminal Posts:

1. Maximum intervals: 500 feet.

2. At vertical and horizontal changes in alignment equal to or greater than 30 degrees.

3.02 GROUND CONNECTIONS

A. Provide connections for fence in accordance with Section 26 05 20 - Grounding and Bonding.

3.03 REPAIR

A. Repair damage to zinc coatings in accordance with Section 09 96 20 - Coatings.

3.04 TESTING AND ADJUSTING

A. After installation, test and adjust gates for proper operation.

END OF SECTION

SECTION 32 91 60
EROSION CONTROL BLANKET

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Erosion Control Blanket:

1. Measurement: Surface area required to be covered, except no allowance will be made for overlaps, repairs, or waste.
2. Payment: Square yard price offered in Price Schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 91 60-1, Manufacturer's Information:

1. Literature listing specified essential characteristics.
2. Installation instructions.
3. Excelsior color sample.

C. RSN 32 91 60-2, Installation Plan:

1. Describe sequence of placing blanket.

PART 2 PRODUCTS

2.01 TOPSOIL EROSION CONTROL BLANKET

A. AEC Premier Coconut erosion control blanket, as manufactured by American Excelsior Company, 850 Avenue H East, Arlington TX, telephone: 800-777-7645; or equal, having the following essential characteristics:

1. Machine-assembled mat with 100 percent aspen or coconut excelsior within 2 layers of netting stitched to form a 3 dimensional matrix.
   a. Netting: Jute or other natural biodegradable fiber.
2. Consistent thickness with aspen or coconut excelsior curled, interlocked, and evenly distributed over entire area of mat.
3. Excelsior Color: Sand.
4. Unit Weight: 8 ounces per square yard.
5. Thickness, Minimum: 1/2 inch.

6. Thread Pattern: 4 inch wide by 4 inch long.

B. Supply blanket in protected, rolled mat form.

2.02 ANCHORS

A. Biodegradable staples, 6 inch minimum length, as recommended by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install erosion control blanket on seeded slopes steeper than 3:1, at locations shown on drawings or as directed by COR and in accordance with manufacturer's recommended installation procedures and approved installation plan.

B. At overlaps, shingle upstream matting over downstream matting.

C. Secure topsoil erosion control matting in a 6 by 6 inch anchor trench at top and bottom of berms and at upstream and downstream ends of mats.

D. Before backfilling anchor trenches, pin or staple erosion control blanket into anchor trench no more than 12 inch spacing as recommended by manufacturer.

E. Outside anchor trench, anchor topsoil erosion control matting with 3 to 4 staples per square yard as recommended by manufacturer.

3.02 REPAIR

A. Repair or replace damaged during installation topsoil erosion control matting at Contractor's expense.

END OF SECTION

SECTION 32 92 20

SEEDING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Seeding:

1. Measurement: Length of area disturbed or as directed by the COR.
2. Payment: Linear foot price based on pipe length installed offered in the Price Schedule.

1.02 DEFINITIONS

A. Pure live seed content: Weight of seed multiplied by percent purity multiplied by percent germination.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 92 20-1, Seeding Plan:

1. Qualifying experience for person responsible for supervision of seeding, for approval.
2. Names, addresses, and telephone numbers of references.
3. Equipment.
4. Name and address of seed suppliers.

C. RSN 32 92 20-2, Certifications:

1. Origin of seed.
2. Percent purity and germination.
3. Prohibited and restricted weed seed content.

1.04 DELIVERY STORAGE AND HANDLING

A. Seed containers:

1. Sealed.
2. Labeled:
    a. Identify seed origin on label.

1) Intrastate shipping: In accordance with New Mexico State Seed Laws and Regulations.

2) Interstate shipping: In accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

1.05 AMBIENT CONDITIONS

A. Do not seed or fertilize when ambient temperature is below 38 degrees F without approval of the COR.

B. Do not seed or fertilize when ground is snow covered.

C. Do not seed, fertilize, or mulch, or hydroseed when wind velocities prevent uniform application of materials or would drift materials.

PART 2 PRODUCTS

2.01 SEED

A. Weed seeds classified by State Seed Department:

1. Prohibited noxious weeds: None allowed.
2. Restricted noxious weeds: 0.5 percent maximum, by weight.

B. Seed Mixture:

1. Purity, Minimum: 85 percent.
2. Germination, Minimum: 85 percent.
   a. Germination test: Less than 1-year old at time of seeding.
3. Uniform mixture shown in Table 32 92 20A - Seed Mixture.

Table 32 92 20A - Seed Mixture

Common Name	Scientific Name	Variety	Season	Form	PLS lbs./acre*
Reduced Palatability seed mix (for Sagebrush and Greasewood Communities south of Largo Wash) (Sta: 22249+53 to Sta: 22464+67 And Sta: 22613+92 to Sta: 23093+39)					
Rubber rabbitbrush	*Ericameria nauseosa*	VNS	NA	Shrub	2.00
Fourwing saltbush	*Atriplex canescens*	VNS	NA	Shrub	2.00

Table 32 92 20A - Seed Mixture

Common Name	Scientific Name	Variety	Season	Form	PLS lbs./acre*
Fringed sage	*Artemisia frigida*	VNS	NA	Sub-shrub	2.00
Purple threeawn	*Aristida purpurea*	VNS	Warm	Bunch	3.00
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.50
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Sod	2.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.25
Scarlet globemallow	*Sphaeralcea coccinea*	VNS	Warm	Forb	0.25
Rocky Mountain beeplant	*Cleome serrulata*	VNS	Warm	Forb	0.25
Hairy false goldenaster	*Heterotheca villosa*	VNS	Warm	Forb	0.25
Pinyon-Juniper Wooded Shrubland seed mix, (Sta: 22464+67 To Sta: 22613+92)					
Antelope bitterbrush	*Purshia tridentata*	VNS	Cool	Shrub	2.00
Western wheatgrass	*Pascopyrum smithii*	Arriba	Cool	Sod	2.00
Needle-and-thread grass	*Hesperostipa comate*	VNS	Cool	Bunch	3.00
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.50
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Sod	2.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.25

Table 32 92 20A - Seed Mixture

Common Name	Scientific Name	Variety	Season	Form	PLS lbs./acre*
Scarlet globemallow	*Sphaeralcea coccinea*	VNS	Warm	Forb	0.25
Species in bold are known to grow in the project area. VNS = Variety not specified. NA = Not applicable.					
*Based on 60 pure live seeds (PLS) per square foot, drill seeded. Double this rate (120 PLS/ft.2) if broadcast or hydroseeded.					
†mmhos/cm = Millimhos per centimeter. Millimhos is an electrical conductivity measurement used to determine total concentration of soluble salts in soil.					

2.02 HYDROMULCH

A. Mat-Fiber Plus, manufactured by Mat Inc.,12402 Hwy 2, Floodwood, MN 55736, 1 -888-477-3028; Spray Mulch X-80 manufactured by Pacific Wood Fibers, PO Box 2109, Redmond WA 98052; or equal, having the following essential characteristics:

1. Wood cellulose fiber.
2. No germination or growth inhibiting factors.
3. Dyed appropriate color to allow visual metering of application.
4. Evenly dispersed and suspended when agitated in water.
5. Forms blotter like ground cover that readily absorbs water and allows infiltration to underlying soil.

2.03 TACKIFIER

A. Mixture of at least 3 specially blended compatible hydrocolloids.

1. One hydrocolloid will act as a slippery agent during suspension.
2. Will form loose, long-chain-like film on drying.
3. No growth or germination inhibiting factors.
4. Hydrates and disperses in circulating water to form homogeneous slurry.
5. Equilibrium air dry moisture content at time of manufacture of 8 percent, plus or minus 2 percent.
6. Minimum water holding capacity: 6-1/2 times weight of dry material.

PART 3 EXECUTION

3.01 SEEDBED PREPARATION

A. Complete prior to seeding, and mulching or hydromulching.

B. Scarify or harrow and rake topsoil to minimum depth of 3 inches.

C. Remove stiff clods, lumps, roots, litter, stones, and other foreign material greater than 6 inches in size from the surface. Dispose of removed materials in accordance with Section 01 74 00 - Cleaning and Waste Management.

D. Fill or smooth topsoil surface to remove rills, gullies and depressions.

E. Protect prepared topsoil surfaces from erosion and washouts. Repair damaged surfaces.

3.02 SEEDING

A. Apply seed and mulch by one of the following methods:

1. Broadcast seeding.
2. Drilling seed.

B. Apply seed mixture at rate specified in Table 32 92 20A - Seed Mixture.

C. Seed between July 15 to September 15 unless approved by COR.

3.03 BROADCAST SEEDING

A. Broadcast seed only in areas not accessible for drilling.

B. Mechanical broadcasting:

1. Equipment:
    a. Centrifugal type.
    b. Pull type similar to fertilizer spreader.
2. Designed and regulated to apply seed uniformly at proper rate per acre.

C. Hand Broadcasting:

1. By hand broadcaster.
2. By hand.
3. Uniformly applied.

D. Cover seed with soil to depth of 1/4 inch to 1/2 inch immediately after broadcasting.

1. Use hand rake or float.
2. Do not use log chain or similar device.

3.04 DRILLING SEED

A. Regulate drill to uniformly distribute seed at rate specified and cover with soil depth of 1/4 inch to 1/2 inch.

B. Drill crosswise to general slope where possible to safely operate equipment.

3.05 MULCHING

A. Consists of crimping certified weed-free straw into the soil.

B. Hydromulching may be used in areas, as directed by COR:

1. Of interim reclamation where crimping is impracticable,
2. Of interim reclamation that were hydroseeded,
3. In areas of temporary seeding regardless of seeding method,

3.06 HYDROMULCHING

A. Mulch slurry:

1. Mix to keep homogeneous.
2. Ingredients:
    a. Water.
    b. Tackifier.
    c. Wood cellulose fiber mulch: 3,000 pounds per acre at 10 percent moisture content.
    d. Nitrogen fertilizer may be applied with hydromulching.
3. Maximum time between batching slurry and application: 1 hour.

B. Spray apply mulch slurry mix uniformly.

C. Use mulch coloring as metering agent.

D. Apply mulch slurry within 24 hours after applying seed.

END OF SECTION

SECTION 33 05 21
BORED UTILITY CROSSINGS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Bore and Jack Station 22251+30 to 22252+80:

1. Payment: Lump sum price offered in Price Schedule.

a. Includes installing carrier pipes in casing pipes.

B. Bore and Jack Station 22283+50 to 22285+90:

1. Payment: Lump sum price offered in Price Schedule.

a. Includes installing carrier pipes in casing pipes.

C. Bore and Jack Station 22415+40 to 22418+00:

1. Payment: Lump sum price offered in Price Schedule.

a. Includes installing carrier pipes in casing pipes.

D. Bore and Jack Station 22938+50 to 22939+55:

1. Payment: Lump sum price offered in Price Schedule.

a. Includes installing carrier pipes in casing pipes.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36/A36M-12	Carbon Structural Steel
2.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates

B. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 in (150 mm) and Larger

C. Bureau of Reclamation (USBR)

1.	RSHS	Reclamation Safety and Health Standards, including revisions posted at http://www.usbr.gov/ssle/safety/RSHS/rshs.html

D. Western Wood Products Association (WWPA)

1. WWPA G5-11 Western Lumber Grading Rules

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 05 21-1, Placement Plan:

1. Detail work including boring, casing materials and equipment used.

a. Assembly.

b. Casing geometry (longitudinal and transverse sections).

c. Cross section of installation including soil/bedrock profile.

C. RSN 33 05 21-2, Material Certification:

1. Certification, signed by material producer and Contractor that material complies specified requirements.

1.04 SITE CONDITIONS

A. Bedrock may be encountered during boring operations. Refer to Section 53 10 00 - Geology.

1.05 PERMITS

A. In accordance with Section 01 56 15 - Protection of Existing Utilities.

PART 2 PRODUCTS

2.01 CASING PIPE

A. Smooth Steel Pipe:

1. In accordance with Section 33 21 95 - Metal Piping for Line Pipe Installations, except:

a. Hydrostatic test not required.

b. Thickness: 0.25 inches.

c. Diameter: 36 inches.

d. Epoxy lined.

e. Welded joints.

1.02 CARRIER PIPE

A. See Section 33 11 10 - Pipeline General Requirements.

1.03 SPACERS AND RUNNERS

A. Insulated casing, spacers and runners, per manufacturer's recommendations.

1.04 END SEAL

A. Model AW Wrap Around End Seal, Manufactured by Advance Products & Systems, Incorporated, www.apsonline.com or equal with the following essential characteristics:

1. Rubber end seal with stainless steel clamps.
2. Rubber seal manufactured with butyl mastic strips.

PART 3 EXECUTION

3.01 GENERAL

A. Verify utility locations prior to excavation in accordance with Section 01 56 15 - Protection of Existing Utilities.

B. Remove and replace fence in accordance with 01 56 20 - Existing Fences.

C. Excavate suitable pits or trenches for boring operations.

1. Strip in accordance with Section 31 14 10 - Stripping.
2. Earthwork in accordance with Section 31 23 10 - Earthwork.

D. Do not interfere with normal operations of highway, street, or other facilities.

1. Exception: Public safety in accordance with Section 01 55 20 - Traffic Control.

E. Do not weaken or damage highway, street or facility. Repair at Contractor's expense, as determined by COR.

F. Remove and replace, without additional cost, pipe damaged during boring operations.

G. Install casing pipes to lines and grades shown on drawings.

1. Final position of pipe:
   a. Less than 1 inch in 40 feet laterally or vertically.
   b. Variation: Regular and only 1 direction.
2. Grout bored annulus, outside of casing pipe, if annulus exceeds 1 inch.

H. No pit or trench, excavated to install pipe, shall remain open longer than 5 days after installation, unless otherwise approved by COR.

I. Install safety fencing around pit or trenches in accordance with Section 01 56 32 - Temporary Safety Fence. Remove as required for construction.

3.02 BORING

A. Pilot Hole Method:

1. Bore pilot hole entire length of crossing.
2. Check line and grade of bore from exit hole, and correct.
3. Use pilot hole as centerline for larger diameter hole to be bored.

B. Auger Method:

1. Proper diameter steel pipe equipped with a cutter head to mechanically perform excavation.
2. Augers shall be of sufficient diameter to convey excavated material to work pit.

C. Gel-forming Colloidal Drilling Fluid:

1. Minimum 10 percent of high grade processed Bentonite.
    a. Consolidate cuttings of bit, seal holes in boring wall, and furnish lubrication for cuttings removal and immediate installation of line pipe.
2. Use water or other fluids in boring only to lubricate cuttings for removal.
3. Jetting not permitted.

D. Dispose of drilling fluid in accordance with Section 01 74 00 - Cleaning and Waste Management.

3.03 CARRIER PIPE

B. Install carrier pipe, spacers, skids, runners and end seal per manufacturer’s recommendations.

3.04 BACKFILL

A. If pit or trench is backfilled prior to installation of carrier pipe, install a wooden bulk head at ends of casing to keep backfill material out of casing pipe. Mark ends with of casing pipe with utility markers to allow for relocation.

B. Backfill in accordance with accordance with Section 31 23 10 - Earthwork.

C. Reconstruct highway slopes and embankments with same materials excavated and to existing dimensions.

D. Dispose of excavated material in accordance with Section 31 23 39 - Disposal of Excavated Materials.

END OF SECTION

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SECTION 33 09 08

PROBE MAGNETIC FLOWMETER

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the Price Schedule for NAPI Turnout.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM F593-13a	Stainless Steel Bolts, Hex Cap Screws, and Studs

B. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and External Threaded Wedge Bolt Anchors

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with the Section 01 33 00 - Submittals.

B. RSN 33 09 08-1, Approval Data:

1. Commercial products data for flowmeter system:
   a. Single-point electromagnetic sensor with operating cable.
   b. Dedicated microprocessor-based processing unit (console).
   c. Insertion assembly.
   d. Include manufacturer’s name, model number, and specification requirements.
2. Detailed installation instructions and drawings showing installation details, detail dimensions, and locations of conduit connections. Include manufacturer’s instructions for attaching flowmeter to the pipe and cabling to flowmeter display indicator/transmitter console.
3. Schematic and wiring diagrams including those showing connections to external equipment in accordance with Division 26 - Electrical.

C. RSN 33 09 08-2, Final Data:

1. Service Manuals:

a. Bound service manual containing:

1) Installation, maintenance and operating instructions,

2) Identifying parts list,

3) Schematic and wiring diagrams,

4) Recommenced parts list.

D. RSN 33 09 08-3, Test Reports:

1. Simulated test reports.

1.04 SYSTEM REQUIREMENTS

A. Flowmeter based on Faraday's law.

B. Single-point electromagnetic system.

C. Dedicated indicator/transmitter microprocessor-based processing unit (console).

D. Provides an electronic output signal proportional to the flow of a conductive liquid in the closed pipe system.

E. Capable of operating up to 100 feet between the flowmeter sensor and the remote indicator/transmitter console.

F. Flowmeter with insertion assembly designed to allow removal and insertion of the flowmeter sensor from pipes under pressure for easy inspection, cleaning, calibrating, or replacement.

G. System Pipe Parameters are tabulated below in Table 33 09 08A:

Table 33 09 08A - Pipe Parameters

Pipe Size, O.D.	6.625 inch
Pipe Wall Thickness	0.280 inch
Pipe Material	Carbon Steel
Maximum Flowrate	1 cfs
Approx. Velocity Range	0 to 6 feet per second
Pipe Pressure	120 psi

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect equipment from corrosion, deformation, and other types of damage during delivery, storage and handling.

PART 2 PRODUCTS

2.01 PROBE MAGNETIC FLOWMETER SYSTEM

A. Probe Magnetic Flowmeter System:

1. Accuracy: Plus or minus 2 percent of flowrate. Accuracy based on the following assumptions:
    a. Velocities greater than 1 foot per second.
    b. At least 15 straight pipe diameters upstream of the flowmeter.
    c. At least 5 straight pipe diameters downstream of the flowmeter.
2. Suitable for operation in ambient temperatures ranging from minus 20 to plus 120 degrees F.
3. Sensor housing: Stainless steel, Type 316.
4. Insertion tube: Stainless steel.

B. Indicator/Transmitter Console:

1. Display: Backlit alphanumeric, digital LCD readout. All menu commands are visible to display.
2. Input/Output Module:
    a. 4-20 mA Output Module.
    b. RS485 or RS232C Input/Output Module.
3. Remote wall mounted enclosure: NEMA 250 Type 4X.
4. Micro-processor based.
5. Display readout to simultaneously display flowrate and totalized flow.
6. Readout: User selectable flow in units of cubic feet per second and gallons per minute with at least 1 significant digit in tenths. Eight digit (minimum) display of totalized volume in acre feet at least one significant digit in tenths.
7. Self-test routine that checks for proper operation.

C. Insertion Assembly:

1. Material: Stainless steel, Type 304 or 316.
2. Extension tube.
3. Adjustable restraining rods.
4. Compression seal assembly.
5. Ball valve, pipe tap, and pipe nipple: To be provided in accordance with Section 33 22 15 - Valves and Equipment for Line Pipe Installations.
    a. Flowmeter manufacturer’s recommended size.

b. Materials: Stainless steel, Type 304 or 316.

c. Ball valve: Fully ported, manual lever-operated, with female threads.

2.02 MATERIALS

A. Expansion Anchors:

1. CID A-A-1923A, Type A, galvanized steel. At the Contractor's option, an equivalent sized threaded stainless steel rod, ASTM F593 type 304 or 316, with adhesive anchor system may be substituted.

2. Minimum embedment: In accordance with manufacturer's recommendations.

2.03 ELECTRICAL EQUIPMENT

A. Cable between the flowmeter sensor and the indicator/transmitter console: Type specified by flowmeter manufacturer that is suitable for pulling through conduit.

B. Electrical conduit between the sensor and the console to be provided in accordance with Division 26 - Electrical.

C. Electrical service for device operation: Match electrical services provided in Division 26.

2.04 COATINGS

A. Coat in accordance with Section 09 96 20 - Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with this section and the manufacturer's instructions.

B. Install the flowmeter sensor within the discharge pipeline as shown on drawing 1695-D-60050.

C. Install the flowmeter remote console within the flowmeter vault shown on drawing 1695-D-60050. Mount the flowmeter console to the vault wall next to the access ladder and below the hatch at the location approved by the COR.

D. Furnish bolts, brackets, supports, and mounting hardware required to install the equipment.

E. Make connections between the flowmeter console and the flowmeter sensor.

1. Cable splicing not allowed.

2. The cable to run in grounded conduit (flexible and rigid) between the flowmeter sensor and the console.

F. Make connections between the flowmeter console and the incoming power.

G. Electrical:

1. Install in accordance with Division 26 - Electrical.
2. Install electrical wiring, shielded telemetry cable, conduit, power supplies, electrical boxes, terminal blocks, and necessary accessories that are required to complete the installation.

H. Expansion Anchors:

1. Drill holes in concrete for installation of expansion anchors. Drill holes:
   a. Straight,
   b. True to diameter,
   c. Depth recommended by the anchor manufacturer to the minimum embedment requirement.
2. If embedded steel or reinforcement is encountered during drilling, use core drilling in accordance with the expansion anchor manufacturer's recommendations.
3. If drilling water is used, clean exposed concrete surfaces immediately after drilling to prevent discoloration.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Preform test after installing the flowmeter system.
2. Test will be witnessed by the COR. Notify COR at least 5 days in advance of when test are to be performed.
3. Furnish testing equipment and additional hardware necessary for complete testing.
4. Demonstrate that flowmeter sensor can be installed and retracted from the pipe without draining or depressurizing the system.

B. Simulated Test: Demonstrate equipment operates in accordance with this Section, including:

1. Apply simulated flow signal inputs. Simulates signals to cover the minimum and maximum flows over the velocity range listed in Table 33 09 08A - Pipe Parameters.
2. Check displays for correct readouts, and check each I/O (input/output) point for correct I/O signal.
3. Test each output connection for correct output conformance.
4. Verify instrumentation and indication devices function properly. Test functions of the flowmeter transmitter for correct operation.

C. Make corrections and adjustments to provide a complete installation satisfactory to COR.

END OF SECTION

SECTION 33 11 10
PIPELINE GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Line Pipe:

1. Measurement: Length along pipe centerline between ends of pipe in place. Continuous through fittings, and road crossings with no allowance for lap at joints.

    a. Measurement for line pipe will begin downstream of Pumping Plant No. 1 yard (1695-D-60028) and end upstream of Regulating Tank No. 2 (1695-D-60044).

    b. Stations shown on plan and profile drawings are break points between various bid items for providing line pipe.

    c. Includes

        1) Coating Line Pipe and Fittings.

        2) Pipe Crossings.

2. Payment: Applicable linear foot price offered in the Price Schedule for various sizes and classes of line pipe.

    a. Includes cost of furnishing materials; providing pipe; fittings, providing bedding and embedment; providing utility markers; providing concrete, cement, and reinforcement steel in encasements, blocking, and collars not included elsewhere.

    b. If after award of contract, the next larger size of pipe is required to meet the inside diameter requirement of this section, fittings and associated valves must be the same as the larger pipe size.

    c. Payment for larger size pipe, valves, and fittings will be made at the unit price offered in the Price Schedule for this section denoted size and not for the larger size.

B. Filling and Testing Water:

1. Measurement: Volume of Water for filling and testing.

    a. Only water used as directed by the COR will be included.

    b. Quantity will be measured in tanks or tank trucks of predetermined capacity or by means of water meters.

c. Types of water meters used for measuring water for subject to COR's approval.

2. Payment: M (1,000) gallons price offered in the Price Schedule.

C. Repair Kit:

1. Payment: Lump sum price offered in Price Schedule.

1.02 DEFINITIONS

A. Line Pipe Stationing:

1. Sta 22249+52.72 to Sta 22608+47.06.

2. Sta 22610+23.06 to Sta 23092+42.55.

B. Pipe sizes and classes: Designated on plan and profile drawings by an alphanumeric symbol.

1. PVC and HDPE pipe:

a. Symbol identifies pipe diameter and dimension ratio as follows:

1) First number in the symbol indicates nominal diameter in inches.

2) Alphanumeric indicates dimension ratio as defined in AWWA C900, AWWA C905 and AWWA C906.

3) Number in parenthesis is the hydrostatic head measured to centerline of pipe.

4) A symbol of 24DR25 means the pipe is 24 inches in diameter with a dimension ratio (DR) of 25.

2. Metallic and Fiberglass pipe:

a. Symbol identifies pipe diameter and dimension ratio as follows:

1) First number in the symbol indicates nominal diameter in inches.

2) The alphabetic character represents the cover class of pipe where; A < 5 ft., 5 ft. < B < 10 ft., and 10 ft. < C < 15 ft.

3) Second number in the symbol is the hydrostatic head measured to centerline of pipe.

4) A symbol of 24C600 means the pipe is 24 inches in diameter with a cover between 10 and 15 feet and a hydrostatic head of 600 feet at the center line of pipe.

3. Unless specific reference is made to outside diameter of pipe, pipe diameters shown on drawings and used in this section are inside diameters.

4. Ductile Iron Pipe (DI):

a. Symbol identifies pipe as follows:

1) First number indicates nominal diameter in inches.

2) Nominal diameter nomenclature DIOD for ductile iron outside diameter.

3) The next number is the pipe pressure class in psi.

4) A symbol of 24DIOD250 means the nominal diameter of the pipe is 24 inches with a ductile iron outside diameter nomenclature. The pressure class is 250 psi.

5. Steel Pipe:

a. Symbol identifies the pipe as follows:

1) First number is the nominal diameter in inches.

2) The second number is the steel pipe wall thickness in inches.

3) A symbol of 24 inches - 0.125 inches means the nominal diameter for the pipe is 24 inches and the steel pipe wall thickness is 0.125 inches.

6. Pipe designations shown on drawings and in this section establish minimum requirements for pipe types allowed.

Table 33 11 10A- Symbol Pipe Equivalents

Symbol Pipe Designation	PVC	HDPE	Steel	Ductile Iron
24B50	24DR32.5	30DR32.5	N/A	N/A
24D50	24DR25	30DR32.5	N/A	N/A
24B75	24DR32.5	30DR32.5	N/A	N/A
24B100	24DR32.5	30DR32.5	N/A	N/A
24B125	24DR32.5	30DR32.5	N/A	N/A
24B150	24DR32.5	30DR26	N/A	N/A
24B175	24DR32.5	30DR26	N/A	N/A
24C175	24DR32.5	30DR26	N/A	N/A
24D175	24DR32.5	30DR26	N/A	N/A
24B200	24DR32.5	30DR21	N/A	N/A
24C200	24DR32.5	30DR21	N/A	N/A
24B225	24DR32.5	30DR21	N/A	N/A
24C225	24DR32.5	30DR21	N/A	N/A
24B250	24DR32.5	30DR19	N/A	N/A
24C250	24DR32.5	30DR19	N/A	N/A
24B275	24DR32.5	30DR17	N/A	N/A
24B300	24DR25	30DR15.5	N/A	N/A
24C300	24DR25	30DR15.5	N/A	N/A
24D300	24DR25	30DR15.5	N/A	N/A
24B325	24DR25	30DR13.5	N/A	N/A

Table 33 11 10A- Symbol Pipe Equivalents

Symbol Pipe Designation	PVC	HDPE	Steel	Ductile Iron
24C325	24DR25	30DR13.5	N/A	N/A
24B350	24DR25	30DR13.5	N/A	N/A
24C350	24DR25	30DR13.5	N/A	N/A
24B375	24DR25	30DR11	N/A	N/A
24C375	24DR25	30DR11	N/A	N/A
24B400	24DR21	30DR11	N/A	N/A
24C400	24DR21	30DR11	N/A	N/A
24D400	24DR21	30DR11	N/A	N/A
24B425	24DR21	30DR11	N/A	N/A
24C425	24DR21	30DR11	N/A	N/A
24B450	24DR21	30DR11	N/A	N/A
24C450	24DR21	30DR11	N/A	N/A
24B475	24DR18	30DR9	N/A	N/A
24C475	24DR18	30DR9	N/A	N/A
24D475	24DR18	30DR9	N/A	N/A
24B500	24DR18	30DR9	N/A	N/A
24C500	24DR18	30DR9	N/A	N/A
24D500	24DR18	30DR9	N/A	N/A
24B525	24DR18	30DR9	N/A	N/A
24C525	24DR18	30DR9	N/A	N/A
24D525	24DR18	30DR9	N/A	N/A
24C540	24DR18	30DR9	N/A	N/A
24B550	N/A	30DR9	24 inches - 0.103 inches	24DIOD250
24B575	N/A	30DR9	24 inches - 0.125 inches	24DIOD250
24B600	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24C600	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24D600	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24B625	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24C625	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24B650	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24C650	N/A	N/A	24 inches - 0.125 inches	24DIOD300

Table 33 11 10A- Symbol Pipe Equivalents

Symbol Pipe Designation	PVC	HDPE	Steel	Ductile Iron
24C675	N/A	N/A	24 inches - 0.125 inches	24DIOD300
24D675	N/A	N/A	24 inches - 0.125 inches	24DIOD300
Fiberglass pipe: Submit in accordance with Section 33 11 19 - Fiberglass Pipe. N/A indicates that the particular pipe option is not allowed.				

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM C150/C150M-13 Portland Cement
2. ASTM F2164-13 Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

B. American Water Works Association (AWWA)

1. AWWA C205-12 Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger - Shop Applied
2. AWWA C207-13 Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 in. (100 mm Through 3,600mm)
3. AWWA C600-10 Installation of Ductile Iron Water Mains and Their Appurtenances
4. AWWA C604-11 Installation of Steel Water Pipe 4 in. (100mm) and Larger
5. AWWA C605-13 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
6. AWWA C900-07 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
7. AWWA C905-10 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 Inches through 48 Inches (350 mm Through 1,200 mm) for Water Transmission and Distribution

8.	AWWA C906-15	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
9.	AWWA C950-13	Fiberglass Pressure Pipe

C. International Organization for Standardization (ISO)

1.	ISO 9001-15	Quality Management

D. National Sanitation Foundation (NSF)

1.	NSF Standard 61-13	Drinking Water System Components - Health Effects

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals:

B. RSN 33 11 10-1, Qualifications:

1. Resumes and references of line pipe manufacturers.
2. Pipe fuser certifications, if needed, for equipment to be used.

C. RSN 33 11 10-2, Pipelaying Diagrams:

1. For each type of pipe furnished.
2. Show position and marking of pipe sections.
3. Include centerline and invert stationing and elevations at horizontal and vertical changes in alignment, and subgrade elevation for each pipe fitting.

D. RSN 33 11 10-3, Filling and Testing Plan:

1. Proposed rate, time, and procedure for:
   a. Cleaning.
   b. Filling.
   c. Field and pressure testing.
   d. Draining pipeline.
2. Method of disposing of water drained from pipeline.

E. RSN 33 11 10-4, Floatation Prevention Plan:

1. Show location and describe method of preventing pipe from floating.

1.05 DELIVERY, STORAGE AND HANDLING

A. Place pipe in storage as directed by COR. Within 150 miles from site, as designated by COR.

1.06 REPAIR KIT

A. Furnish 1 repair kit for each type and size of pipe used.

B. Repair kit:

1. One standard length of pipe and 2 couplings.
2. At highest loading and pressure rating for each type of pipe used.

1.07 QUALIFICATIONS

A. Pipe manufacturer shall be certified in accordance with ISO:9001 or similar nationally certified program approved by COR.

B. Line pipe and specials manufacturers: 10 years of successful experience producing products as specified.

PART 2 PRODUCTS

2.01 PIPE CROSSINGS

A. See Section 33 11 50 - Pipe Crossings at Existing Utility Pipelines.

2.02 GENERAL

A. Confirm elevations and locations shown on drawings with COR prior to ordering pipeline materials.

2.03 PIPE OPTIONS

A. Listed in Table 33 11 10A-Symbol Pipe Equivalents and following sections:

1. 33 11 12 - Steel Line Pipe,
2. 33 11 13 - Ductile Iron Pipe,
3. 33 11 16 - PVC Pressure Pipe,
4. 33 11 18 - HDPE Pressure Pipe,
5. 33 11 19 - Fiberglass Pipe.

B. Materials and chemicals that may come into contact with drinking water certified by NSF 61.

2.04 PIPE ACCESSORIES

A. Two Inch Diameter Air Valve Assemblies: See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

B. Four Inch Diameter Blowoff Assemblies: See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

PART 3 EXECUTION

3.01 GENERAL

A. Perform cleaning, filling and testing after backfill has been placed to finished grade or as approved by COR.

B. Surveyor licensed in the State of New Mexico shall be on site during excavation and pipelaying.

C. Protect pipe from contamination, damage, and the elements during storage on site by covering it with a tarp as directed by the COR.

3.02 INSTALLATION

A. Install pipe in accordance with appropriate Section for pipe option installed.

B. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

C. Keep openings to installed pipe closed with watertight plugs during work stoppage, including end of work day, breaks, work delays.

D. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

E. If pipe is flooded during construction, clear floodwater by draining and flushing with water, or other approved method, until pipe is clean.

F. Lubricant:

1. Keep clean.
2. Apply with dedicated, clean applicator brushes.

G. Concrete in encasements, blocking and collars: Section 03 30 00 - Cast-in-Place Concrete.

H. Wash Crossings:

1. Pipe joints to be fused or restrained from beginning to end of Wash Crossing stationing. See Section 35 42 35 - Bank Protection and drawings for locations.

3.03 FIELD EXAMINATION

A. Flush pipe before filling.

1. Flush foreign material from pipeline prior to testing.
2. Flush using a minimum velocity of 3 feet per second toward low points in reach.
3. Flush at least 3 pipe volumes until the water is clean as approved by COR.
4. Dispose of flush water in accordance with permits in Section 01 57 30 - Water Pollution Control.
5. Operate valves several times during flushing period.

3.04 FILLING PIPELINE

A. Provide water for filling and testing pipeline in accordance with Section 01 51 00 - Temporary Utilities.

B. Pipeline fill rate, maximum: 2 cubic feet per second.

C. Maintain pipeline completely filled for at least 72 hours before testing.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. Leak testing pipeline:

1. Notify the COR at least 7 days before applying pressure to pipeline.
2. Do not start leak testing when snow or standing water is on the ground. Suspend testing as directed by the COR if precipitation accumulates on the ground.
3. Furnish pumps, power, pressure gages, air valves at each end of line and calibrated flow meters for testing.
4. Comply with applicable test standard except as noted below:
    a. AWWA C605 for PVC.
    b. ASTM F2164 for HDPE.
5. Test pipeline with hydrostatic pressure equal to:
    a. 420 feet elevation downstream of Pre-manufactured Pump Station No. 1.
    b. 460 feet elevation downstream of Pre-manufactured Pump Station No. 2.
6. Prior to starting test, maintain pressure in pipe for 24 hours.

7. Test for 96 hours or as approved by COR.
8. If leakage is detected, halt test. Identify and repair leaks.
9. Repeat test until acceptance criteria is achieved.
10. Drain pipe using both gravity flow and sump pump at blowoffs or as approved by COR.
11. Repeat field examination as detailed above.
12. Seal openings to pipe as approved by COR.

END OF SECTION

SECTION 33 11 12
STEEL LINE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the priced offered in the Price Schedule for Line Pipe.

1.02 DEFINITIONS

A. Steel Line Pipe: See Section 33 11 10 - Pipeline General Requirements.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A139/A139M-04	Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 and Over)
2.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM A1011/A1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Allow and High-Strength Low-Allow with Improved Formability
4.	ASTM A1018/A1018M-08a	Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability
5.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry

B. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 In (150 mm) and Larger
2.	AWWA C205-07	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In (100 mm) and Larger - Shop Applied
3.	AWWA C206-11	Field Welding of Steel Water Pipe

4.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
5.	AWWA C604-11	Installation of Buried Steel Water Pipe 4 In. (100 mm) and Larger

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 12-1, Shop Drawings:

1. Show fitting fabrication details.
2. Show exact dimensions of joints, and proposed restraint.

C. RSN 33 11 12-2, Ventilation Plan:

1. Method for ventilating the inside of pipe when placing mortar lining.

1.05 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with the code under which welding is specified to be accomplished.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage during loading, transporting, unloading, laying, and at final storage location.

1. Supply:
    a. Padded bolsters curved to fit under outside of pipe.
    b. Heavy padding under ties during transportation and storage.

B. Tightly close open ends of shop-applied, cement-mortar-lined pipe with plastic wrap for protection of cement-mortar lining during shipment.

1. Plastic Wrap:
    a. At least 2 thicknesses of 6 mil sheet polyethylene plastic.
    b. Remain on pipe until installation.

C. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

D. Government will inspect pipe once it is delivered.

E. Repair damage to lining or coating as directed if, in the opinion of the COR, a satisfactory repair can be made; otherwise, replace damaged section at the expense of the Contractor.

PART 2 PRODUCTS

2.01 STEEL LINE PIPE

A. Steel Line Pipe:

1. Electric fusion (arc) welded helical-seam steel pipe: ASTM A139, grade C, D, or E.
2. Fabricated in accordance with AWWA C200 Except:
    a. Steelplate: ASTM A283, grade C or D.
    b. Steel Sheet: ASTM A1011, designation SS, grade 40, 45, or 50; or ASTM A1018, designation SS, grade 40.

B. Pipe Diameter: To inside of lining.

C. Minimum Steel Wall Thickness of Pipe:

1. As shown in Table 33 11 10A- Symbol Pipe Equivalents or as otherwise shown on the drawings.
2. Alternate yield stress steel with the resulting minimum steel wall thickness is allowed with government approval.

D. Prepare pipe ends for field welding.

2.02 FITTINGS

A. Flanges:

1. AWWA C207.
    a. Class: Working pressure meets or exceeds head class of attached pipe.

B. Flange Gaskets:

1. Model No. 19, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:
    a. Full flat face-type.
    b. For AWWA C207 flanged joints.
    c. For cold water service.

C. Flange Bolts:

1. AWWA C207.

D. Tapers (or Adaptors):

1. Lengths: As shown on drawings.

2. Ends: Fit type of joint in adjacent pipeline.

2.03 LININGS AND COATINGS

A. Coating and lining in accordance with Section 09 96 20 - Coatings.

B. Do not field apply mortar lining without COR approval.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Steel Pipe and Fittings:

1. Hydrostatic Test for Pipe and Fittings: Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.
2. Hold pressure long enough to allow a thorough inspection of welded joints.
3. Repair leaks by rewelding and retesting of joints.
4. Hydrostatic Test for Pipe:
    a. Test sections prior to forming bell and spigot joints.
    b. Repair defects and retest section before applying lining and coating.
    c. The Government may witness the hydrostatic testing and calibration of the pressure gauges. Notify the Government 30 days prior to performing the hydrostatic test.
5. Hydrostatic Test for Fittings:
    a. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.
        1) Perform dye penetrant test on welds in accordance with ASTM E165.
    b. Chip, flame gouge, or grind to sound metal defects in welds as disclosed by the dye penetrant or hydrostatic tests. Reweld and retest the resulting cavities.

B. Joint Testing:

1. Assemble one joint for each pipe diameter to check the bell and spigot to check fit prior to coating or lining.

PART 3 EXECUTION

3.01 INSTALLATION

A. Excavate and backfill pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along the bottom of pipe.
2. At joints involving bells or collars, excavate holes at the joint of ample size to prevent bells or collars from coming in contact with the subgrade.
3. Lower the pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

B. Install the steel pipe to line and grade as shown on drawings.

1. On grades exceeding 10 percent, lay pipe uphill.

C. Joints for Pipe with Gasketed Joints:

1. Before Assembling Pipe Joints:
   a. Clean gasket, bell, especially the groove, and the spigot with a rag, brush, or paper towel to remove any dirt or foreign material.
   b. Use only gaskets which are designed for and supplied with the pipe.
   c. Insert gaskets in accordance with AWWA C604 or as approved by COR.
   d. Lubricate spigot end of pipe as recommended by the manufacturer.
2. Joining Pipe:
   a. In accordance with AWWA C604.
   b. Verify inside joint gap meets manufacturer's tolerances as the work progresses.
   c. Do not encase flanged joints in concrete.

D. Joints for Pipe with Welded Joints:

1. In accordance with AWWA C206.
2. Perform dye penetrant test on butt welds in accordance with ASTM E165.
3. Double Lap Weld Joints:
   a. Provide joint with a full fillet weld and a seal weld.
   b. Air test double lap welds in accordance with AWWA C206.

E. Changes in Alignment and Grade:

1. Where shown on the drawings, makes changes in alignment and grade with miter bends.
2. Make other changes in alignment and grade by providing small deflections between adjacent pipe. Do not exceed manufacturer's deflection tolerances.

F. Thrust Restraint:

1. Restrained joints, or

a. Minimum restrained joint length as shown on drawing 1695-D-60049.

2. Miter bends with blocking, or

3. Other methods of restraint, as proposed by the contractor, may be used as approved by the COR.

G. Closure Sections:

1. Use closure sections where necessary as determined by the Contractor, subject to the approval of the COR.

H. Schedule works so that at no time will pipe remain in the trench more than 7 days before backfill is placed to original ground surface or to other specified backfill limits shown on the drawings.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Total departure from established alignment and grade, maximum: 1 inch.

3.03 JOINT LINING AND COATING

A. Field joints for pipe with shop applied cement-mortar lining.

1. Line field joints with cement-mortar in accordance with AWWA C205.

2. Coat exterior joints as specified in Section 09 96 20 - Coatings.

3. Do not backfill field joints until coating is approved by the COR.

B. Apply shrink sleeves to field joints in accordance with Section 09 96 20 - Coatings.

3.04 BACKFILL

A. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Place backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.

2. In certain pipeline reaches, where determined necessary by the COR to prevent the possibility of flotation, do not lay more than 300 linear feet of pipe ahead of backfilling operations.

3. If pipelaying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

B. Keep internal supports in place until backfill has been placed and compacted above the bottom of the pipe to a minimum height of 0.7 times the diameter.

END OF SECTION

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SECTION 33 11 13
DUCTILE IRON PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Line Pipe.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B18.2.1-12	Square, Hex, Heavy Hex, And Askew Head Bolts And Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)

B. ASTM International (ASTM)

1.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
2.	ASTM A1011/A1011M-14	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
3.	ASTM A1018/A1018M-15	Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
4.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry

C. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel

D. American Water Works Association (AWWA)

1.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings for Water
2.	AWWA C111-12	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings

3.	AWWA C151-09	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
4.	AWWA C153-11	Ductile-Iron Compact Fittings for Water Service
5.	AWWA C600-10	Installation of Ductile-Iron Mains and Their Appurtenances

E. Federal Specifications (FED-STD)

1.	FED-STD FF-N-836E	Nut: Square, Hexagon, Cap, Slotted, Castle Knurled, Welding and Single Ball Seat

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 13-1, Shop Drawings:

1. Show fitting fabrication, connection, and thrust restraint details.
2. Show exact dimensions of joints, and diameter of rubber gasket including tolerances, other major dimensions, proposed restraint.

1.04 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with AWS D1.1.

B. Pipelaying Workers: Skilled and experienced in laying pipe with type of joint being furnished.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

B. Transport pipe and fittings on padded bolsters curved to fit the outside of the pipes. Use heavy padding under ties.

C. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

D. Replace or repair, as approved by the COR, any pipe that is damaged during shipment, storage, or installation at the Contractor’s expense.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile Iron Pipe: AWWA C151.

1. Nominal laying length: 20 feet.

B. For allowable pipe size and classes refer to Section 33 11 10 - Pipeline General Requirements.

C. Rubber Gaskets: AWWA C111.

1. Lubricant:

a. Recommended by pipe manufacturer.

b. Approved for potable water use.

D. Coatings and Linings in accordance with Section 09 96 20 - Coatings.

2.02 FITTINGS

A. Tees, bends, and connections at structures and encasements: As shown on drawings.

B. Fittings: Steel or ductile iron.

1. Steel Fittings:

a. Steel for fittings: ASTM A283, grade C, D or E, ASTM A1011, designation SS, grade 40, 45 or 50, ASTM A1018, designation SS, grade 40 or designation HSLAS-F, grade 50.

b. Minimum steel wall thickness: 0.25 inches or thickness required to meet pipe classification shown on the plan and profile, whichever is greater.

c. Pipe Diameter: Pipe inside diameter measured to the inside of the lining shall not be less than the nominal diameter shown on the drawings.

d. Welding:

1) AWS D1.1.

2) Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.

3) Temporary or permanent welding for convenience of the Contractor: Not permitted on areas where welding will damage lining and coating.

e. Bolts and nuts: ASME B18.2.1 and FED-STD FF-N-836.

f. Coating and lining in accordance with Section 09 96 20 - Coatings.

g. Tees:

1) Tees as shown on drawings.

2) Tee lengths, minimum: As shown on drawings or as required for blocking.

h. Joints between fittings and ductile iron pipe:

1) Rubber gasket joints.

2) Joint dimensions and tolerances: Same as pipe manufacturer's joint design.

i. Miter Bends: Fabricate steel bends as shown on drawings.

j. Closure Section Joints: Sleeve Coupling.

2. Ductile Iron Fittings:

a. AWWA C110 or AWWA C153.

1) Match pipe pressure class.

2) Flanges: AWWA C110 or AWWA C153.

3) Bolts: AWWA C110 or AWWA C153.

4) Gaskets: AWWA C110 or AWWA C153.

b. Coatings and lining: Refer to Section 09 96 20 - Coatings. Cement mortar lining to be double thickness as defined by AWWA C104.

3. Joints between fittings and ductile iron pipe:

a. Rubber gasket joints.

b. Joint dimensions and tolerances: Same as pipe manufacturer's joint design.

2.03 CONCRETE

A. Concrete in Encasements, Blocking and Collars: Section 03 33 00 - Cast-in-Place Concrete.

B. Other methods of restraint may be used as approved by the COR.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Ductile Iron Pipe: AWWA C151.

B. Steel Fittings:

1. Testing:

a. Hydrostatic test fittings fabricated from steel plate.

1) Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.

2) Hold pressure long enough to allow inspection of welded joints.

3) Repair leaks by re-welding and retesting of joints.

b. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Girth weld test: Dye penetrant test in accordance with ASTM E165.

2) Weld defect repair. Chip, flame gouge, or grind to sound metal; re-weld; and test the repaired weld.

C. Ductile Iron Fittings:

1. Test in accordance with AWWA C110 and AWWA C153.

2.05 SOURCE QUALITY ASSURANCE

A. Approval for Shipment:

1. Pipe and fitting approval will be determined by inspection, during and after manufacture.

2. Notify the Technical Service Center, Attn: 86-68140, and COR at least 14 days before manufacturing pipe and fittings and 3 days before shipping pipe and fittings.

3. The Government may inspect pipe units and fittings and approve for shipment those which have been manufactured and tested in accordance with this section, unless the Contractor is notified in writing.

4. Further inspection of pipe units and fittings will be in accordance with the clause entitled "Inspection of Construction".

PART 3 EXECUTION

3.01 LAYING PIPE

A. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.

2. At joints involving bells or collars, provide holes at joint of ample size to prevent bells or collars from coming in contact with subgrade.

B. Keep pipe trenches free of water during pipelaying operations.

C. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

D. On grades exceeding 10 percent, lay pipe uphill.

E. When pipelaying is not in progress, keep ends of pipelines closed.

F. Joining Pipe:

1. Before assembling pipe joints, clean parts with a rag, brush, or paper towel to remove dirt or foreign material.

2. Assemble push-on or mechanical joints in accordance with AWWA C111 and the manufacturer's recommendations.

3. If adjustment of the position of a length of pipe is required after installation, remove and relay the length of pipe as for a new pipe.

4. Maintain pipe firmly in final position.

G. Changes in Alignment and Grade:

1. Where shown on drawings, make changes in alignment and grade with miter bends as shown on drawings, or

2. Make changes in alignment and grade by providing deflections at joints.

a. Maximum deflection angle between adjacent pipe sections as shown in Table 31 11 13B - Maximum Deflection Angle Between Adjacent Pipe Sections.

Table 31 11 13B. - Maximum Deflection Angle Between Adjacent Pipe Sections

Push-on Joint	
Pipe Size, inches	Deflection Angle, degrees*
24	3

* Or manufacturers recommendation whichever is less.

H. Thrust Restraint:

1. Joint Restraint Products: AWWA C600.

2. Coat in accordance with Section 09 96 20 - Coatings.

3. Other methods of restraint, as proposed by the Contractor, may be used as approved by the COR. Address cathodic protection.

I. Connections at Structures and Encasements:

1. Where ductile iron pipe adjoins a concrete structure or is fully encased in concrete, except at concrete collars and air valve and blowoff encasements provide flexible joint.

2. Maximum distance from pipe joint to concrete face: D/2 inches.

J. Connections to Other Types of Pipe:

1. Use rubber gasket joints to make connections between ductile iron pipe and other types of pipe.

K. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

L. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16 inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1 inch.

3.03 PIPE DEFLECTION

A. Allowable vertical pipe diameter deflection after backfilling is complete.

1. Decrease, maximum: 2 percent of nominal pipe diameter.

2. Elongation, maximum: 3 percent of nominal pipe diameter.

B. Within 2 weeks after backfilling is completed, take measurements of internal diameters.

C. Measurement Frequency:

1. One pipe unit out of 3 for the first 30 units laid and 1 pipe unit out of 10 thereafter.

2. In areas of deep burial or where special problems are encountered, the frequency of measurements may be increased at the discretion of the COR.

D. Measurements:

1. Measure vertical and horizontal diameter at approximate midpoint of pipe unit.

2. Record pipe deflections and station where measurements were taken.

3. Mark inside of pipe so that future comparisons can be made.

E. If a pipe unit deflection exceeds the allowable.

1. Take measurements in adjacent pipe units to determine extent of excessive deflection.

2. Provide deflection data to the COR.

3. Additional direction will be provided after deflection data is analyzed.

END OF SECTION

SECTION 33 11 16
PVC PRESSURE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Line Pipe.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry
4.	ASTM F1674-11	Joint Restraint Products for Use with PVC Pipe

B. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel

C. American Water Works Association (AWWA)

1.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings
2.	AWWA C153-11	Ductile-Iron Compact Fittings
3.	AWWA C208-12	Dimensions for Fabricated Steel Water Pipe Fittings
4.	AWWA C223-13	Fabricated Steel and Stainless Steel Tapping Sleeves
5.	AWWA C605-13	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
6.	AWWA C800-14	Underground Service Line Valves and Fittings
7.	AWWA C905-10	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in.

(350 mm Through 1,200 mm), for Water Transmission and Distribution

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 16-1, Shop Drawings:

1. Show fitting fabrication details. Include: miter bend fabrication details (angles, leg lengths), restrained lengths, inside pipe diameters.
2. Dimensions of joints, diameter of rubber gasket including tolerances, other major dimensions, proposed restraint, and location which include station and elevation.
3. Connections details to other pipe types.

C. RSN 33 11 16-2, Pipe Manufacture Certification:

1. Pipe and miter bends meet AWWA C905.
2. Saddle and Sleeve product data.

D. RSN 33 11 16-3, Test Results:

1. Manufacturer’s steel fitting test results.

1.04 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with AWS D1.1.

B. Pipe laying workers: Skilled and experienced in laying pipe with type of joint being furnished.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ship pipe after receiving COR approval of pipe manufacture per submittal.

B. Prevent damage to PVC pipe and fittings during loading, transporting, unloading, storing, and laying.

C. Transport coated fittings with padded bolsters between the pipes. Use heavy padding under ties.

D. Provide sun protection for PVC pipe that is stored outside.

1. At a minimum, wrap pipe in an adequately fastened opaque covering.
    a. In warm climates, allow air circulation through and around the pipe by puncturing or cutting the covering in the area of the pipe ends.

E. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

PART 2 PRODUCTS

2.01 PIPE

A. PVC Pressure Pipe: AWWA C905, elastomeric joint only.

1. Nominal laying length: 20 feet.
2. PVC pipe dimension ratios (DR) shown on the plan and profile drawings are based on AWWA Cast Iron (CI) sizes for diameters.

B. Rubber Gaskets: Manufactured and tested in accordance with AWWA C905.

1. Petroleum-resistant gaskets: Use in pipe joints in accordance with Section 33 05 21 - Bored Utility Crossings.
2. Lubricant: Approved for potable water use.

2.02 FITTINGS

A. Tees, adaptors, couplings, bends, and connections at structures and encasements: As shown on drawings.

B. Fittings: Steel or ductile iron.

C. Steel Fittings:

1. Steel for fittings: ASTM A283, grade C or D or ASTM A36.
2. Minimum steel wall thickness: 10 gauge or greater.
3. Welding:
    a. AWS D1.1.
    b. Temporary or permanent welding for convenience of the Contractor: Not permitted on areas where welding will damage fusion-epoxy lining and coating.
    c. Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.
4. Coatings and Linings: In accordance with Section 09 96 02 - Coatings.
5. Joints between fittings and PVC pressure pipe:
    a. Rubber gasket joints.
    b. Joint dimensions and tolerances: Same as PVC pipe manufacturer's joint design.

c. Joint Restraint Products: ASTM F1674.

6. In accordance with AWWA C208.

D. Ductile Iron Fittings:

1. AWWA C110 or AWWA C153.

2. Coatings and Linings: In accordance with Section 09 96 02 - Coatings.

3. Joints between fittings and PVC pressure pipe:

a. Rubber gasket joints.

b. Joint dimensions and tolerances: Same as PVC pipe manufacturer's joint design.

4. Joint Restraint Products: ASTM F1674:

a. Between pipe sections:

1) Megalug Series 2800, EBAA Iron Sales, Incorporated, P.O. Box 857, Eastland TX 76448, telephone: 800-433-1716, http://www.ebaa.com or equivalent.

b. Between pipe and fittings:

1) Megalug Series 2500, EBAA Iron Sales, Incorporated, P.O. Box 857, Eastland TX 76448, telephone: 800-433-1716, http://www.ebaa.com or equivalent.

E. Tapping Saddles:

1. AWWA C800.

2. Provide threaded outlet to match remaining 2 inch air valve assembly.

3. NSF/ANSI 61 Compliant.

F. Tapping Sleeves:

1. AWWA C223.

2. Provide tapping flange to match remaining 4 inch blowoff assembly.

3. NSF/ANSI 61 Compliant.

2.03 CONCRETE

A. Concrete in encasements, blocking and collars in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Steel Fittings:

1. Testing:

a. Hydrostatic test fittings fabricated from steel plate.

1) Hydrostatic pressure: Sufficient to stress steel to 75 percent of minimum yield point of steel.

2) Hold pressure long enough to allow inspection of welded joints.

3) Repair leaks by rewelding and retesting of joints.

b. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Girth weld test: Dye penetrant test in accordance with ASTM E165.

2) Repair weld defect: Chip, flame gouge, or grind to sound metal; reweld resulting cavities; and retest.

B. Ductile Iron Fittings: Test in accordance with AWWA C110 and AWWA C153.

PART 3 EXECUTION

3.01 LAYING PIPE

A. Keep pipe trenches free of water during pipelaying operations.

B. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.

2. At joints involving bells or collars, provide holes at joint of ample size to prevent bells or collars from coming in contact with subgrade.

3. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

C. On grades exceeding 10 percent, lay pipe uphill.

D. Before Assembling Pipe Joints:

1. Clean gasket, bell, and spigot with a rag, brush, or paper towel to remove any foreign material.

2. Apply lubricant as specified by pipe manufacturer:

a. Use only lubricant supplied by the pipe manufacturer.

b. Lubricate spigot end of pipe as recommended by the manufacturer.

c. Do not lubricate either the gasket or gasket groove in bells where gaskets are field installed.

d. Lubricate factory-installed, nonremovable-type gaskets as recommended by the pipe manufacturer.

E. Joining Pipe:

1. Join pipe in accordance with AWWA C605 or as directed by COR.

2. Align spigot to bell, and insert spigot into bell until spigot contacts gasket uniformly.

3. Apply firm, steady pressure either by hand or by using bar and block until spigot easily slips through gasket.

a. Mechanical equipment such as come-alongs may also be used to join pipe.

b. Do not damage pipe during joint assembly.

4. Push spigot until reference mark on spigot end is flush with bell end.

a. Spigot end of pipe: Marked by manufacturer to indicate proper depth of insertion.

5. Do not swing or "stab" the joint. Do not suspend pipe and swing into the bell.

6. If adjustment of the position of a length of pipe is required after installation, remove and relay the length of pipe as for a new pipe.

F. Changes in Alignment and Grade:

1. Where shown as miter bends on drawings, make changes in alignment and grade with steel or ductile-iron miter bends.

2. Cathodically protect metallic miter bends and/or metallic restraint joints.

3. Make other changes in alignment and grade by providing deflections at joints.

a. Maximum deflection: 1 degree or deflection recommended by pipe manufacturer, whichever is less.

4. Longitudinal bending of pipe to obtain deflection: Not permitted.

5. Other methods of providing curves in pipelines may be submitted; and if approved, use these methods to install curves at no additional cost to the Government.

a. Methods of providing curves in pipelines which incorporate rubber gasket joints encased in concrete will not be approved.

G. Connections Between PVC Pressure Pipe and Other Types of Pipe:

1. Use rubber gasketed mechanical joints to make connections between PVC pressure pipe and other types of pipe.

H. Schedule work so that at no time will pipe remain in the trench more than 7 days before backfill is placed to original ground surface or to other specified backfill limits shown on drawings.

I. Thrust Restraint:

1. Joint restraint products or other restraint method at miter bends as shown on drawing 1695-D-60049.

a. Other methods of restraint may be used as approved by COR.

b. Coat in accordance with Section 09 96 20 - Coatings.

J. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Place backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.

2. In certain pipeline reaches, where determined necessary by the COR to prevent the possibility of flotation, do not lay more than 300 linear feet of pipe ahead of backfilling operations.

3. If pipelaying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16 inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1 inch.

3.03 PIPE DEFLECTION

A. Allowable vertical pipe diameter deflection after backfilling is complete:

1. Decrease, maximum: 5 percent of nominal pipe diameter.

2. Elongation, maximum: 3 percent of nominal pipe diameter.

B. Within 2 weeks after backfilling is completed, take measurements of internal diameters.

C. Measurement Frequency:

1. One pipe unit out of 3 for the first 30 units laid and 1 pipe unit out of 10 thereafter.

2. In areas of deep burial or where special problems are encountered, the frequency of measurements may be increased at the discretion of the COR.

D. Measurements:

1. Measure vertical and horizontal diameter at approximate midpoint of pipe unit.
2. Record pipe deflections and station where measurements were taken.
3. Mark inside of pipe so that future comparisons can be made.

E. If a pipe unit deflection exceeds the allowable:

1. Take measurements in adjacent pipe units to determine extent of excessive deflection.
2. Provide deflection data to the COR.
3. Additional direction will be provided to the Contractor after deflection data is analyzed.

END OF SECTION

SECTION 33 11 18
HDPE PRESSURE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Line Pipe.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.1-10	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM D2513-14	Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
4.	ASTM D3350-14	Polyethylene Plastics Pipe and Fittings
5.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry
6.	ASTM F714-13	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
7.	ASTM F2206-14	Fabricated Fittings of Butt-Fused Polyethylene (PE)
8.	ASTM F2620-13	Heat Fusion Joining of Polyethylene Pipe and Fittings
9.	ASTM F2634-15	Laboratory Testing of Polyethylene (PE) Butt Fusion Joints using Tensile-Impact Method

C. American Water Works Association (AWWA)

1.	AWWA C600-10	Installation of Ductile Iron Water Mains and Their Appurtenances
2.	AWWA C906-15	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code – Steel

E. Plastic Pipe Institute (PPI)

1.	TR-33-12	Generic Butt Fusion Joint Procedure for Field Joint of Polyethylene Pipe

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 18-1, Heat Fusion Joint Operator Qualifications:

1. Certifications from manufacturer.
2. Inspection results.

C. Date of CertificationRSN 33 11 18-2, 2, Shop Drawings:

1. Show fitting fabrication details such as dimensions and location which includes station and elevation.

D. Connections details to other pipe typesRSN 33 11 18-3, 3, Certification:

1. Pipe meets AWWA C906.

E. Test reports correlated to shipping billsRSN 33 11 18-4, 4, Fusion Procedures:

1. Fusion temperature.
2. Interface pressure.
3. Cooling time.
4. Record of pipe size and DR being joined and each joints fusion temperature, interface pressure and cooling time.

1.04 QUALIFICATIONS

A. Heat Fusion Joint Machine Operator:

1. Certified by machine manufacturer or representative.

2. Trained on specific fusion machine and bonding procedure and shall:
    a. Perform 1 pipe-to-pipe bond and,
    b. One pipe-to-fitting bond on each machine to be used.
    c. Bonds made as part of operator certification shall be:
        1) Visually inspected and tested in accordance with PPI and ASTM standards.
3. Qualification remain in effect for 6 months from date of qualification.
    a. Ability to be revoked by certifying entity.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

B. Transport pipe and fittings with padded bolsters. Use heavy padding under ties.

C. Support and store pipe above ground surface.

PART 2 PRODUCTS

2.01 PIPE

A. HDPE Pressure Pipe: AWWA C906, except;
1. PE material:
    a. Standard PE code designation: PE 4710.
    b. Minimum cell Classification, ASTM D3350: PE 445574C, or E.
2. Each production lot of pipe shall be tested for melt index, density, percent carbon, dimensions and ring tensile strength.
3. Approved for potable water in accordance with NSF Standard 61.
4. Not less than 4 permanent co-extruded, equally spaced, blue color stripes in outside surface of pipe.

2.02 FITTINGS

A. Adaptors, couplings, bends, and connections at structures and encasements: Fabricated from HDPE unless otherwise specified, or as shown on drawings.

B. Metal Back-up Flange:
1. Material: Ductile iron, Class 150, ASME B16.1 or ASME B16.5, coat in accordance with Section 09 96 02 - Coatings.

C. Steel Fittings:

1. Steel for Fittings: ASTM A283, grade C or D; or ASTM A36.
2. Minimum Steel Wall Thickness: 10 gauge or greater.
3. Welding:
   a. AWS D1.1.
   b. Temporary or permanent welding for convenience of Contractor: Not permitted on areas where welding will damage fusion-epoxy lining and coating.
   c. Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.
4. Coatings and Linings:
   a. Fusion epoxy or coal-tar epoxy paint in accordance with Section 09 96 02 - Coatings.

D. HDPE Pipe Fittings:

1. Molded fittings constructed of HDPE PE 4710 in accordance with ASTM F714 and ASTM F2206.
2. Made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings;
   a. Rated for internal pressure service at least equal to full service pressure rating of mating pipe.
   b. Tested in accordance with AWWA C906.
3. HDPE flange and mechanical joint adaptors shall be rated to at least the same pressure as mating pipe.
4. Polyethylene flange or mechanical joint 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.
5. HDPE fabricated mechanical adapters shall have steel stiffeners.

2.03 CONCRETE

A. Concrete in encasements, blocking and collars: Section 03 30 00 - Cast-in-Place Concrete.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. HDPE Pipe and Fittings:

1. General: AWWA C906 testing of HDPE pipe and fittings and ASTM F2634 testing of HDPE factory test fusions.
    a. Completed and documented by qualified personnel.
    b. Government reserves right to:
        1) Observe testing while in process and to receive testing documentation.
        2) Inspect materials both during and after manufacture.
    c. Testing reports shall have unique identifiers with shipping bills to verify that pieces shipped belong to same as those tested.
2. Test in accordance with AWWA C906 and/or ASTM F714.
    a. Perform 1 butt fusion in accordance with ASTM F2620 and PPI Technical Report TR-33 on each run of pipe and from each batch of material feedstock.
        1) Test using Tensile Impact Test in accordance with ASTM F2634 prior to shipping pipe.
    b. Joints exhibiting yield point lower than unfused pipe or that fails in a brittle mode is considered unacceptable.
    c. Unacceptable test result, Government may reject pipe manufactured in same run and from same batch of material feedstock represented by unacceptable test. Manufacturer may, at own expense, supply additional testing to COR.
    d. Acceptable test results do not:
        1) Mean that pipe from pipe run or material feedstock batch will be acceptable.
        2) Relieve pipe manufacturer or supplier from liability for defects in material or workmanship of pipe discovered during installation or warrantee period.
3. HDPE pipe out-of-roundness tolerances shall not exceed maximum allowances in ASTM D2513, Table 2.
    a. HDPE pipe ovality: plus or minus 3 percent at pipe manufacturing facility.

B. HDPE Fittings:

1. Test at least 1 piece for every 50 fabricated; in the event that the number of pieces fabricated is not a multiple of 50, test at least 1 additional piece to ensure that over 2 percent of pieces fabricated are tested.

2. Government reserves right to require up to 2 percent of HDPE fittings shipped to job site be tested in accordance with AWWA C906 at no additional cost to Government.

C. Steel Fittings:

1. Hydrostatic test fittings fabricated from steel plate.
    a. Hydrostatic test for pipe and fittings: Stresses steel to 75 percent of minimum yield point of steel.
    b. Inspect welded joints during test.
    c. Repair leaks by rewelding and retesting of joints.
2. Girth Weld Test:
    a. Testing not required if girth butt welds are complete penetration welds.
    b. Dye penetrant test in accordance with ASTM E165.
    c. Weld defect repair: Chip, flame gouge, or grind to sound metal; reweld and retest weld.

PART 3 EXECUTION

3.01 LAYING PIPE

A. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.
2. At joints involving flanges, provide holes at joint to prevent flanges from coming in contact with subgrade.

B. Joining Pipe:

1. HDPE pipe butt fusions: In accordance with PPI Technical Report TR-33 (TR-33-12) and ASTM F2620.
2. Pipe may be joined above ground and then lowered into position, provided pipe is supported and handled in a manner that prevents damage.
3. Connections between HDPE pressure pipe and other types of pipe: as shown on drawings.
4. Tied Joint Restraint System:
    a. Clean surfaces of pipe and fittings to receive tied joint restraint system.
    b. In accordance with AWWA C600.
    c. Install joint restraint system so joints are mechanically locked together to prevent joint separation.

5. Saddle Fittings: Fusion weld saddle fittings to pipe in accordance with ASTM F2620.

6. Polyethylene Pipe Fusion Machine Data Loggers:

   a. Used during joint fusions.

   b. Record:

      1) Joint temperature,

      2) Pressure,

      3) Time.

   c. Supply data on fusion joints upon request of COR.

7. Thermal Contraction and Expansion of HDPE Pipe:

   a. COR may unbolt flange at transition between HDPE and steel to check for tensile or compressive loading due to thermal contraction of the HDPE pipe.

   b. Excessive tension or excessive compression of flange shall be cause for Contractor to excavate HDPE pipe, lengthen or shorten and re-bury at own cost.

C. Changes in Alignment and Grade:

1. Where shown as miter bends on drawings, make changes in alignment and grade with miter bends or submit proposal to COR for approval.

2. Make other changes in alignment and grade by bending pipe.

   a. Minimum cold (field) bend radius shown in Table 33 11 18A - Minimum Cold Bending Radius.

Table 33 11 18A - Minimum Cold Bending Radius

Pipe DR	Minimum Cold Bending Radius
≤ 9	20 times pipe OD
>9 to 13.5	25 times pipe OD
>13.5 to 21	27 times Pipe OD
>21	30 times pipe OD
Fitting or flange present or to be installed in bend	100 times pipe OD

D. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

E. Closure sections:

1. Last fusion joint for HDPE pipe to HDPE pipe closure sections:

a. Make during the coolest part of the day.

b. Air temperature, maximum: 65 degrees F.

F. Pipe will remain in the trench no more than 7 days before backfill is placed to original ground surface or to other specified backfill limits shown on drawings.

G. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16 inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1 inch.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Fusion Quality Testing on Polyethylene pipe:

1. Frequency:

a. Minimum: 1 per crew per week or at request of COR.

b. Maximum: 10 percent of welds.

c. Additional testing may be required during changes in:

1) Weather.

2) Fusion machine.

3) Fusion crew.

2. Procedure:

a. Cool trial fusion, then.

1) Cut out test coupons.

2) Test using Tensile Impact Method accordance with ASTM F2634.

3. Rejection of Fusion Joints:

a. Exhibits a yield point lower than unfused pipe or,

b. Fails in brittle mode.

c. Field fusions represented by trial fusion shall be rejected.

1) Make corrections at Contractor expense and re-make rejected fusions.

B. Test field welds on steel pipe and fittings using ultrasonic or radiographic method in accordance with AWS D1.1.

END OF SECTION

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SECTION 33 11 19
FIBERGLASS PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for Line Pipe.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B18.2.1-10	Square and Hex Bolts and Screws, Inch Series

B. ASTM International (ASTM)

1.	ASTM A36/A36M-12	Carbon Structural Steel
2.	ASTM A283/A283M-12a	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM D3517-11	Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
4.	ASTM D4161-01(2010)	Fiberglass (Glass-Fiber-Reinforcing Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
5.	ASTM F477-10	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
6.	ASTM E165-12	Liquid Penetrant Examination

C. American Water Works Association (AWWA)

1.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings for Water
2.	AWWA C153-11	Ductile-Iron Compact Fittings for Water Service
3.	AWWA C950-13	Fiberglass Pressure Pipe
4.	AWWA M45-05	Fiberglass Pipe Design

D. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-08	Structural Welding Code - Steel
2.	AWS D1.4/D1.4M-11	Structural Welding Code Reinforcing Steel

E. Federal Specifications (FED-STD)

1.	FED-STD FF-N-836E	Nut, Square, Hexagon, Cap, Slotted, Castle, Knurled, Welding and Single Ball Seat, February 14, 1994

F. International Organization for Standardization

1.	ISO 9001-08	Quality Management Systems - Requirements

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 19-1, Shop Drawings:

1. Show fitting fabrication details.
2. Show exact dimensions of joints, and diameter of rubber gasket including tolerances, and other major dimensions.

C. RSN 33 11 19-2, Joint Repair Plan:

1. Proposed equipment, materials, and procedures for repairing leaks in pipe joints.

D. RSN 33 11 19-3, Qualifications:

1. Pipe manufacturer:
   a. ISO 9001 or similar nationally certified quality program certification.
   b. At least 10 years of successful experience producing products as specified.
   c. References for at least 3 completed projects.

1.04 QUALIFICATIONS

A. Pipe manufacturer:

1. Certified in accordance with ISO 9001 or similar nationally certified quality program as approved by COR.
2. At least 10 years of successful experience producing products as specified.
3. Provide references for at least 3 completed projects.

B. Welding procedures and welders in accordance with AWS D1.1.

C. Pipelaying Workers: Skilled and experienced in laying pipe with type of joint being furnished.

1.05 DELIVERY, STORAGE AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storage, and installation.

B. Package, handle, and ship in accordance with manufacturer's recommendations.

C. Transport pipe and fittings on padded bolsters either curved to fit the outside of the pipe or using triangular chocks. Use heavy padding under ties.

D. Support and store pipe above ground surface. Do not allow bells, couplings or spigots to contact each other or the ground.

E. Use manufacturer's instructions for handling of pipe.

F. Replace or repair, as approved by the COR, pipe that is damaged during shipment, storage, or installation at the Contractor's expense.

PART 2 PRODUCTS

2.01 PIPE

A. Fiberglass Pipe: In accordance with AWWA C950 and ASTM D3517.

1. Pressure pipe utilizing either a continuous filament wound process or centrifugally cast process with:

   a. Type 1: glass fiber-reinforced thermosetting polyester resin mortar.

   b. Liner 1: reinforced thermoset liner.

   c. Grade 1: polyester resin surface layer - reinforced.

   d. Class: see Table 33 11 10A - Symbol Pipe Equivalents for required line pipe sizes and pressure classes.

   e. Pipe Stiffness: 18 psi minimum.

B. Design pipe for the maximum sustained working pressure and the surge pressure.

1. The maximum sustained and surge pressures are considered the same and are defined by the head classes shown on pipeline plan and profile drawings.

C. Elastomeric Sealing Gaskets: Manufactured and tested in accordance with ASTM F477.

2.02 FITTINGS

A. Tees, bends, adapters, and connections at structures and encasements: As shown on drawings.

B. Fittings: Fabricated from steel or ductile iron.

1. Fiberglass Fittings: In accordance with AWWA M45 and AWWA C950.
    a. Installed in accordance with manufacture's recommendations.
2. Steel Fittings:
    a. Steel for Fittings: ASTM A283, grade C or D or ASTM A36.
    b. Minimum steel wall thickness: 0.25 inches or thickness required to meet pipe classification shown on the plan and profile, whichever is greater.
    c. Pipe Diameter: Pipe inside diameter measured to the inside of the lining shall not be less than the nominal diameter shown on the drawings.
    d. Welding:
        1) AWS D1.1.
        2) Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.
        3) Temporary or permanent welding for convenience of the Contractor: Not permitted on areas where welding will damage fusion-epoxy lining and coating.
    e. Bolts and Nuts: ASME B18.2.1 and FED-STD FF-N-836.
    f. Coating and lining in accordance with Section 09 96 20 - Coatings.
    g. Tees:
        1) Tees as shown on drawings.
        2) Tee lengths, minimum: As shown on drawings or as required for blocking.
    h. Miter bends: Fabricate steel bends as shown on drawings.
    i. Closure Section Joints: Sleeve coupling.
    j. Joints between steel fittings and Fiberglass pipe: Metal outlet nozzle for blowoff and air valve only.
        1) Laminate overlay encasing a metal key ring around the metal piping blowoff outlet nozzle.
3. Ductile Iron Fittings:
    a. AWWA C110 or AWWA C153.
        1) Match pipe pressure class.
        2) Flanges: AWWA C110 or AWWA C153.

3) Bolts: AWWA C110 or AWWA C153.

4) Gaskets: AWWA C110 or AWWA C153.

b. Coatings and lining:

1) Refer to Section 09 96 20 - Coatings.

c. Plan, profile and restraint system shown on drawings shall require modification if ductile iron fittings are used.

d. Submit plan, profile, restraint system, details and connections for COR review and approval.

2.03 FABRICATION

A. Fiberglass fittings and couplings shall be designed, manufactured, and tested in accordance with AWWA C950, ASTM D3517, and ASTM D4161.

B. Fiberglass fittings should resist the same loading conditions as the adjacent pipe.

C. Steel Fittings:

1. Tees:

a. Tees for blowoffs and air valves as shown on drawings.

b. Tee length, minimum: As shown on drawings or as required for blocking.

2.04 CONCRETE

A. Concrete in Encasements, Blocking and Collars: Section 03 33 00 - Cast-in-Place Concrete.

B. Other methods of restraint may be used as approved by the COR.

C. Plan, profile and restraint system shown on drawings require modification if alternate methods are used.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Fiberglass:

1. Test in accordance with AWWA C950 and ASTM D3517.

B. Fiberglass Fittings: Pipe outlets for air valves, blowoffs and tapers (or adaptors) as shown on drawings.

1. Pipe Outlets for air valves and blowoffs:

a. Hydrostatic test in accordance with AWWA C950, ASTM D3517, and ASTM D4161,

b. Use a fiberglass reinforcement collar connection for blowoffs.

c. Place metal piping securely in fiberglass laminated overlay outlet pipe.

d. Welding in accordance with AWS D1.4.

C. Steel Fittings, testing:

1. Hydrostatic test fittings fabricated from steel plate.

a. Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.

b. Hold pressure long enough to allow thorough inspection of welded joints.

c. Repair leaks by re-welding and retesting of joints.

2. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

a. Girth weld test: Dye penetrant test in accordance with ASTM E165.

b. Weld defect repair. Chip, flame gouge, or grind to sound metal; re-weld; and test the repaired weld.

D. Ductile Iron Fittings:

1. AWWA C110 or AWWA C153.

2. Coatings and lining: Refer to Section 09 96 20 - Coatings.

3. For straight fittings.

4. Plan, profile and restraint system shown on drawings shall require modification if ductile iron fittings are used.

E. Joints between fittings and ductile iron pipe.

1. Rubber gasket joints.

2. Joint dimensions and tolerances: Same as pipe manufacturer's joint design.

2.06 SOURCE QUALITY ASSURANCE

A. Approval for Shipment:

1. Pipe and fitting approval, will be determined by inspection, during and after manufacture.

2. Notify the Technical Service Center, Attn: 86-68140; and the COR at least 14 days before manufacturing pipe and fittings and 3 days before shipping pipe and/or fittings.

3. The Government will inspect pipe and fittings and will approve for shipment of those which have been manufactured and tested in accordance with these specifications.

4. Further inspection of pipe units and fittings will be in accordance with the clause at FAR 52.246-12 "Inspection of Construction".

PART 3 EXECUTION

3.01 LAYING PIPE

A. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.
2. At joints involving bells or collars, provide holes at joint of ample size to prevent bells or collars from coming in contact with subgrade.

B. Keep pipe trenches free of water during pipelaying operations.

C. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

D. On grades exceeding 10 percent, lay pipe uphill.

E. When pipelaying is not in progress, keep ends of pipelines closed.

F. Joining Pipe:

1. Follow manufacturer’s recommendations for installation.
2. Inspect pipe end and/or coupling, elastomeric gasket, and sealing surfaces for damage.
3. Before assembling pipe joints, clean gasket, bell or coupling, especially the groove, and the spigot with a rag, brush, or paper towel to remove dirt or foreign material.
4. Placing Elastomeric Gasket:
    a. Spigot Groove Method:
        1) Follow manufacturer’s recommended practices for gasket installation.
        2) Apply manufacturer’s approved joint lubricant to spigot interior and elastomeric gasket.
        3) After placing elastomeric gasket in spigot groove, equalize elastomeric gasket cross section by inserting a tool such as a large screwdriver under the elastomeric gasket and moving it around the periphery of the pipe spigot.
    b. Coupling Groove Method:
        1) Follow manufacturer’s recommended practices for gasket installation. Typically this method is factory installed.
5. Fit pipe units together, spigot to bell or coupling, and draw the joints together so that the bells or couplings and spigots are fully engaged.

6. Do not swing or "stab" the joint and do not suspend the pipe and swing it into the bell or coupling.

7. Fit pipe units together in a manner to avoid twisting or otherwise displacing or damaging the elastomeric gasket.

8. When using gaskets of circular cross section, after pipe units have been joined, insert a feeler gauge between the pipe bell and pipe spigot and move it around the periphery of the pipe to determine that the position of the elastomeric gasket is correct and there are no fish-mouth problems. If adjustment of the position of a length of pipe is required after installation, remove and relay the length of pipe as for a new pipe.

9. Maintain pipe securely in final position.

G. Changes in Alignment and Grade:

1. Make changes in alignment and grade with miter bends.

2. Make minor changes in alignment and grade by pulling pipe joints.

a. Pull rubber gasket coupling or bell-and-spigot joint.

b. A total pull of 0.5 degree joint deflection may be permitted. When pipe joint is pulled, use a full 20 foot length of pipe on each side.

c. Maximum deflection: As recommended by pipe manufacturer.

3. Lay ends of each section of pipe on the theoretical centerline of the curve and to the grade shown on the drawings within the laying tolerances prescribed above.

H. Thrust Restraint:

1. Restrained joint couplings in combination with concrete blocking, encasements and collars.

a. Concrete in encasements, blocking and collars in accordance with Section 03 33 00 - Cast-in-Place Concrete.

2. Joint restraint couplings to lengths shown on drawing 1695-D-60049:

a. Double bell with rubber gaskets and locking rods.

3. Alternate methods of coupling restraint may be used if approved by the COR.

I. Closure Sections:

1. Use closure sections where necessary as determined by the Contractor, subject to the approval of the COR.

2. Follow manufacturer’s recommendations.

J. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on the drawings or established by the COR to the following tolerances:

1. Total departure from established alignment and grade, maximum: 1 inch.

3.03 BACKFILL

A. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Place backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.
2. In certain pipeline reaches, where determined necessary by the COR to prevent the possibility of flotation, do not lay more than 300 linear feet of pipe ahead of backfilling operations.
3. If pipelaying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

3.04 PIPE DEFLECTION

A. Allowable vertical pipe diameter deflection after backfilling is complete.

1. Decrease, maximum: 3 percent of nominal pipe diameter.
2. Elongation, maximum: 1.5 percent of nominal pipe diameter as measured when backfill reaches pipe crown.

B. Within 2 weeks after backfilling is completed, take measurements of internal diameters.

C. Measurement Frequency:

1. Midpoint of pipe section at approximate 50 feet intervals for the first 500 feet of backfilled pipe, and once every 200 feet intervals thereafter.
2. In areas of deep burial or where special problems are encountered, the frequency of measurements may be increased at the discretion of COR.

D. Measurements:

1. Measure vertical and horizontal diameter at approximate midpoint of pipe unit.
2. Record pipe deflections and station where measurements were taken.
3. If a pipe deflection exceeds the allowable:
    a. Take measurements at midpoint of pipe unit upstream and downstream at approximate 50 foot intervals to determine extend of excessive deflection.
    b. Provide measurements to COR.
4. Mark inside of pipe so that future comparisons can be made.

E. If a pipe unit deflection exceeds the allowable.

1. Take measurements in adjacent pipe units to determine extent of excessive deflection.
2. Provide deflection data to COR.

F. Additional direction will be provided after deflection data is analyzed.

1. Take corrective action that including removing and replacing pipe that exceeds allowable deflection tolerance.

END OF SECTION

SECTION 33 11 50

PIPE CROSSINGS AT EXISTING UTILITY PIPELINES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices in the Price Schedule for Line Pipe.

1.02 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1.	AWWA C105-10	Polyethylene Encasement for Ductile-Iron Pipe Systems

B. ASTM International (ASTM)

1.	ASTM C1619-11	Elastomeric Seals for Joining Concrete Structures

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 50-1, Rubber Gasket Data:

1. In accordance with ASTM C1619.

PART 2 PRODUCTS

2.01 MATERIALS

A. Polyethylene Film: AWWA C105.

1. Minimum width for flat tube: 1.65 times outside diameter of pipe bell.
2. Minimum width for sheet: 3.30 times outside diameter of pipe bell.

B. Gaskets: ASTM C1619.

C. Roofing Felt: 15 pound roofing felt.

PART 3 EXECUTION

3.01 PIPE PROTECTION

A. Protect pipe and fittings at utility pipeline crossings in accordance with requirements of Table 33 11 50A - Protection for Pipe Crossings at Existing Utility Pipelines.

Table 33 11 50A - Protection for Pipe Crossings at Existing Utility Pipelines

Type of Line Pipe	Existing Utility Pipeline	Protection Required
The following types of pipe with rubber gasket joints: Cement-mortar-coated steel line pipe	Metallic water, storm sewer, or natural gasline	Encase line pipe with polyethylene for 200 feet on each side of utility.
	Nonmetallic gasoline, natural gasline, oil, or sanitary sewer	Encase line pipe with polyethylene for 100 feet on each side of utility.* Install petroleum-resistant gaskets in joints within 100 feet on each side of utility.**
	Nonmetallic water or storm sewer	None
The following types of pipe with rubber gasket joints: Polyethylene encased ductile-iron line pipe	Metallic or nonmetallic gasoline, oil, or sanitary sewer	Install petroleum-resistant gaskets in joints within 100 feet each side of utility.
The following types of pipe with rubber gasket joints: PVC Dielectric-coated steel line pipe Dielectric coated ductile iron line pipe Fiberglass	Metallic or nonmetallic gasoline, natural gasline, oil, or sanitary sewer	Encase joints that are within 100 feet on each side of the crossing with polyethylene. Extend polyethylene for 5 feet on each side of the joint.*** Install petroleum-resistant gaskets in joints within 100 feet on each side of utility.**
	Metallic or nonmetallic water or storm sewer	None

Table 33 11 50A - Protection for Pipe Crossings at Existing Utility Pipelines

Type of Line Pipe	Existing Utility Pipeline	Protection Required
The following types of pipe with welded joints: Cement-mortar-coated steel line pipe	Metallic utility pipeline	Encase line pipe with polyethylene for 200 feet on each side of utility.
	Nonmetallic utility pipeline	None
The following types of pipe with welded or fused joints: Dielectric-coated steel line pipe HDPE PVC	Metallic or nonmetallic utility pipeline	None

* At sanitary sewer crossings, encase line pipe with polyethylene for 10 feet on each side of crossing.
** At natural gaslines, petroleum-resistant gaskets are not required.
*** At sanitary sewer crossings, encase pipe joints that are within 10 feet on each side of the crossing.

3.02 PREPARATION AND INSTALLATION

A. Provide polyethylene encasement to prevent contact between pipe and surrounding backfill and bedding material.

1. Polyethylene encasement is not intended to be a completely airtight and watertight enclosure.
2. Secure overlaps by using adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

B. Prior to encasing with polyethylene, remove foreign substances, such as mud, dirt, clods, and any loose aggregate, on pipe and fitting surfaces.

C. Overlap junctions of tube or sheet polyethylene at least 1 foot longitudinally.

D. Encase fittings for pipe with polyethylene in the same manner as for pipe.

E. Repair rips, punctures, or other damage to polyethylene with adhesive tape or with a suitable polyethylene film patch. Make repairs prior to wrapping with roofing felt.

F. Wrap roofing felt around entire polyethylene encasement and tape in place.

G. Do not puncture polyethylene encasement and roofing felt during backfilling operations.

END OF SECTION

SECTION 33 12 05
NAPI TURNOUT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. NAPI Turnout:

1. Payment: Lump sum price offered in Price Schedule. Includes:
    a. Forming.
    b. Reinforcing.
    c. Concrete.
    d. Precast Concrete Manhole and Aggregate.
    e. Barrier Posts.
    f. Excavation.
    g. Backfill and Compaction.
    h. Probe Magnetic Flowmeter.
    i. Six inch butterfly valve.
    j. Four inch butterfly valve.
    k. Miscellaneous Valves.
    l. Valve box.
    m. Steel Pipe, Tee and Fittings.

PART 2 PRODUCTS

2.01 FORMING

A. See Section 03 11 10 - Concrete Forming.

2.02 REINFORCING

A. See Section 03 20 00 - Concrete Reinforcing.

2.03 CONCRETE AND COARSE CONCRETE AGGREGATE

A. See Section 03 30 00 - Cast-in-Place Concrete.

2.04 PRECAST CONCRETE MANHOLE

A. See Section 03 48 00 - Precast Concrete Structures.

2.05 BARRIER POSTS

A. See Section 05 50 00 - Metal Fabrications.

2.06 EXCAVATION

A. See 31 23 10 - Earthwork.

2.07 BACKFILL AND COMPACTION

A. See Section 31 23 22 - Pipe Trench Earthwork.

2.08 PROBE MAGNETIC FLOWMETER

A. See Section 33 09 08 - Probe Magnetic Flowmeter.

2.09 BUTTERFLY VALVES, VALVE BOX, MISCELLANEOUS VALVES

A. See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

2.10 STEEL PIPE, TEE AND FITTINGS

A. See Section 33 21 95 - Metal Piping for Line Pipe Installations.

PART 3 EXECUTION

3.01 INSTALLATION

A. As shown on drawing 1695-D-60050.

END OF SECTION

SECTION 33 12 10
VALVES AND EQUIPMENT FOR LINE PIPE INSTALLATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Class 150B Two Inch Diameter Air Valve Assemblies:

1. Measurement: Number of air valve assemblies installed.
2. Payment: Unit price offered in Price Schedule. Includes:
    a. Precast Concrete Manhole and Coarse Aggregate.
    b. Two Inch Air Valve.
    c. Barrier Posts.
    d. Air Valve Equipment Supports.
    e. Miscellaneous metal fittings.
    f. Coatings.

B. Class 250B Two Inch Diameter Air Valve Assemblies:

1. Measurement: Number of air valve assemblies installed.
2. Payment: Unit price offered in Price Schedule. Includes:
    a. Precast Concrete Manhole and Coarse Aggregate.
    b. Two Inch Air Valve.
    c. Barrier Posts.
    d. Air Valve Equipment Supports.
    e. Miscellaneous metal fittings.
    f. Coatings.

C. Class 150B Four Inch Diameter Blowoffs:

1. Measurement: Number of blowoff assemblies installed.
2. Payment: Unit price offered in the Price Schedule. Includes:
    a. Coarse Aggregate.
    b. Meter Box.
    c. Valve Box.
    d. Four inch Ball Valve.
    e. Automatic Ball Drip Valve.

f. Miscellaneous metal fittings.

g. Coatings.

D. Class 250B Four Inch Diameter Blowoffs:

1. Measurement: Number of blowoff assemblies installed.

2. Payment: Unit price offered in the Price Schedule. Includes:

a. Coarse Aggregate.

b. Meter Box.

c. Valve Box.

d. Four inch Ball Valve.

e. Automatic Ball Drip Valve.

f. Miscellaneous metal fittings.

g. Coatings.

E. Cost:

1. Include valves and equipment in the price in the Price Schedule for NAPI Turnout. Includes:

a. Six inch butterfly valve.

b. Four inch butterfly valve.

c. Valve box.

d. Flanges and gaskets.

e. Miscellaneous metal fittings.

1.02 DEFINITIONS

A. Valves and Equipment for Line Pipe Installations.

1. NAPI Turnout.

2. Blowoffs per drawing 1695-D-60048.

3. Air Valve Assemblies per drawings 1695-D-60046.

1.03 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.1-10	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

B. American Water Works Association (AWWA)

1.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
2.	AWWA C504-15	Rubber-Seated Butterfly Valves
3.	AWWA C507-15	Ball Valves, 6 In. Through 48 In. (150 mm Through 1,500 mm)

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

1. General:
    a. Submit data that demonstrates equipment provided meets requirements.
    b. Submit data giving manufacturer's name, type, model, size, and construction and performance characteristics of equipment.
    c. Mark proposed catalog sheet item which allows data to be legibly reproduced.

B. RSN 33 12 10-1, Commercial Product Data.

1. Butterfly valves for buried or submerged service.
    a. Products data for butterfly valves including hydrostatic pressure testing certification. Include pressures used in testing valves.
2. Valve boxes for buried valves.
3. Air valves.
4. Ball valves.
5. Automatic ball drip valve.

C. RSN 33 12 10-2, Service Manuals.

1. For items in RSN 33 12 10-1.

PART 2 PRODUCTS

2.01 PRECAST MANHOLE AND AGGREGATE

A. See Section 03 48 00 - Precast Concrete Structures.

2.02 BARRIER POSTS AND AIR VALVE EQUIPMENT SUPPORTS

A. See Section 05 50 00 - Metal Fabrications.

2.03 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.04 MISCELLANEOUS METAL FITTING

A. See Section 33 32 95 - Metal Piping for Line Pipe Installations.

2.05 EQUIPMENT

A. Manually Operated Butterfly Valves:

1. General:
    a. AWWA C504, Class 150B or 250B. Class of valve to suit the pressure class at the line pipe locations.
    b. Bubbletight at rated pressure in either direction and suitable for operation after long periods of inactivity.
    c. Axis of valve leaf: Horizontal when valve is in installed position except where shown on drawings.
2. Provide valve body flanges for connection to ASME B16.1, Class 125 or 250 or AWWA Class D, E, or F flanges as necessary.
3. Valve seat: Located either in valve body mating with a stainless steel seating surface located on valve disc; or in valve disc mating with a stainless steel seating surface located in valve body. Fully rubber lined bonded seat in body type seats are unacceptable.
4. Manual operators. Provide:
    a. Manually-operated butterfly valves with a worm-gear or traveling nut type manual operator in accordance with AWWA C504.
    b. Operators that open and close the valves under maximum unbalanced pressure conditions. Design for a maximum unbalanced pressure of adjoining pipe pressure.
    c. Gears of self-locking type, holds valve in all positions without fluttering or creeping.
    d. Rim pull and component strength: AWWA C504.
5. Buried butterfly valves. Provide:
    a. Valve boxes.
    b. Two inch square-nut operator.
    c. Two steel tee-handle wrenches, each with a length of 8 feet.
    d. Worm-gear or traveling nut type manual operator in accordance with AWWA C504.

e. Gears of the self-locking type, holds valve in all positions without fluttering or creeping.

f. Ensure rim pull and component strength meets AWWA C504.

B. Four inch Ball Valve:

1. AWWA C507, class 150 or 300. Class of valve to suit the pressure class at the line pipe locations.

2. Flanged connection to ASME B16.1, Class 125 or 250 or AWWA Class D or E flanges as necessary.

3. Suitable for buried service.

4. Valve boxes.

5. Two inch square nut operator.

6. Manually-operated with a worm-gear or a traveling nut type manual operator.

7. Gears of the self-locking type, holds valve in all positions without fluttering or creeping.

8. Bubble tight at rated pressure in either direction and suitable for operation after long periods of inactivity.

C. Automatic Ball Drip Valve:

1. Threaded end.

2. Automatic draining, ball check.

3. Minimum 300 psig.

4. Provide dielectric insulating union as necessary to prevent galvanic corrosion between dissimilar metals.

D. Two inch Air Valve:

1. Val-Matic model 201C manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th street, Lyons, IL 60534; Dezurik Model 145C manufactured by Valve and Primer Corporation, 1420 South Wright Boulevard, Schaumburg, IL 60193-4599; Crispin Model AL21 Air and Vacuum Valve manufactured by Multiplex Manufacturing Company, 600 Fowler Avenue, Berwick, PA 18603; or equal, having the following essential characteristics:

a. Combination air-inlet and air-release type actuated by a float.

b. Remains open for filling line until water has displaced air at point of attachment of valve assembly after which it closes.

c. Opens when pressure in pipeline drops sufficiently to create a vacuum.

d. Releases trapped air when the pipeline is under pressure.

e. Furnish with 2 petcocks for valve; one at the top to permit checking the effectiveness of air valve, and one at bottom to allow valve to be drained.

f. Stainless steel internal parts such as guides, bushings, and screws.

g. Stainless steel floats.

h. Float-pivot supports: Brass, bronze, stainless steel, or cast iron.

i. Cold water pressure rating for the body: Minimum of 300 pounds per square inch.

j. Inlet connection: Internally threaded NPT.

E. Valve Box:

1. Model 6855 series, manufactured by Tyler Pipe, PO Box 2027, Tyler TX 75710; or equal, having the following essential characteristics:

a. 5-1/4 inch minimum inside diameter cast iron, composite, or PVC valve boxes for valves 4 inches in diameter and larger.

b. Two piece or 3 piece and slip type.

c. Cast iron collar with lid marked "WATER".

d. Base and adequate extension items to extend from valve nut operator to ground surface. Extension items may be PVC or metal.

e. Concrete medallion flush mounted with grouted surface except at blowoff locations. Refer to Detail A, drawing 1695-D-60050.

F. Meter Box:

1. Model VB-MAX-H, manufactured by Rain Bird, 6991 East Southpoint Road, Tucson, AZ 85756; or equal having the following essential characteristics:

a. Lockable lid.

b. Approximate dimensions of 40 inches by 27 inches by 18 inches.

G. Flanges:

1. Slip-on ring type, flat faced: AWWA C207 or ASME B16.5.

2. Flat face with a finish suitable for full face gasket for flanged joints.

H. Flange gaskets:

1. Model No. 19, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:

a. Full flat face-type.

b. For AWWA C207 flanged joints.

c. For cold water service.

2. Correct flange face gasket surface finish.

3. Spiral or concentric serrated grooved flange face gasket surface finishes suitable for flat gasket material provided and operating pressures.

I. Miscellaneous metal fittings:

1. Provide fittings for attaching valves and other appurtenances as shown on drawings.

J. Valve Insulation Jacket for Air Valve Installations:

1. Manufactured by ThermaXX LLC, 16 Hamilton Street, West Haven CT 06516; or equal, having the following essential characteristics:

a. Insulation material should be adequate to prevent freezing from generally accepted temperatures at location being installed.

b. Non-asbestos.

c. Hydrophobic.

2.06 CONTRACTOR SOURCE QUALITY TESTING

A. Shop test AWWA butterfly valves in accordance with AWWA C504 for butterfly valves and AWWA C507 for ball valves.

1. Leak test valves at manufacturer's facility or an alternate facility approved by COR.

2. Tests may be Government witnessed. Notify Government 30 days prior to testing valves.

3. Test valves during same trip for Government from each manufacturer.

4. Prior to shop leakage test and in presence of Government, verify that when valve is fully closed, valve indicator shall indicate closed.

5. If indicator is not in closed position (exactly at closed), remove operator from valve, fully close valve, reinstall operator so that it indicates "CLOSED".

6. Shop leakage test:

a. Test valves and their seats for leaks with water in 100 percent closed position for timed period of 5 minutes with a pressure equal to rated design pressure. Valves shall be drip tight with no leakage.

b. Upstream position of valve shall be visible to Government.

c. Spray or high velocity leakage will not be acceptable.

d. If valve leaks, adjust until valve is drip tight with no leakage. Adjustments may include adjusting valve stops, seats, actuators, etc.

e. If a valve is not drip tight (any leakage), valve will not be acceptable.

B. After adjustments are made, inspect again valve indicator and corrected.

PART 3 EXECUTION

3.01 INSTALLATION

A. Class 150B and 250B Two Inch Diameter Air Valve Assemblies: As shown on drawing 1695-D-60046.

B. Class 150B and 250B Four Inch Diameter Blowoffs: As shown on drawing 1695-D-60048.

C. NAPI Turnout: As shown on drawing 1695-D-60050.

D. Install valves and equipment to line and grade as shown on drawings.

E. Install valves complete and lubricated in accordance with the manufacturer's instructions.

F. Valves with flanged connections: Bolt holes to straddle vertical centerline when in installed position.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. After each valve has been completely installed, test valve in pipeline by opening and closing valve through full range of operation 3 times.

B. Make changes or adjustments until operation is approved by COR, and valves are bubbletight and do not leak water past seats.

C. Provide means for inspecting area downstream of the valve during testing by Government.

3.03 COATINGS

A. In accordance with Section 09 96 20 - Coatings.

END OF SECTION

SECTION 33 16 14
AIR CHAMBERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Air Chamber No. 1:

1. Payment: Lump sum price offered in the Price Schedule. Includes:
    a. Forming.
    b. Reinforcing.
    c. Concrete.
    d. Reinforced Concrete Unit Masonry Assemblies.
    e. Steel Joists.
    f. Metal Roof Deck.
    g. Preinsulated Metal Roof Panels.
    h. Preinsulated Metal Wall Panels.
    i. Roof Hatches.
    j. Security Doors and Frames.
    k. Door Hardware.
    l. Rubber Wall Base.
    m. Coatings.
    n. HVAC Ducts.
    o. Unit Heaters.
    p. Testing and Balancing HVAC.

B. Air Chamber No. 2:

1. Payment: Lump sum price offered in the Price Schedule. Includes:
    a. Forming.
    b. Reinforcing.
    c. Concrete.
    d. Reinforced Concrete Unit Masonry Assemblies.
    e. Steel Joists.

f. Metal Roof Deck.

g. Preinsulated Metal Roof Panels.

h. Preinsulated Metal Wall Panels.

i. Roof Hatches.

j. Security Doors and Frames.

k. Door Hardware.

l. Rubber Wall Base.

m. Coatings.

n. HVAC Ducts.

o. Unit Heaters.

p. Testing and Balancing HVAC.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.3-11	Malleable Iron Threaded Fittings: Classes 150 and 300
2.	ASME B16.9-12	Factory Made Wrought Buttwelding Fittings
3.	ASME B16.39-14	Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
4.	ASME B40.100-13	Pressure Gauges and Gauge Attachments
5.	ASME BPVC-VIII-15	Boiler and Pressure Vessel - Section VIII - Pressure Vessels
6.	ASME BPVC-IX-15	Boiler and Pressure Vessel - Section IX - Pressure Vessels

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3.	ASTM A139/A139M-15	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
4.	ASTM A193/A193M-15	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

5.	ASTM A193/A193M-15	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
6.	ASTM A516/A516M-15	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

C. American Water Works Association (AWWA)

1.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)

D. Manufacturers Standardization Society (MSS)

1.	MSS SP-85-11	Cast Iron Globe and Angle Valves Flanged and Threaded Ends
2.	MSS SP-110-10	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

E. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 - Submittals, and in accordance with the requirements of Section 01 33 26 - Electrical Drawings and Data.

B. RSN 33 16 14-1, Qualifications.

C. RSN 33 16 14-2, Shop Drawings, Design Calculations, and Design Data:

1. Checked, detailed shop drawings which include dimensions and tolerances, steel plate thicknesses, foundation connection, material data, joint details, ladder and platform, welding requirements; and painting, lining and coating.
2. Design calculations, design considerations, and referenced publications and standards used in the design of the air chamber, structural supports, anchor bolts, and base plate.
3. Commercial products data for equipment associated with the air chamber.
4. Hydrostatic test results.

D. RSN 33 16 14-3, Surge Analysis:

1. Hydraulic transient analysis of the system.

E. RSN 33 16 14-4, Commercial Products Data:

1. Level indicating and switch module assembly.
2. Pressure transducer.
3. Solenoid valves.
4. Ball valves.
5. Globe valves.
6. Pressure gauges.
7. Ladder and ladder accessories.

F. RSN 33 16 14-5, Service Manuals:

1. For items provided under RSN 33 16 14-4.

G. RSN 33 16 14-6, Control Cabinet Equipment Layouts, Electrical Bill of Material, Nameplate Lists, Schematic Diagrams Approval Drawings:

1. Provide separate schematic diagram drawings for electrical equipment showing entire control circuit, including devices mounted on air chamber.

H. RSN 33 16 14-7, Wiring Diagrams Approval Drawings:

1. Provide wiring diagram drawings for each control cabinet.

I. RSN 33 16 14-8, Final Drawings:

1. Schematic diagrams.
2. Wiring diagrams.
3. Air chamber drawings.

1.04 PERFORMANCE REQUIREMENTS

A. Design and provide vertical, bladder-type air chambers suitable for raw water.

B. Food grade, heavy duty butyl rubber bladder.

C. Materials for the tank, design, and shop fabrication and inspection shall comply with ASME BPVC-VIII, Division 1 with only plate steels in Table UCS-23. Provide ASME code stamp, National Board Registration number and pressure rating on tank.

D. Provide a threaded fitting at the top of the tank for the gas charging valve and pressure gauge.

E. Function of the Air Chambers:

1. Air chambers:

a. Provide surge protection to prevent formation of water column separation due to downsurge and keep maximum pressure below the pressure ratings of the steel pipe and associated equipment during the upsurge.

1) Maximum internal pressure rise during maximum upsurge, due to transients pressures, measured at the invert of the air chamber are:

a) Pre-manufactured Pump Station No. Station No. 1: 231 psig.

b) Pre-manufactured Pump Station No. 2: 258 psig.

2) During normal operations, the maximum internal pressure during normal operations measured at the invert of the air chamber are:

a) Pre-manufactured Pump Station No. 1: 200 psig.

b) Pre-manufactured Pump Station No. 2: 220 psig.

3) Minimum volumes:

a) Pre-manufactured Pump Station No. 1: 4750 gallons.

b) Pre-manufactured Pump Station No. 2: 5280 gallons.

F. Structural Design Codes:

1. Design the air chambers in accordance with ASME BPVC-VIII, Division 1.

2. Wind and earthquake loads: See drawing 1695-D-60017.

G. Determine steel plate thickness of the air chamber, structural supports, and base plate.

H. Structural design and supports shall include the tank, supports, and anchor bolts shall be based up local building codes in addition to the following criteria:

1. Design for maximum transient pressures with no reactive load permitted through inlet/outlet steel piping.

2. Support tank by support legs (4 minimum) for attaching to a concrete floor or slab.

I. Determine size and number of anchor bolts needed to fasten the air chamber and structural supports to concrete foundation. Provide complete anchor bolt assembly (studs, nuts, washers, etc.). Anchor bolt requirements:

1. Minimum anchor bolt diameter:

a. 1.25 inch.

b. A larger diameter bolt may be necessary.

1.05 QUALIFICATIONS

A. Supplier shall have a minimum of 5 years' experience, designing, supplying, and startup of air chamber tank systems.

B. Welders and welding procedures: In accordance with ASME BPVC-IX.

C. Government may witness the welding of qualification test plates and physical testing of specimens taken from these plates. Provide Government 14 days of advance notice to witness the qualification test plate welding.

D. Certification of tests and results from a testing laboratory approved by the Government may be accepted in lieu of witnessing tests.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to equipment during loading, transportation and unloading. Repair or replace damaged equipment as directed by COR.

1. Assemble and match mark to ensure correct fitting of parts in the manufacturer's shop.
2. Disassemble as necessary for shipment.
3. Cover pipe connections with wood flange covers, pipe plugs, or other suitable means for protection and to prevent entrance of foreign matter during delivery, storage and handling.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Level Indicating and Switch Module Assembly:

1. SureSite model as manufactured by Gems Sensors or equal, with the following essential characteristics:
    a. Flag style magnetic level gauge for visual monitoring of tank level.
    b. Standard size, 2-1/2 inch diameter, 316 stainless steel material suitable for an operating pressure equal to 300 psig.
    c. Provide switch modules at the following levels as determined by the air chamber manufacturer:
        1) HIGH PRESSURE.
        2) LOW PRESSURE.
2. Manual isolation ball valves on the air and water side connections.

3. Three 2 way 120 VAC solenoid valves powered by a control panel such that a pushbutton on the panel face initiates a sequence that will:

   a. Open solenoid valves installed at the top and bottom of the level gauge for 2 minutes (adjustable) to allow water level in the gauge to fill and then reach steady state.

   b. Close solenoid valves at the top and bottom of the level gauge and allow the gauge to display the tank level for an additional 2 minutes (adjustable). An indicating light on the panel face shall indicate gauge is ready to read.

   c. Open drain solenoid for 1 minute (adjustable) to allow water in the gauge to drain completely before re-closing.

B. Pressure Transducer: Rosemount Model 3051 differential pressure transducer by Emerson Process Management, Rosemount Measurement, 8200 Market Boulevard, Chanhassen, MN 55317 or equal with following essential characteristics:

1. Suitable for connection to 2 inch side mounted flange.
2. Measurement range: 0 to 300 psig.
3. Isolating diaphragm: 316L stainless steel.
4. Sensor fill: Silicone oil.
5. Liquid Crystal Display with local operator interface.
6. Output: 4-20 milliamperes DC.
7. Transmitter: Suitable for operation on 10 to 36 volt DC external power supply.
8. Adjustable offset (zero) and span.
9. Accuracy: Plus or minus 0.25 percent.
10. Vent/Drain valve.
11. Housing: Aluminum with 1/2 inch 14 NPT conduit entry size.
12. Enclosure: In accordance with NEMA 250; insulated NEMA Type 4X.

C. Steel Plate:

1. ASTM A36 for structural elements.
2. ASTM A516, grade 60 or 70 for pressure vessel.

D. Standard and Schedule Steel Pipe: ASTM A53, grade B.

E. Electric-Fusion (Arc)-Welded, Spiral Seam Steel Pipe: ASTM A139, Grade B or C.

F. Malleable Iron Threaded Fittings: ASME B16.3.

G. Malleable Iron Threaded Unions: ASME B16.39.

H. Welding Fittings: ASME B16.9.

I. Flanges, Gaskets, Bolts, and Nuts:

1. AWWA C207.

2. Class D, E, or F flanges indicated on drawings, flat faced with finish suitable for flat gaskets.

   a. Flange class and diameter to match that provided for the steel pipe connection.

3. Gasket:

   a. Multi-Swell Style 3760-U as manufactured by Garlock, Website: www.garlock.com or equal with the following essential characteristics:

      1) Dimensional requirements of AWWA C207.

      2) NSF 61 listed.

      3) Suitable for cold water service.

J. Manholes:

1. Designed by air chamber manufacturer.

2. Minimum 24 inch diameter.

3. Provide davited manhole door.

4. Provide handle on the door.

K. Pressure gauges:

1. Model 213.40 as manufactured by Wika Instrument Corporation, 1000 Wiegand Boulevard, Lawrenceville, GA 30043, Ashcroft Duragauge 1279 as manufactured by Dresser Industries Instrument Division, 250 East Main Street, Stratford CT 06614; or equal, having the following essential characteristics:

   a. Range displayed on the pressure gauges: 0 to 100 psig.

   b. Bronze bourdon-tube, adjustable-movement type.

   c. Movement made of phosphor bronze, nylon, nickel, silver, stainless steel, Monel steel, nitride steel, or combinations thereof.

   d. Bushings of any of the above-mentioned material but different composition or hardness than the shafts.

   e. Case of brass or aluminum alloy.

   f. Dust-proof and moisture-proof case.

   g. Glycerin liquid filled.

   h. 2.5 inch diameter or larger dial.

i. Dial in white with black markings.

j. Black indicating pointer.

k. Provide on each gauge a red maximum reading pointer to indicate the highest pressure attained.

l. Shatter resistant window.

m. Conform to ASME B40.100, grade A accuracy or better.

n. Bottom connected with 0.25 inch diameter male pipe connection.

L. Ladders:

1. Metal safety steps for ladders: "Tread-Grip" No. 11-gauge sheet steel ladder rungs, manufactured by Morton Manufacturing Company, PO Box 640, Libertyville IL 60048; "One Diamond Ladder Rung" manufactured by GS Metals Corporation, PO Box 7, Pinckneyville IL 62274; 1 inch square "Mebac" solid ladder rungs, manufactured by IKG Industries, 270 Terminal Avenue, Clark NJ 07066; or equal, having following essential characteristics:

   a. Concentrated design load at center of rung of at least 200 pounds.

   b. Raised button, serrated-edge, or metal bonded encapsulated grit surface.

2. Safety posts: "Ladder - Up" ladder extensions manufactured by The Bilco Company, PO Box 1203TR, New Haven CT 06505; or equal, having following essential characteristics:

   a. High-strength galvanized steel.

   b. Tubular section that provides upward and downward movement and locks automatically when fully extended in up position.

   c. Upward and downward movement controlled by stainless steel springs.

   d. Operates in corrosive environment.

   e. Attach ladder extensions securely to ladder rungs.

   f. Extend ladder extensions a minimum of 42 inches above walking surface.

3. Safety rail for ladders:

   a. Safety rail: Saf-T-Climb as manufactured by Air Space Devices of Norton Company, PO Box 197, Paramount CA 90723; or equal, having following essential characteristics:

      1) Round cross section.

      2) Flat safety rail is not acceptable.

      3) Provide 1 sleeve and belt for tank.

M. Ball Valves:

1. MSS SP-110, stainless steel, full-ported, female screwed ends.
2. Cold-water pressure rating, minimum: 400 psig.
3. Bubble tight at rated pressure in either direction.
4. Suitable for operation after long periods of inactivity.

N. Globe Valves:

1. MSS SP-85.
2. Suitable for air or water service.

O. Anchor Bolts:

1. ASTM A193, Grade B7.
2. Size and number of anchor bolts: Determined by air chamber designer.
3. Embedded in the air chamber foundation similar to that shown on the drawings.
   a. "J" or "L" shaped ends are not acceptable.

P. Appurtenances:

1. Provide fasteners, lubricating devices, gaskets, and other appurtenances required to make the level indicating assembly complete and ready for operation.

Q. Coatings: In accordance with manufacturer's recommendation and Section 09 96 20 - Coatings.

2.02 AIR CHAMBER FABRICATION

A. Fabricate in accordance with ASME BPVC-VIII, Division 1.

B. Stamp finished tank with official ASME code symbol.

C. Air Chamber Weld Tests:

1. Maintain a quality assurance program to ensure that minimum standards are met. Include an ASME Authorized Inspector to verify that welders and welding procedures are qualified, procedures are being followed within the limitations of testing, and quality assurance functions are being implemented.
2. Radiograph longitudinal and girth butt welds. COR will witness weld tests. Radiograph in accordance with requirements of the ASME BPVC-VIII, Division 1.
3. Before radiographing weld, place suitable identification markers adjacent to weld. Paint, stamp, or fasten the markers to shell as directed by the COR. Do not remove the markers until welds in one joint have been accepted.

4. In addition, provide temporary corresponding markers at each film location so that the images of these markers will appear on the radiographs.
5. Deliver radiographs to the COR.
6. The Authorized ASME Inspector shall judge the acceptability of welded joints.
7. Repair defects in welds in accordance with requirements of the ASME Code.
8. Portions of welds that have been repaired are to be radiographed again.

2.03 SURGE ANALYSIS

A. Submit a surge analysis:

1. Initial and maximum expanded air volume.
2. Envelope of maximum and minimum line pressure throughout pipe system.
3. Predicted pressure-time history at the Pump Stations and at other critical points in pipe system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Coordinate with air chamber manufacturer and make measurements of actual air chamber tank dimensions and pipe connection locations prior to constructing foundation or installing steel piping riser. Align foundations, piping, and any other connections with air chambers in the field.

B. Air Chambers:

1. Mount air chamber with structural supports on grout pad on concrete foundation.
2. Securely anchor with anchor bolts and chairs.
3. Terminate conduit and wiring for the level indicating assembly and its associated electrical equipment at designated control board.

3.02 CONTRACTOR FIELD QUALITY CONTROL

A. Air Chamber Hydrostatic Pressure Test:

1. Perform hydrostatic pressure test in the shop or in the field. Give Government 30 days advance notice of shop test or 2 days advance notice for field test.
2. Test before cleaning and painting.
3. Welded attachments to be connected to the air chamber prior to testing.
4. Test pressure: In accordance with ASME BPVC-VIII, Division 1.

5. Provide temporary supports, bulkheads, air vents, dead weight tester, and other equipment necessary to perform the hydrostatic tests.
6. Remove temporary supports before final placement of the air chamber on its base.
7. Provide equipment necessary to complete test:
8. Provide a minimum of 2 calibrated pressure gauges.
    a. Upper limit of pressure gauges: 1.5 to 3 times required test pressure.
    b. Accuracy: To within 1 percent of full scale.
    c. One shall be recording type.
    d. Gauges shall be calibrated within 30 days prior to use.
    e. Calibrate pressure gauges with a deadweight tester. The COR will witness calibration of pressure gauges.
9. Water for field test:
    a. Obtain adequate supply of potable water, transport to the site, and dispose of the water after the test.
    b. Temperature of test water, minimum: 45 degrees F.
10. Test procedure:
    a. Fill air chamber with water.
    b. Uniformly increase pressure until required test pressure is reached.
    c. Make time - pressure record of the hydrostatic pressure test.
    d. The COR will witness the hydrostatic test.
    e. Apply and release test pressure three times.
    f. Hold at required pressure each time until welded joints and seams can be examined. Hold time shall not be less than 15 minutes.
11. Repair defects, re-radiograph repairs, and retest air chamber.
12. No welding permitted on air chamber after hydrostatic test has been accepted.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Provide the COR a copy of the field installation procedure.

B. Provide a full 8 hour day of service from manufacturer's representative per air chamber tank to approve installation and advise the Contractor during startup, testing, and final adjustment.

C. Make required changes or adjustments until the operation of the Air Chamber tank system is approved by the COR.

D. Coordinate with both Air Chamber manufacturer's representative and Pumping Plant representative to schedule start-up, and allow for simultaneous start-up and testing of both pieces of equipment.

E. Verify pre-charge, static, and dynamic working pressures are within manufacturer's recommended ranges.

1. Test dynamic working pressures must be tested during Pumping Plant start-up, with pumps running.

F. Verify tank water levels under static, dynamic, and transient conditions are within manufacturer's recommended ranges.

1. Test transient water levels during Pumping Plant start-up by running pumps to full operating speed and performing an emergency sudden shut-down to simulate pump power failure. Air chamber water levels shall not exceed manufacturer's recommended ranges under these conditions.

G. Test water level indicators, gauges, and pressure transducers.

H. Test air lines and fittings for leaks.

3.04 TRAINING

A. Duration: 8 hours.

B. Topic: Operation and maintenance of the system.

C. Number of attendees: 8.

END OF SECTION

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SECTION 33 16 50
STEEL TANKS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Regulating Tank No. 1:

1. Payment: Lump sum price offered in Price Schedule. Includes:
   a. Epoxy Grout.
   b. Coatings.

B. Regulating Tank No. 2:

1. Payment: Lump sum price offered in Price Schedule. Includes:
   a. Epoxy Grout.
   b. Coatings.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.9-12	Factory-made Wrought Steel Buttwelding Fittings
2.	ASME B16.11-11	Forged Steel Fittings, Socket-welding and Threaded

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
3.	ASTM A105/A105M-14	Carbon Steel Forgings for Piping Applications
4.	ASTM A126-04-14	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
5.	ASTM A139/A139M-04(2015)	Electric-Fusion (Arc) - Welded Steel Pipe (Sizes 4 In. and over)
6.	ASTM A193/A193M-15	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
7.	ASTM A276/A276M-16	Stainless Steel Bars and Shapes

8.	ASTM A283/A283-13	Low and Intermediate Tensile Strength Carbon Steel Plates
9.	ASTM A307-14	Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
10.	ASTM A536-84-14	Ductile Iron Castings
11.	ASTM A568/A568M-15	Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
12.	ASTM A1011/1011M-14	Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
13.	ASTM B21/B21M-14	Naval Brass Rod, Bar, and Shapes
14.	ASTM B98/B98M-13	Copper-Silicon Alloy Rod, Bar and Shapes
15.	ASTM B584-14	Copper Alloy Sand Castings for General Applications
16.	ASTM F593-13a	Stainless Steel Bolts, Hex Cap Screws, and Studs.
17.	ASTM F1554-15	Anchor Bolts, Steel, 36, 55, A126 and 105-ksi Yield Strength

C. American Water Works Association (AWWA)

1.	AWWA C206-11	Field Welding of Steel Water Pipe
2.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
3.	AWWA C606-15	Grooved and Shouldered Joints
4.	AWWA D100-11	Welded Carbon Steel Tanks for Water Storage
5.	AWWA D103-09	Factory-Coated Bolted Carbon Steel Tanks for Water Storage

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel

E. Commercial Item Description (CID)

1.	CID-A-A-1923A	Shield Expansion (Lag, Machine, and Externally Threaded Wedge Bolt Anchors)

F. Manufacturers Standardization Society (MSS)

1.	MSS SP-110-10	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

G. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 - Submittals.

B. RSN 33 16 50-1, Shop Drawings, Design Calculations and Design Data.

1. Design calculations for steel tank including design, details of safety features, and overflow supports.
2. Design calculations for reinforced concrete foundation including:
    a. List of loading criteria and values, specific code references and load combinations.
    b. Magnitude and direction of steel tank base reactions and anchor bolt loading.
    c. Maximum bearing pressures.
3. Shop drawings including dimensions, tolerances, material data, joint details, welding requirements, painting, lining, and coating requirements.
4. Design drawings of reinforced concrete foundation including:
    a. Concrete foundation layout, elevations and dimensions.
    b. Typical sections through ringwall foundation.
    c. Steel reinforcement details and sizes including bar lengths, location of construction joints and lap splices.
    d. Anchor bolt setting plan including size, location and projection of anchor bolts, base mounting details, grout and sand cushion.
5. Manufacturer’s instructions for erection of tank, including:
    a. Details on bolting.
    b. Placement of gaskets and/or sealants.
    c. Coating repair procedures.
    d. Assembly procedures.
6. Sign and seal by design engineer.

C. RSN 33 16 50-2, Qualifications.

1. Designers.
2. Welder.
3. Erection Engineer.

D. RSN 33 16 50-3, Nondestructive Weld Test Reports:

1. For steel tank.

E. RSN 33 16 50-4, Commercial Products Data:

1. Commercial product data including catalog illustrations, sizes, material, pressure ratings, manufacturer's installation instructions, and parts lists for commercial products provided.
    a. Grooved-end couplings.
    b. Pipe couplings.
    c. Safety rails for ladders.
    d. Ball valves.
    e. Pressure transmitter.
    f. Pipe supports.
    g. Flap Gates.
    h. Globe valves.

F. RSN 33 16 50-5, Final Drawings and Data:

1. As-built drawings of steel tank and reinforced concrete foundation, including:
    a. Associated steel pipe, dimensions and tolerances, material data, joint details, painting, and welding.
2. Clearly mark drawings to show field modifications.

1.04 DESIGN REQUIREMENTS

A. Design, fabricate, erect, inspect and test a flat-bottom steel tank for non-potable water storage, including appurtenances, braces, and structural members in accordance with AWWA D100 or AWWA D103, this section, and as shown on drawings.

1. Wind and earthquake loads: See drawing 1695-D-60017.
2. Butt welds shall have complete penetration.
3. Provide roof in accordance with this section and drawings.
4. Provide exterior ladder from the bottom of shell to roof including safety cage and side rails similar to that shown on drawings.
5. Provide a hinged, lockable, safety gate over bottom of ladder safety cage.
6. Provide a lockable roof hatch with rubber sealing gasket.
7. Design and provide diameter and number of anchor bolts required for tank. Minimum anchor bolt diameter not less than 1-1/4 inches.
    a. Provide anchor bolt chairs for anchor bolts.

8. Fabricate steel pipe in accordance with Section 35 21 95 - Steel Pipe and as indicated on the drawings 1695-D-60065 through 1695-D-60079.

9. Design and provide tank connection for pressure transmitter and associated insulation and heat tape. Route output from pressure transmitter to COR's designated location.

B. Design and construct a reinforced ringwall type concrete foundation for a flat-bottom steel tank in accordance with AWWA D100 or AWWA D103, this section and as shown on drawings.

1. Design reinforced concrete ringwall foundation to support steel tank and collateral loads imposed by equipment, accessories and overflow piping to be supported by steel tank.

2. Provide grouted base ring and clean sand cushion per AWWA D100 or AWWA D103.

a. Grout in accordance with Section 03 63 00 - Epoxy Grout.

3. Concrete design and placement shall be in accordance with Section 03 30 00 - Cast-in-Place Concrete.

1.05 QUALIFICATIONS

A. Designer of Steel Tank: Professional Structural Engineer registered in the State of New Mexico with a minimum of 5 years' experience designing steel tanks.

B. Designer of Reinforced Concrete Foundation: Professional Engineer registered in the State of New Mexico with a minimum of 5 years' experience designing reinforced concrete foundations.

C. Erection Engineer: Specialist in steel tank construction and familiar with applicable AWWA, ASME, AWS, and OSHA standards, and have a minimum of 3 years' experience in fabrication and erection of water storage tanks.

D. Welders: Certified welders in accordance with AWS D1.1, and documented experience using procedures, materials, and equipment of type required for work.

PART 2 PRODUCTS

2.01 EPOXY GROUT

A. See Section 03 63 00 - Epoxy Grout.

2.02 COATINGS

A. See Section 09 96 20 - Coatings.

2.03 PLATES AND SHEETS

A. Steel plate:

1. ASTM A283, grade C or D; or ASTM A36.

B. Steel sheet:

1. Bolted Steel Tanks: A 36; A283, grade C or D.
2. Welded Steel Tanks: ASTM A1011 SS, grade 30, 33, or 36; ASTM A568.

2.04 ANCHOR BOLTS

A. Expansion anchors, anchor bolt chairs, or epoxy type anchor bolts with studs and epoxy capsule as shown on drawings.

1. Bolts: ASTM A307, grade B.
2. Threaded rods:
   a. ASTM A36.
   b. ASTM A193, grade B7.
3. Anchor Bolts: ASTM A307, grade B; ASTM A36; or ASTM F1554, grade 36 or 55.
4. Expansion anchors: CID-A-A-1923A, type 4.
5. Anchor bolts:
   a. Studs with injection adhesive or capsule adhesive:
      1) Parabond manufactured by Molly Division, Emhart Industries Inc., 504 Mount Laurel Avenue, Temple PA 19560; the HVA Adhesive Anchor System or "HIT HY 150" manufactured by Hilti, PO Box 21148, Tulsa OK 74121; or equal, having following essential characteristics:
         a) Stud and epoxy combination to be furnished by same manufacturer.
         b) End of stud: Double cut point.
         c) Stainless steel materials for studs and nuts.

2.05 PIPE, FITTINGS AND VALVES

A. Steel pipe: ASTM A53, grade B.

1. Pipe 4 inches diameter and smaller: Galvanized.
2. Pipe larger than 4 inches diameter: Coat in accordance with Section 09 96 20 - Coatings.

B. Electric-fusion- (arc-) welded, spiral-seam steel pipe: ASTM A139, grade B or C.

C. Field Joints: AWWA C206.

D. Welding fittings: ASME B16.9 or ASTM A105.

E. Threaded fittings: ASME B16.11 or ASTM A105.

F. Flanges: AWWA C207, ring type, Class D.

G. Flange gaskets: AWWA C207.

H. Flange bolts: AWWA C207, grade A or B.

I. Pipe couplings: AWWA C606; Flexible joint type with rolled or cut grooves.

J. Support and clamps:

1. P-1000 as manufactured by Unistrut Corp., 4118 South Wayne Road, Wayne MI 48184; or equal, having following essential characteristics:

a. Minimum 12 gauge.

b. Galvanized-strip steel.

K. Ball valves:

1. MSS SP-110, carbon steel, full port, female threaded ends.

2. Pressure rating: Minimum 400 psig cold water.

3. Bubble tight at rated pressure in either direction.

4. Suitable for operation after long periods of inactivity.

L. Flap Gates:

1. Model 50C, Manufactured by Rodney Hunt, Series FG-AC, www.rodneyhunt.com, 46 Mill Street, Orange, MA 01364 USA; Hydro Gate, www.hydrogate.com 7010 Broadway, Suite 400, Denver, CO 80221 USA; or equal, having the following essential characteristics:

a. Circular opening.

b. Size as shown on the drawings.

c. Materials:

1) Body (frame) and cover (flap): Cast iron, ASTM A126, Class B

2) Hinge pins and washers: Stainless Steel, ASTM F593, Type 304 or 316 or Silicon Bronze, ASTM B98 C655.

3) Body and cover seat facing: Bronze, ASTM B21, Silicon Bronze, ASTM B98, Alloy 651, or Stainless steel ASTM A276, type 304 or 316.

a) Held securely without use of fasteners.

b) Seating face machined to a plane with a minimum 63 micro-inch finish.

4) Hinge arms or links:

a) Bronze, ASTM B584, or Ductile Iron, ASTM A536 Grade 80-55-06, or Stainless Steel, ASTM A276, Type 304 or 316.

2. Design Requirements:

a. Cover shall be at an angle between 2 degrees and 5 degrees from the vertical when in the seated position.

b. Flap Gates shall open whenever the upstream head is over 0.2 feet higher than the downstream head.

c. Flap Gates design head: 0 to 5 feet to gate center line.

d. Flanged end suitable for bolting to AWWA C207, Class D flat-faced flanges to match pipe mounting flange and hole pattern.

e. Equipped with an anti-lock bar, or similar device, to prevent the cover from opening and rotating over the top of the gate and pipe end.

M. Globe Valves:

1. MSS SP80, type 2.

2. Threaded female ends.

3. Suitable for cold water service and pressures up to 400 psig.

2.06 ACCESSORIES

A. Pressure Transmitter: Rosemount Model 3051TG in-line pressure transmitters by Emerson Process Management, Rosemount Measurement, 8200 Market Boulevard, Chanhassen, MN 55317 or equal with following essential characteristics:

1. HART communication protocol.

2. Enclosure type: NEMA 4X, IP 67 or 68.

3. Output shall be 4-20 milliamperes D. C.

4. Transmitter shall be suitable for operation on 10 to 36 volt D.C. external power supply.

5. Adjustable offset (zero) and span shall be provided.

6. Accuracy: plus or minus 0.25 percent.

7. Vent/Drain valve shall be provided.

8. Process connection shall be 1/2-inch 14 NPT female.

9. Isolating diaphragm shall be 316L stainless steel.

10. Sensor fill shall be silicone oil.

11. Housing shall be Low-copper aluminum or CF-8M with 1/2-inch 14 NPT conduit entry size.

12. Transmitter materials in contact with potable water shall be National Sanitation Foundation listed.

13. Liquid Crystal Display with local operator interface shall be provided.

14. Insulate piping, valves, and pressure transmitter at air valve assembly.

15. Transient Protector:

    a. Protects pressure transmitter from damage due to lightning and switching surges.

    b. Compatible with pressure transmitter output of 4 to 20 milliamperes.

    c. Same manufacturer as pressure transmitter.

    d. Mounting: As shown on the drawings.

B. Liquid level indicator:

1. Model 92302, manufactured by: Shand & Jurs, 5911 Butterfield Road, Hillside IL 60162; Varec, Figure No. 6700, 5834 Peachtree Corners East Norcross (Atlanta), GA 30092; or equal, having following essential characteristics:

    a. Float-actuated level gauging system consisting of a target sliding vertically over an aluminum gauge board.

    b. Gauge board graduated in feet and inches with numerals at each foot.

    c. Type 316 stainless steel for float, cable, and guide wires.

C. Ladders:

1. Metal safety steps for ladders: "Tread-Grip" No. 11 gauge sheet steel ladder rungs, manufactured by Morton Manufacturing Company, PO Box 640, Libertyville IL 60048; "One Diamond Ladder Rung" manufactured by GS Metals Corporation, PO Box 7, Pinckneyville IL 62274; 1 inch square "Mebac" solid ladder rungs, manufactured by IKG Industries, 270 Terminal Avenue, Clark NJ 07066; or equal, having following essential characteristics:

    a. Concentrated design load at center of rung of at least 200 pounds.

    b. Raised button, serrated-edge, or metal bonded encapsulated grit surface.

2. Safety posts: "Ladder - Up" ladder extensions manufactured by The Bilco Company, PO Box 1203TR, New Haven CT 06505; or equal, having following essential characteristics:

    a. High-strength galvanized steel.

    b. Tubular section that provides upward and downward movement and locks automatically when fully extended in up position.

c. Upward and downward movement controlled by stainless steel springs.

d. Operates in corrosive environment.

e. Attach ladder extensions securely to ladder rungs.

f. Extend ladder extensions a minimum of 42 inches above walking surface.

3. Safety rail for ladders:

a. Safety rail: Saf-T-Climb as manufactured by Air Space Devices of Norton Company, PO Box 197, Paramount CA 90723; or equal, having following essential characteristics:

1) Round cross section.

2) Allow sleeve to swing completely around when climber reaches top platform, to allow climber to step onto top platform without disconnecting sleeve.

3) Flat safety rail is not acceptable.

4) Provide 1 sleeve and belt for tank.

4. Provide hinged lockable safety gate with door hatch sensor over entrance to safety ladder cage for tanks. For details of the door hatch sensor requirements, see Section 25 00 02 - Programmable Controller.

PART 3 EXECUTION

3.01 INSTALLATION

A. On-Site Erection Engineer:

1. Supervise and be responsible for erecting steel tank. Have erection engineer onsite during installation of steel tank.

2. Coordinate work of erection engineer with COR.

B. Follow tank manufacturer’s erection procedures.

C. Welding procedures in accordance with AWS D1.1 and AWWA D100 or AWWA D103.

1. Make available to the COR, certification that welds were made by AWS qualified welders and inspected according to AWS standards.

2. Surfaces to be welded shall be:

a. Free from loose scale, slag, heavy rust, grease, paint, and foreign material.

b. Smooth, uniform, and free from defects that adversely affect proper welding.

c. Cleaned and removed of weld scale or slag prior to coating.

D. Welded Joints:

1. Butt welds shall have complete penetration.

E. Bolted Joints:

1. Field bolt vertical, horizontal, shell-to-roof, and shell-to-bottom plates. Bolt holes shall be shop-punched or drilled for field assembly in accordance with AWWA D103.

2. Seal bolted joints required to contain water or be weather-tight with gasket material and/or sealant to make a water-tight joint.

a. Welded Joints:

1) Permitted for shop-fabricated sub-assemblies that are bolted into place in the field.

2) Do not weld vertical joints in tank.

3. Provide bolts, nuts, and washers with tank.

a. Install between joints in compliance with manufacturer's erection instructions.

b. Use only hardware supplied with tank.

4. Provide gaskets and sealants with tank. Install between joints.

F. Provide steel pipe supports and bracing to hold steel pipe in place and prevent distortion during erection, placing of concrete, and backfilling.

G. Heat trace and insulation:

1. Install heat trace and insulation on exposed portion of level transmitter and level indicating assembly.

2. Install heat trace and insulation in accordance with manufacturer's instructions.

3. Spacing of heat trace and insulation: Such that combination will maintain standing water in objects being insulated at 42 degrees F in an outdoor ambient temperature of minus 10 degrees F with a 20 mile per hour wind.

3.02 COATINGS

A. In accordance with Section 09 96 20 - Coatings, tank manufacturer's specific procedure and AWWA D100 or AWWA D103.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Government will witness field testing. Notify COR 14 days prior to field testing.

B. Hydrostatically test tank in accordance with AWWA D100 or AWWA D103.

1. Repair leaks in tank in accordance with manufacturer's recommendations.

2. Notify COR minimum 14 days' notice prior to test.

C. Testing of welds: Radiographic testing for welded shell butt joints.

D. Ultrasonic testing for groove welds.

3.04 REPAIR

A. Repair damage to factory applied coatings in accordance with erection instructions.

B. Make available, upon request to COR, certified test data on coating thickness.

END OF SECTION

SECTION 33 21 95

METAL PIPING FOR LINE PIPE INSTALLATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price in the Price Schedule for NAPI Turnout.

B. Cost:

1. Include in the price in the Price Schedule for Class 150B Two Inch Diameter Air Valve Assemblies.

C. Cost:

1. Include in the price in the Price Schedule for Class 250B Two Inch Diameter Air Valve Assemblies.

D. Cost:

1. Include in the price in the Price Schedule for Class 150B Four Inch Diameter Blowoffs.

E. Cost:

1. Include in the price in the Price Schedule for Class 250B Four Inch Diameter Blowoffs.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
2.	ASME B16.9-12	Factory-Made Wrought Steel Buttwelding Fittings
3.	ASME B16.11-11	Forged Fittings, Socket-Welding and Threaded

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3.	ASTM A105/A105M-14	Carbon Steel Forgings for Piping Applications
4.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates
5.	ASTM D2000-12	Standard Classification System for Rubber Products in Automotive Applications
6.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry
7.	ASTM E709-15	Magnetic Particle Testing

C. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel

D. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 In (150 mm) and Larger
2.	AWWA C206-11	Field Welding of Steel Water Pipe
3.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
4.	AWWA C227-11	Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe
5.	AWWA C606-15	Grooved and Shouldered Joints

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 21 95-1, Shop Drawings:

1. Shop drawings showing dimensions and tolerances, material data, joint details, welding requirements; and coating, lining, and coating requirements.

C. RSN 33 21 95-2, Commercial Products Data:

1. Pipe couplings.

D. RSN 33 21 95-3, Final Drawings:

1. Submit final drawings.
    a. After equipment is fabricated and is accepted by the Government.
    b. Detailed drawings which clearly show steel piping sections exactly as they exist after completion, including dimensions and tolerances, material data, joint details, coating, and welding.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage during loading, transporting, unloading, and at final storage location.

1. Supply:

a. Padded bolsters curved to fit under outside of pipe.

b. Heavy padding under ties during transportation and storage.

B. Do not store directly on ground.

C. Store so that lifting straps can be passed beneath pipe sections.

D. Provide space to allow personnel to move between pipe sections.

E. Cover with tarps and tie tarps down securely.

PART 2 PRODUCTS

2.01 NAPI TURNOUT

A. See Section 33 12 05 - NAPI Turnout.

2.02 CLASS 150B AND 250B TWO INCH DIAMETER AIR VALVE ASSEMBLIES AND FOUR INCH DIAMETER BLOWOFFS

A. See Section 33 12 10 - Valves and Equipment for Line Pipe Installations.

2.03 EQUIPMENT

A. Steel plate: ASTM A283, grade C or D, or ASTM A36.

B. Standard and schedule steel pipe:

1. ASTM A53, grade B:

2. Coat in accordance with Section 09 96 20 - Coatings.

C. Flanges:

1. Slip-on ring type, flat faced: AWWA C207 or ASME B16.5.

2. Flat face with finish suitable for flat gasket.

D. Flange gaskets:

1. Model No. 22, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:

a. Full flat face-type.

b. For AWWA C207 flanged joints.

c. For cold water service.

E. Flange bolts: AWWA C207.

F. Threaded steel fittings:

1. ASME B16.11 or ASTM A105.

2. Provide where shown on the drawings.

G. Butt-welding steel fittings:

1. ASME B16.9 or ASTM A105.

2. Provide where shown on drawings.

H. Grooved-end Pipe Couplings:

1. AWWA C606.

2. Flexible joint type with rolled or cut grooves.

I. Pipe couplings:

1. Style 233, manufactured by Victaulic, P.O. Box 48776, Atlanta, GA 30362; or equal, having following essential characteristics:

a. Conform to AWWA C227.

1) Steel material.

2) Coupling housing: Arched, 2 or more segmented, sleeve-type which when closed compresses elastomeric O-ring gaskets beneath arches of sleeve to create radial seal around pipe ends joined inside of coupling.

3) Gaskets: Isoprene, ASTM D2000, suitable for cold-water service.

4) Suitable for pressure of 300 psig.

5) Supply regular and (electrically) insulating type as shown on drawings.

2.04 FABRICATION

A. Fabricate steel piping as indicated on drawings, and in accordance with AWWA C200.

B. Longitudinal, girth, and spiral joints, other than field welds:

1. Double-welded butt joints with complete penetration.

2. Stagger longitudinal joints.

3. Longitudinal, girth, and spiral joints shall not intersect at outlet connections.

C. Cut plates accurately to size and shape.

D. Bend or roll plates to true circular form with curvature continuous from edges of plates.

E. Properly form edges to be joined by welding to suit type of welding and to allow complete penetration.

F. Tolerances, inside surface of the pipe:

1. Inside surface of pipe: It shall not be possible to insert at any point a feeler gauge greater than 3/8 inch thickness between a template made to nominal curvature of inside surface extending over an arc of 30 degrees and inside surface of pipe.

2. Ends of straight pipe sections shall lie in a plane normal to longitudinal axis of section with maximum deviation of 1/8 inch on either side of plane.

G. Perform welding with a process that protects molten metal from atmosphere.

1. Where practicable, use automatic machines.

2. Where weld metal is deposited in successive layers, clean each layer before subsequent layer is deposited.

3. Align and separate edges of plates to be joined by butt welding to allow complete penetration and fusion of weld.

4. After welding is complete, remove weld spatter.

H. Protect work and operator from weather during welding operations.

1. Welding is not permitted on wet surfaces or when temperature of steel is lower than 0 degrees F.

2. Apply heat to welding areas during field installation. At pipe surface temperatures between 0 and 32 degrees F, heat surface of areas within 3 inches of start of weld to at least 60 degrees F.

I. End to be joined by sleeve-type coupling:

1. Exterior surface of pipe end to be connected with sleeve-type coupling shall be free from weld reinforcement (bead), seams, scars, dents, flats, or other defects likely to interfere with joint-sealing process in accordance with coupling manufacturer instructions.

J. Flanges and flanged connections:

1. During attachment of flanges to steel pipe, ensure that face of flanges remain flat and perpendicular to centerline of attached piping.

2. Limit irregularities or warping in face of flanges to 0.0015 inch measured from:

a. A high point on face of flange at an inside diameter to a corresponding low point on face of flange at an outside diameter, along any radial line, (concave orientation of the flange is not permissible) and,

b. A high point on face of flange along a circumferential line at centerline of flange bolt holes, to a low point on face of flange along same circumferential line, within a distance equal to circumferential distance between every third bolt hole.

3. Remove by machining, irregularities or warping that remains in face of flange after its attachment to steel piping that exceeds the above.

4. After machining, flange thickness shall not be reduced below minimum thickness specified in AWWA C207, ASME B16.5, or as shown on drawings.

5. Weld pipe flanges to piping so that bolt holes straddle vertical centerline when in installed position.

6. Provide pipe flanges that connect to valve body flanges with same number of bolt holes, bolt pattern, and bolt circle diameter as connecting valves.

K. Maintain circularity of pipe sections during coating, lining, transporting, and installing operations.

1. Provide stulls or adjustable spiders.

2. Measured deviation between maximum and minimum diameters at stulls or spiders shall not exceed 0.5 percent of nominal pipe diameter.

L. Continuously weld joints of flange supports and pipe supports.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Flange Weld Testing:

1. Test flange welds by magnetic particle or liquid penetrant method in accordance with AWS D1.1.

2. Repair and retest defects.

B. Hydrostatic Pressure Testing:

1. Notify Government a minimum of 14 days before test.

2. Government will witness hydrostatic test and calibration of pressure gauges.

3. Use 2 or more pressure gauges with 1 being a recording type.

a. Upper limit of pressure gauges shall be between 1.5 and 3 times required test pressure. Calibrate pressure gauges with a deadweight tester.

b. At least 1 gauge, which is used for acceptance of test, shall be calibrated within 30 days prior to use.

c. Make a time-pressure record of hydrostatic pressure test.

4. Furnish equipment necessary to perform hydrostatic tests.
5. If a flange is attached to a piping section, after piping section has been hydrostatically tested, piping section will not require retesting.
6. Water temperature for tests: Greater than 45 degrees F.
7. Vent air from test sections.
8. Fill each section with water and uniformly increase pressure until required test pressure is reached.
    a. Hold test pressure for a minimum of 15 minutes.
    b. Apply and release test pressure 3 successive times.
    c. After each application, hold pressure to 2/3 of required pressure until welded joints and seams can be examined.
    d. Repair defects. After defects are repaired, repeat complete test procedure.
9. After hydrostatic testing is complete, cut sections for handling purposes on planes normal to pipe axis.

PART 3 EXECUTION

A. Install the steel pipe to line and grade as shown on drawings.

B. Refer to 31 23 22 - Pipe Trench Earthwork for excavation and backfill requirements.

C. Provide supports and bracing as may be required to hold the metal pipe in place and prevent distortion during erection and placing of concrete; however, the embedment of timber supports will not be permitted.

D. Contact between pipe and rebar will not be allowed.

E. Install pipe spools with flanged connections so that the bolt holes straddle the vertical centerline when in the installed position.

F. Install pipe couplings in accordance with manufacturer instructions.

G. Field Joints:
1. Field joints shown on the drawings are required to facilitate lining or installation of the steel manifolds.
2. Welded field joints: in accordance with AWWA C206.
3. Allowable field joints for the metal pipe:
    a. Threaded couplings for pipe less than 4 inches in diameter.
    b. Flanged for pipe from 4 to 27 inches in diameter, inclusive. Flanges shall be suitable for the working pressure of the adjacent pipe.

c. Except as shown on drawings, field joints for pipe larger than 27 inches in diameter:

1) AWWA flanged joints.

2) Full-penetration butt welds.

3) Double welded lap joints, or double welded butt strap joints.

H. Nondestructive Testing of Field Welds:

1. Test welds in accordance with AWWA C206 and this paragraph.

2. Complete inspections and tests as work progresses in presence of COR and in accordance with AWS D1.1.

3. When welds are found to be defective by the standards of AWS, repair welds in accordance with AWS D1.1 and reexamine welds to ensure the adequacy of repairs.

4. Visual Inspection: Visually inspect welds following procedures, techniques, and standards of AWS D1.1.

5. Testing of full penetration butt welded field joints:

a. Ultrasonic or radiograph methods in accordance with AWS D1.1.

6. Testing of partial penetration joint field welds and fillet field welds, including testing of double welded butt strap joints or double welded lap joints:

a. Magnetic particle or dye penetrant:

1) Technique and procedure for the magnetic particle test in accordance with ASTM E709.

2) Technique and procedure for the dye penetrant in accordance with ASTM E165.

3) Standards of acceptance for both types: AWS D1.1.

b. In addition, test the double welded butt strap joints and the double welded lap joints with an air test in accordance with AWWA C206.

3.02 COATING

A. Coat metal piping in accordance with Section 09 96 20 - Coatings.

END OF SECTION

SECTION 33 42 30
CORRUGATED METAL PIPE CULVERT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Corrugated Metal Culverts:

1. Measurement: Linear foot of installed culvert.
2. Payment: For the liner foot price offered in the Price Schedule. Includes:
    a. Excavation.
    b. Backfill.
    c. CLSM.
    d. Compaction.
    e. Metal Culvert.
    f. Flared end for Entry and Exit.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A760/A760M-13	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

1.03 DELIVERY, STORAGE, AND HANDLING

A. Haul and handle pipe to avoid damage to the galvanized coating.

B. Do not use rope, cable, or chain slings for handling pipe.

PART 2 PRODUCTS

2.01 CORRUGATED METAL PIPE

A. Corrugations:

1. 2-2/3 inch by 1/2 inch unless:
    a. Annular or helical.

B. Sheet Thickness: 0.064 inches.

C. Corrugated Steel Pipe and Coupling Bands:

1. ASTM A760, Type I.
2. Galvanized.

D. Flared End Sections:

1. Prefabricated sections of standard manufacture.
2. Same metal as pipe to which they are attached.

PART 3 EXECUTION

3.01 GENERAL

A. Perform roadway work in accordance with Section 01 55 20 - Traffic Control.

B. Furnish and lay corrugated metal pipe of sizes and gauges shown on drawings complete with coupling bands and joint materials.

C. Install flared end sections on outlet ends of pipe.

3.02 EXCAVATION

A. Excavation for pipe trench: In accordance with Section 31 23 22 - Pipe Trench Earthwork.

3.03 LAYING CORRUGATED METAL PIPE

A. Lay corrugated metal pipe to lines and grades shown on drawings or established by COR.

1. Laying Tolerances:
    a. Departure from and return to established alignment and grade, maximum: 1/8 inch per foot of pipe.
    b. Total departure, maximum: 1 inch.

B. Place pipe carefully to be fully supported over bottom quarter of circumference.

C. Place pipe on soil pads as shown on drawing 1695-D-60045.

1. Material: Suitable for backfill.
2. Compact soil pads in accordance with Section 31 23 02 - Compacting Earth Materials.

D. Lay pipe with outside laps of circumferential joints pointing upstream and with longitudinal joints at sides.

E. Coupling Bands:

1. Use where necessary to join sections of pipe.

2. Draw fastenings up tight.
3. Install to ensure tight joints.
4. Joints between sections approximately at center of couplings.

F. Install flared end sections in accordance with manufacturer's instructions.

3.04 BACKFILL

A. As each unit of pipe is laid, tamp backfill material about pipe to hold it rigidly in place until joints are completed.

B. After joints have been completed, place and compact backfill in accordance with Section 31 23 22- Pipe Trench Earthwork.

C. CLSM in accordance with Section 31 23 70 - Controlled Low Strength Materials (CLSM).

D. Compact to 95 percent compaction.

E. Equipment travel over pipe not permitted until backfill has been placed and compacted to depth recommended by pipe manufacturer, but not less than 1 foot above top of pipe. Provide adequate earth cover over pipe to prevent damage from construction equipment loads.

3.05 SURFACING

A. Reconstruct roadway surface to match adjacent roadway or parking surface.

3.06 REPAIR

A. Repair damage to galvanized coatings including factory or field cut edges and welding in accordance with ASTM A760.

END OF SECTION

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SECTION 35 21 95

STEEL PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Piping:

1. Payment: Lump sum price offered in Price Schedule. Includes:
   a. Coatings.
   b. Excavation, compaction and backfill.
   c. Encasements and Blocking.
   d. CLSM.

1.02 DEFINITIONS

A. This section is for the steel pipe shown on the following drawings: 1695-D-60065 to 1695-D-60077.

B. For steel pipe requirements for the Pre-manufactured Pumping Stations, see Section 22 11 35 - Pre-manufactured Pump Station.

1.03 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
2.	ASME B16.9-12	Factory-made Wrought Steel Buttwelding Fittings
3.	ASME B16.11-11	Forged Fittings, Socket-welding and Threaded

B. ASTM International (ASTM)

1.	ASTM A36/A36M-14	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3.	ASTM A105/A105M-14	Carbon Steel Forgings for Piping Applications
4.	ASTM A283/A283M-13	Low and Intermediate Tensile Strength Carbon Steel Plates

5.	ASTM D2000-12	Standard Classification System for Rubber Products in Automotive Applications
6.	ASTM E165/E165M-12	Liquid Penetrant Examination for General Industry
7.	ASTM E709-15	Magnetic Particle Testing

C. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-15	Structural Welding Code - Steel

D. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 In (150 mm) and Larger
2.	AWWA C206-11	Field Welding of Steel Water Pipe
3.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
4.	AWWA C227-11	Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe
5.	AWWA C606-15	Grooved and Shouldered Joints

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 35 21 95-1, Shop Drawings:

1. Checked, detailed shop drawings showing dimensions and tolerances, material data, joint details, combined bend details, valve placement, welding requirements, coating and lining.
2. Steel Pipe Encasement Installation Procedure:
    a. Description of exterior pipe support system including:
        1) Calculations verifying system can support pipe during installation of concrete.
        2) Tie down methods to prevent floating during pouring of concrete.
        3) Material and installation procedures to prevent corroding steel pipe at support locations.

C. RSN 35 21 95-2, Commercial Products Data:

1. Pipe couplings.
2. Gaskets.
3. Insulation kit.

D. RSN 35 21 95-3, Final Drawings:

1. Submit final drawings.

a. After equipment is fabricated and is accepted by Government.

b. Detailed drawings which clearly show steel piping sections exactly as they exist after completion, including dimensions and tolerances, material data, joint details, welding requirements, coating, and lining.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage during loading, transporting, unloading, and at final storage location.

1. Provide:

a. Padded bolsters curved to fit under outside of pipe.

b. Heavy padding under ties during transportation and storage.

B. Do not store directly on ground.

C. Store so that lifting straps can be passed beneath pipe sections.

D. Provide space to allow personnel to move between pipe sections.

E. Cover with tarps and tie down securely.

PART 2 PRODUCTS

2.01 ENCASEMENTS AND BLOCKING

A. See Section 03 30 00 - Cast-in-Place Concrete.

2.02 CLSM

A. See Section 31 23 70 - Controlled Low Strength Materials (CLSM)

2.03 EQUIPMENT

A. Steel plate: ASTM A283, grade C or D, or ASTM A36.

B. Standard and schedule steel pipe:

1. ASTM A53, grade B:

2. Coat in accordance with Section 09 96 20 - Coatings.

C. Flanges:

1. Slip-on ring type, flat faced: AWWA C207 or ASME B16.5.

2. Flat face with a finish suitable for full face gasket for flanged joints.

D. Flange gaskets:

1. Model No. 22, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:

a. Full flat face-type.

b. AWWA C207 flanged joints.

c. Cold water service.

E. Flange Bolts: AWWA C207.

F. Threaded steel fittings:

1. ASME B16.11 or ASTM A105.

2. Provide where shown on drawings.

G. Butt-welding steel fittings:

1. ASME B16.9 or ASTM A105.

2. Provide where shown on drawings.

H. Grooved-end Pipe Couplings:

1. AWWA C606.

a. Flexible or rigid joint type as shown on drawings with rolled or cut grooves.

2. Suitable for 300 psig cold water service.

I. Pipe couplings:

1. Style 233 or Style 230, manufactured by Victaulic, P.O. Box 48776, Atlanta, GA 30362; or equal, having following essential characteristics:

a. Conform to AWWA C227.

1) Steel material.

2) Coupling housing: Arched, 2 or more segmented, split sleeve-type which when closed compresses elastomeric O-ring gaskets beneath arches of sleeve to create radial seal around pipe ends joined inside of coupling.

3) Gaskets: Isoprene, ASTM D2000, suitable for cold-water service.

4) Suitable for pressure of 300 psig.

5) Supply regular and (electrically) insulating type as shown on drawings.

J. Flange insulation:

1. Manufactured by PSI, complete with the "Linebacker" type of gasket, Pipeline Seal and Insulator, Inc., 6525 Goforth Street, Houston TX 77021; Advanced Products and Systems, complete with the "Trojan" type of gasket, PO Box 60399, Lafayette LA 70596-0399; or equal with the following salient characteristics:

   a. Full-faced, type to match ASME B16.5, Class 125 or 250 or AWWA Class D, E, or F flanges.

   b. Outside diameter of gasket shall be same as outside diameter of flange.

   c. Retainer with integral Nitrile sealing element ("Linebacker" or "Trojan" type).

   d. Retainer material suitable for cold water service as recommended by gasket manufacturer.

   e. One insulating sleeve and 2 insulating washers for each bolt. Material to be suitable for cold water service as recommended by gasket manufacturer.

   f. Asbestos gaskets are not acceptable.

   g. Supply required bolt torques, recommended bolt tightening sequence, and flange face finish for insulating flanged joints.

   h. Suitable for 300 psig cold water service.

2.04 FABRICATION

A. Fabricate steel piping as indicated on drawings, and in accordance with AWWA C200.

B. Longitudinal, girth, and spiral joints, other than field welds:

1. Double-welded butt joints with complete penetration.

2. Stagger longitudinal joints.

3. Longitudinal, girth, and spiral joints shall not intersect at outlet connections.

C. Cut plates accurately to size and shape.

D. Bend or roll plates to true circular form with curvature continuous from edges of plates.

E. Properly form edges to be joined by welding to suit type of welding and to allow complete penetration.

F. Tolerances, inside surface of the pipe:

1. Inside surface of pipe: It shall not be possible to insert at any point a feeler gauge greater than 3/8 inch thickness between a template made to nominal curvature of inside surface extending over an arc of 30 degrees and inside surface of pipe.

2. Ends of straight pipe sections shall lie in a plane normal to longitudinal axis of section with maximum deviation of 1/8 inch on either side of plane.

G. Perform welding with a process that protects molten metal from atmosphere.

1. Where practicable, use automatic machines.

2. Where weld metal is deposited in successive layers, clean each layer before subsequent layer is deposited.

3. Align and separate edges of plates to be joined by butt welding to allow complete penetration and fusion of weld.

4. After welding is complete, remove weld spatter.

H. Protect work and operator from weather during welding operations.

1. Welding is not permitted on wet surfaces or when temperature of steel is lower than 0 degrees F.

2. Apply heat to welding areas during field installation. At pipe surface temperatures between 0 and 32 degrees F, heat surface of areas within 3 inches of start of weld to at least 60 degrees F.

I. End to be joined by sleeve-type coupling:

1. Exterior surface of pipe end to be connected with a pipe coupling shall be free from weld reinforcement (bead), seams, scars, dents, flats, or other defects likely to interfere with joint-sealing process in accordance with coupling manufacturer instructions.

J. Flanges and flanged connections:

1. During attachment of flanges to steel pipe, ensure that face of flanges remain flat and perpendicular to centerline of attached piping.

2. Limit irregularities or warping in face of flanges to 0.0015 inch measured from:

a. A high point on face of flange at an inside diameter to a corresponding low point on face of flange at an outside diameter, along a radial line, (concave orientation of the flange is not permissible) and,

b. A high point on face of flange along a circumferential line at centerline of flange bolt holes, to a low point on face of flange along same circumferential line, within a distance equal to circumferential distance between every third bolt hole.

3. Remove by machining, irregularities or warping that remains in face of flange after its attachment to steel piping that exceeds the above.

4. After machining, flange thickness shall not be reduced below minimum thickness specified in AWWA C207, ASME B16.5, or as shown on drawings.

5. Weld pipe flanges to piping so that bolt holes straddle vertical centerline when in installed position.

6. Provide pipe flanges that connect to valve body flanges with same number of bolt holes, bolt pattern, and bolt circle diameter as connecting valves.

K. Maintain circularity of pipe sections during coating, lining, transporting, and installing operations.

1. Provide stulls or adjustable spiders.

2. Measured deviation between maximum and minimum diameters at stulls or spiders shall not exceed 0.5 percent of nominal pipe diameter.

L. Continuously weld joints of flange supports and pipe supports.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Flange Weld Testing:

1. Test flange welds by magnetic particle or liquid penetrant method in accordance with AWS D1.1.

2. Repair and retest defects.

B. Hydrostatic Pressure Testing:

1. Notify Government a minimum of 14 days before test.

2. Government will witness hydrostatic test and calibration of pressure gauges.

3. Use 2 or more pressure gauges with 1 being a recording type.

a. Upper limit of pressure gauges shall be between 1.5 and 3 times required test pressure. Calibrate pressure gauges with a deadweight tester.

b. At least 1 gauge, which is used for acceptance of test, shall be calibrated within 30 days prior to use.

c. Make a time pressure record of hydrostatic pressure test.

4. Furnish equipment necessary to perform hydrostatic tests.

5. If a flange is attached to a piping section, after piping section has been hydrostatically tested, piping section will not require retesting.

6. Water temperature for tests: Greater than 45 degrees F.

7. Vent air from test sections.

8. Fill each section with water and uniformly increase pressure until required test pressure is reached.

a. Hold test pressure for a minimum of 15 minutes.

b. Apply and release test pressure 3 successive times.

c. After each application, hold pressure to 2/3 of required pressure until welded joints and seams can be examined.

d. Repair defects. After defects are repaired, repeat complete test procedure.

9. After hydrostatic testing is complete, cut sections for handling purposes on planes normal to pipe axis.

PART 3 EXECUTION

A. Install the steel pipe to line and grade as shown on the drawings.

B. Refer to 31 23 22 - Pipe Trench Earthwork for excavation, backfill and compaction requirements.

C. Provide supports and bracing as may be required to hold the steel manifolds in place and prevent distortion during erection and placing of concrete; however, the embedment of timber supports will not be permitted.

D. Contact between pipe and rebar will not be allowed.

E. Install pipe spools with flanged connections so that the bolt holes straddle the vertical centerline when in the installed position.

F. Install pipe couplings in accordance with manufacturer instructions.

G. Field Joints:

1. Field joints shown on the drawings are required to facilitate lining or installation of the steel manifolds.
2. Welded field joints in accordance with AWWA C206.
3. Allowable field joints for the manifolds:
    a. Threaded couplings for pipe less than 4 inches in diameter.
    b. Flanged for 4 inches to 27 inches in diameter, inclusive. Flanges shall be suitable for the working pressure of the adjacent pipe.
    c. Except as shown on drawings, field joints for pipe larger than 27 inches in diameter:
        1) AWWA flanged joints.
        2) Full-penetration butt welds.
        3) Double welded lap joints, or double welded butt strap joints.

H. Nondestructive Testing of Field Welds:

1. Test welds in accordance with AWWA C206 and this paragraph.
2. Complete inspections and tests as work progresses in presence of COR and in accordance with AWS D1.1.
3. When welds are found to be defective by the standards of AWS, repair welds in accordance with AWS D1.1 and reexamine welds to ensure the adequacy of repairs.

4. Visual Inspection: Visually inspect welds following procedures, techniques, and standards of AWS D1.1.

5. Testing of full penetration butt welded field joints: Ultrasonic or radiograph methods in accordance with AWS D1.1.

6. Testing of partial penetration joint field welds and fillet field welds, including testing of double welded butt strap joints or double welded lap joints:

   a. Magnetic particle or dye penetrant:

      1) Technique and procedure for the magnetic particle test in accordance with ASTM E709.

      2) Technique and procedure for the dye penetrant in accordance with ASTM E165.

      3) Standards of acceptance for both types: AWS D1.1.

   b. In addition, test the double welded butt strap joints and the double welded lap joints with an air test in accordance with AWWA C206.

3.02 COATINGS

A. Coat steel pipe in accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 35 22 15
VALVES AND EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Valves and Equipment:

1. Lump sum price offered in Price Schedule. Includes:
    a. Reinforcing.
    b. Concrete.
    c. Precast Manhole with coarse aggregate.
    d. Coatings.

1.02 DEFINITIONS

A. This section is for the valves and equipment shown on the following drawings: 1695-D-60065 to 1695-D-60077.

1.03 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.1-15	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

B. American Water Works Association (AWWA)

1.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 In Through 144 In. (100 mm Through 3,600 mm)
2.	AWWA C504-15	Rubber-Seated Butterfly Valves
3.	AWWA C507-15	Ball Valves, 6 In. Through 48 In. (150 mm Through 1,500 mm)

C. Manufacturers Standardization Society (MSS)

1.	MSS SP110-10	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals.

1. General:

a. Submit data that demonstrates equipment provided meets requirements.

b. Submit data giving manufacturer's name, type, model, size, and construction and performance characteristics of equipment.

c. Mark proposed catalog sheet item which allows data to be legibly reproduced.

B. RSN 35 22 15-1, Commercial Product Data.

1. Butterfly valves for buried or submerged service.

a. Products data for butterfly valves including hydrostatic pressure testing certification. Include pressures used in testing valves.

2. Valve boxes for buried valves.

3. Air valves.

4. Ball valves.

5. Automatic ball drip valve.

C. RSN 35 22 15-2, Service Manuals.

1. For items in RSN 35 22 15-1.

PART 2 PRODUCTS

2.01 REINFORCING

A. See Section 03 20 00 - Concrete Reinforcing.

2.02 CONCRETE

A. See Section 03 30 00 - Cast-in-place Concrete.

2.03 PRECAST MANHOLE AND AGGREGATE

A. See Section 03 48 00 - Precast Concrete Structures.

2.04 COATINGS

A. See Section 09 96 20 - Coatings.

2.05 EQUIPMENT

A. Manually Operated Butterfly Valves:

1. General:

   a. AWWA C504, Class 150B or 250B. Class of valve to suit the pressure class at the line pipe locations.

   b. Bubbletight at rated pressure in either direction and suitable for operation after long periods of inactivity.

   c. Axis of valve leaf: horizontal when valve is in installed position except where shown on drawings.

2. Provide valve body flanges for connection to ASME B16.1, Class 125 or 250 or AWWA Class D, E, or F flanges as necessary.

3. Valve seat: Located either in valve body mating with a stainless steel seating surface located on valve disc; or in valve disc mating with a stainless steel seating surface located in valve body. Fully rubber lined bonded seat in body type seats are unacceptable.

4. Manual operators. Provide:

   a. Manually-operated butterfly valves with a worm-gear or traveling nut type manual operator in accordance with AWWA C504.

   b. Operators that open and close the valves under maximum unbalanced pressure conditions. Design for a maximum unbalanced pressure of adjoining pipe pressure.

   c. Gears of self-locking type, holds valve in all positions without fluttering or creeping.

   d. Rim pull and component strength: AWWA C504.

5. Buried butterfly valves. Provide:

   a. Valve boxes.

   b. Two inch square nut operator.

   c. Two steel tee handle wrenches, each with a length of 8 feet.

   d. Worm-gear or traveling nut type manual operator in accordance with AWWA C504.

   e. Gears of the self-locking type, holds valve in all positions without fluttering or creeping.

   f. Ensure rim pull and component strength meets AWWA C504.

B. Four inch Ball Valve:

1. AWWA C507, class 150 or 300. Class of valve to suit the pressure class at the line pipe locations.

2. Flanged connection to ASME B16.1, Class 125 or 250 or AWWA Class D or E flanges.
3. Suitable for buried service:
4. Valve boxes.
5. Two inch square nut operator.
6. Manually operated with a worm-gear or a traveling nut type manual operator.
7. Gears of the self-locking type, holds valve in all positions without fluttering or creeping.
8. Bubble tight at rated pressure in either direction and suitable for operation after long periods of inactivity.

C. Two inch Ball Valve:

1. Threaded ends.
2. MSS SP110, carbon steel body, stainless steel ball, full-ported, female screwed ends, with cold-water pressure rating of not less than 400 pounds per square inch.
3. Bubble tight at rated pressure in either direction and suitable for operation after long periods of inactivity.

D. Automatic Ball Drip Valve:

1. Threaded end.
2. Automatic draining, ball check.
3. Minimum 300 psig.
4. Provide dielectric insulating union as necessary to prevent galvanic corrosion between dissimilar metals.

E. Air Valve:

1. Val-Matic model 201C manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th street, Lyons, IL 60534; Dezurik Model 145C manufactured by Valve and Primer Corporation, 1420 South Wright Boulevard, Schaumburg, IL 60193-4599; Crispin Model AL21 Air and Vacuum Valve manufactured by Multiplex Manufacturing Company, 600 Fowler Avenue, Berwick, PA 18603; or equal, having the following essential characteristics:
    a. Combination air inlet and air release type actuated by a float.
    b. Remains open for filling line until water has displaced air at point of attachment of valve assembly after which it closes.
    c. Opens when pressure in pipeline drops sufficiently to create a vacuum.
    d. Releases trapped air when the pipeline is under pressure.

e. Furnish with 2 petcocks for valve; one at the top to permit checking the effectiveness of air valve, and one at bottom to allow valve to be drained.

f. Stainless steel internal parts such as guides, bushings, and screws.

g. Stainless steel floats.

h. Float-pivot supports: Brass, bronze, stainless steel, or cast iron.

i. Cold water pressure rating for the body: Minimum of 300 pounds per square inch.

j. Inlet connection: Internally threaded NPT.

F. Flanges:

1. Slip-on ring type, flat faced: AWWA C207 or ASME B16.5.

2. Flat face with a finish suitable for full face gasket for flanged joints.

G. Flange gaskets:

1. Model No. 22, manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra NY 14522; or equal, having following essential characteristics:

a. Full flat face-type.

b. For AWWA C207 flanged joints.

c. For cold water service.

2. Correct flange face gasket surface finish.

3. Spiral or concentric serrated grooved flange face gasket surface finishes suitable for flat gasket material provided and operating pressures.

H. Valve Box:

1. Model 6855 series, manufactured by Tyler Pipe, PO Box 2027, Tyler TX 75710; or equal, having the following essential characteristics:

a. 5-1/4 inch minimum inside diameter cast iron, composite, or PVC valve boxes for valves 4 inches in diameter and larger.

b. Two piece or 3 piece and slip type.

c. Cast iron collar with lid marked "WATER".

d. Base and adequate extension items to extend from valve nut operator to ground surface. Extension items may be PVC or metal.

e. Concrete medallion flush mounted with grouted surface except at blowoff locations. Refer to drawing 1695-D-60050.

I. Miscellaneous metal fittings:

1. Provide fittings for attaching valves and other appurtenances as shown on drawings.

J. Valve Insulation Jacket for Air Valve Installations:

1. Manufactured by ThermaXX LLC, 16 Hamilton Street, West Haven CT 06516; or equal, having the following essential characteristics:

a. Insulation material should be adequate to prevent freezing from generally accepted temperatures at location being installed.

b. Non-asbestos.

c. Hydrophobic.

2.06 CONTRACTOR SOURCE QUALITY TESTING

A. Shop test AWWA butterfly valves in accordance with AWWA C504 for butterfly valves and AWWA C507 for ball valves.

1. Leak test valves at manufacturer's facility or an alternate facility approved by COR.

2. Tests may be Government witnessed. Notify Government 30 days prior to testing valves.

3. Testing of valves shall occur during same trip for Government from each manufacturer.

4. Prior to shop leakage test and in presence of Government, verify that when valve is fully closed, valve indicator shall indicate closed.

5. If indicator is not in closed position (exactly at closed), remove operator from valve, fully close valve, reinstall operator so that it indicates "CLOSED".

6. Shop leakage test:

a. Test valves and their seats for leaks with water in 100 percent closed position for timed period of 5 minutes with a pressure equal to rated design pressure. Valves shall be drip tight with no leakage.

b. Upstream position of valve shall be visible to Government.

c. Spray or high velocity leakage will not be acceptable.

d. If valve leaks, adjustments shall be made until valve is drip tight with no leakage.

e. If a valve is not drip tight (any leakage), valve will not be acceptable.

B. After adjustments are made, inspect valve indicator again and corrected.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves and equipment to line and grade as shown on drawings.

B. Install valves complete and lubricated in accordance with the manufacturer's instructions.

C. Valves with flanged connections: Bolt holes to straddle vertical centerline when in installed position.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. After each valve has been completely installed, test valve in pipeline by opening and closing valve through full range of operation 3 times.

B. Make changes or adjustments until operation is approved by COR and valves are bubbletight and do not leak water past seats.

C. Provide means for inspecting area downstream of the valve during testing if required by Government.

3.03 COATING

A. In accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 35 42 35
BANK PROTECTION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Wash Crossing Sta 22276+75 to 22279+25:

1. Measurement: Installed cost of wash crossing.
2. Payment: For the lump sum offered in the Price Schedule.

B. Wash Crossing Sta 22343+25 to 22344+50:

1. Measurement: Installed cost of wash crossing.
2. Payment: For the lump sum offered in the Price Schedule.

C. Wash Crossing Sta 22443+50 to 22450+50.

1. Measurement: Installed cost of wash crossing.
2. Payment: For the lump sum offered in the Price Schedule.

D. Cost:

1. Include excavation in the Price Schedule for Common Excavation for Pipe Trenches.

E. Cost:

1. Include backfill in the Price Schedule for Backfill for Pipe Trenches.

F. Cost:

1. Include compaction in the Price Schedule for Compacting Backfill in Pipe Trenches.

G. Cost:

1. Include clearing and grubbing in the Price Schedule for Clearing and Grubbing.

H. Cost:

1. Include stripping in the Price Schedule for Stripping.

I. Cost:

1. Include erosion control blanket in the Price Schedule for Erosion Control Blanket.

J. Cost:

1. Include other Wash Crossings in prices offered in the Price Schedule in cost items listed above.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO M288-15	Geotextile Specification for Highway Applications
2.	AASHTO T96-02	Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
3.	AASHTO T104-99	Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

B. ASTM International (ASTM)

1.	ASTM A641/A641M-09(2014)	Zinc-Coated (Galvanized) Carbon Steel Wire
2.	ASTM A975-11	Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)

C. New Mexico Department of Transportation (NMDOT)

1.	NMDOT SSHB-14	Highway and Bridge Construction

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 35 42 35-1, Samples:

1. Riprap: (Class A wire enclosed) as per NMDOT SSHB Section 602.
2. Stakes: Description of stakes to be used.

C. RSN 35 42 35-2, Certifications:

1. Wire mesh: Certified test reports made by an independent testing laboratory indicating that material meets or exceeds the requirements.
2. Geotextile Fabric: Certified test reports made by an independent testing laboratory indication that material meets or exceeds the requirements.

PART 2 PRODUCTS

2.01 STONE FOR RIPRAP

A. Conform to requirements as per NMDOT SSHB Section 602.2.1, "Class A wire enclosed riprap".

B. Stone sizes are to be no less than 4 inches in the shortest dimensions and are to be between 1/6-2/3 cubic feet by volume.

C. Riprap shall be rocks or rough quarry stone with a percent wear of not more than 60 as determined by AASHTO T96 and a soundness loss of not more than 21 as determined by AASHTO T104 using a magnesium sulfate solution with a test duration of 5 cycles.

D. Stone shall be durable and of suitable quality to ensure permanence in the structure and climate in which it is to be used.

2.02 WIRE AND WIRE MESH

A. Mesh:

1. Fabricate: Wire mesh to be non-raveling and furnished in such lengths and widths so that the number of splices is kept to a minimum.
2. Double twisted wire mesh in accordance with NMDOT SSHB Section 602, wire mesh testing and certification.

B. Wire:

1. In accordance with ASTM A641 and have a Class 3 zinc coating.
2. Wire for wire enclosed riprap shall be 11-1/4 gauge (0.087 inch diameter) or larger.
3. Mesh openings:
    a. Uniform in size with opening size no more than 3-1/4 inches in the largest dimension.
    b. At least east 1 dimension of 2-1/2 inches or less.
4. Gabion baskets:
    a. 8-1/2 gauge (0.120 inch diameter) or larger.
    b. Wire openings:
        1) Uniform in size.
        2) Opening size no more than 4-3/4 inches in the largest dimension.
        3) 1 dimension of 3-1/4 inches or less.

C. Mechanically selvedge the edges of the double-twisted gabion baskets and wire enclose riprap including end panels and diaphragms as shown in NMDOT standard drawings 602-5-1/2 and 602-01-1/1.

D. Provide lacing wire for double-twisted gabion basket wire mesh with a diameter of at least 0.087 inches (11-1/4 gauge) instead of the 14 gauge shown on NMDOT SSHB Standard Drawing 602-05-1/2 "Gabion Basket Details".

E. Provide 9 gauge (0.148 in diameter) lacing wire for wire enclosed riprap in accordance with NMDOT SSHB Standard Drawing 602-01-1/1 "Wire Enclose Riprap Class A".

F. Lacing and tie wire shall have the same tensile strength and coating as the mesh wire. Alternative Fasteners may be used if approved by the engineer in accordance with NMDOT SSHB Section 602.

G. Wire Mesh in accordance with NMDOT SSHB Section 602.2.2.3 "Pull-Apart Test".

2.03 STAKES

A. Use steel railroad rails, standard weight galvanized steel pipe, or steel angles for riprap stakes.

B. Use railroad rails with a unit weight of at least 30 pounds per yard.

C. Use standard weight galvanized steel pipe with a minimum outside diameter of 4 inches.

D. Use steel angles that are at least 4 by 4 by 3/8 inch.

2.04 GEOTEXTILE TEXTILE

A. Provide Class 1 non-woven geotextile (filter fabric) in accordance with AASHTO M288, Table 6 (For In Situ Soil which has 15 to 50 percent passing 0.075 mm).

2.05 VERTICAL STEEL MEMBERS

A. Use angle iron, steel pipe, or steel railroad rails.

B. Use steel angles that are at least 4 by 4 by 1/4 inch.

C. Use standard weight steel pipe with a minimum outside diameter of 4 inches, and minimum of 3/16 thick.

D. Use railroad rails with a unit weight of at least 30 pounds per yard.

PART 3 EXECUTION

3.01 WIRE ENCLOSED RIPRAP INSTALLATION

A. Locations: As shown on drawings

B. Site Preparation:

1. Remove large, sharp objects which include but are not limited to rocks, cut trees, roots, shrubs, glass which may damage geotextile fabric in accordance with Section 31 11 00 - Clearing and Grubbing and Section 31 14 10 - Stripping.

C. Excavation: In accordance with Section 31 23 22 - Pipe Trench Earthwork.

D. Geotextile Placement:

1. Place geotextile between the wire enclosed riprap and the supporting soil.
2. Place fabric as smoothly as possible on the prepared slope.
3. Hold fabric in place by pins or staples.
4. On bends in the wire enclosed riprap, fabric may be folded or cut to conform to the bend.
5. Folds and Overlaps:
   a. Fold or overlap in the direction of construction.
   b. Overlap fabric a minimum of 30 inches.

E. Riprap Placement:

1. Place riprap stones to form a continuous blanket of the minimum thickness indicated on the drawings.
2. Place stones with their long axis parallel to the toe of the slope and have a stable bearing upon the underlying soil or stones.
3. Make joints between larger stones as close as practicable and filled with smaller stones.
4. Do not tear or otherwise damage the fabric.
5. Ensure that a layer of fabric is placed at the interface between the sloped and stone surfaces as shown on the drawings.
6. Draw wire mesh tightly against the stones. Connect edges of the wire mesh using lacing wire, 13-1/2 gauge or larger, and be double loop woven at adjacent edges to ensure that the strength and flexibility at the point of connection is equal to or greater than that of the mesh.
7. Make lacing continuous as far as practicable and pass through each mesh opening. Where splicing is necessary, overlap the lacing at least 12 inches.

a. Use galvanized tie wire, 9 gauge or larger, to connect top and bottom mesh layers at 2 feet on center each way.

b. Approved fasteners may also be used.

c. Anchor ties to the bottom of wire-fabric layer.

d. Extend the ties through the rock layer and secure to the top wire-fabric layer.

e. Anchor wire-enclosed riprap to slopes with steel stakes driven into the embankment.

f. Space stakes in accordance with NMDOT SSHB Standard Drawing 602-1/1.

F. Backfill and Compaction:

1. Place natural soil material in the wash bottom to the same grade as prior to pipeline trench excavation burying the scour protection portion of the wire enclosed riprap.

2. Compact pipe trench backfill beneath wire enclosed riprap.

a. Compact to 90 percent of maximum density in accordance with AASHTO T180 (Modified Proctor), Method D (TTCP Modified), and to field densities in accordance with AASHTO T310.

b. Compact soil material in 12 inch lifts using a hand operated or larger compactor. If conflict exists between this criteria and AASHTO, use the smaller, more conservative criteria.

3. Grade wash bank slope as shown on the drawings.

G. Erosion Control Blanket:

1. As shown on the drawings some wire enclosed riprap may extend part way up the bank from the toe.

2. Grade upper portion of the bank excavated for pipeline installation to 3:1 (H:V) or flatter as shown on the drawings.

3. Install Erosion Control Blankets in accordance with Section 32 91 60 - Erosion Control Blankets.

H. Line Pipe Joints: Restrained or fused from beginning to end of wash crossing stationing.

3.02 EROSION CONTROL BLANKET INSTALLATION

A. Site Preparation:

1. Remove large, sharp objects which include but are not limited to rocks, cut trees, roots, shrubs, glass which may damage geotextile fabric.

B. Excavation: In accordance with Section 31 23 22 - Pipe Trench Earthwork.

C. Backfill and Compaction:

1. Place natural soil material in the wash bottom to the same grade as prior to pipeline trench excavation burying the scour protection portion of the wire enclosed riprap.

2. Compact pipe trench backfill beneath erosion control blanket bank protection.

   a. Compact to 80 percent of maximum density in accordance with AASHTO T180 (Modified Proctor), Method D (TTCP Modified), and to field densities in accordance with AASHTO T310.

3. Grade wash bank slope to the natural topography prior to pipe installation.

D. Erosion Control Blanket:

1. Install Erosion Control Blankets in accordance with Section 32 91 60 - Erosion Control Blankets.

END OF SECTION

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SECTION 48 14 00
SOLAR AND ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price in the Price Schedule for Complete Electrical System.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-14	Enclosures for Electrical Equipment (1000 Volts Maximum)

B. National Fire Protection Association (NFPA)

1.	NFPA 70-11	National Electrical Code (NEC)
2.	NFPA 70E-12	Standard for Electrical Safety in the Workplace

C. Underwriters Laboratories, Inc. (UL)

1.	UL 98-12	Enclosed and Dead-Front Switches
2.	UL 248-13	Low-Voltage Fuses
3.	UL 1703-02	Standard for Flat-Plate Photovoltaic Modules
4.	UL 1741-10	Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 48 14 00-1, Approval Data.

1. Manufacturer's technical data sheets.

C. RSN 48 14 00-2, Approval Drawings.

1. Provide drawings and calculations showing the following:
    a. Azimuth angle and tilt of solar panels.
    b. Layout of solar panels.
    c. Calculations showing solar panels supply the required battery load.
2. Details for mounting system.

D. RSN 48 14 00-3, Test Report:
1. Provide test report as stated in Article 3.02.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PROJECT CONDITIONS

A. See Section 01 14 10 - Use of Site.

1.06 DESIGN REQUIREMENTS

A. Two distinct systems required:
1. NAPI Turnout.
2. Regulating Tank No. 2 Site.

B. Design photovoltaic system to include:
1. Photo voltaic panel mounting equipment. Design mounting structure for optimal tilt to mount photovoltaic modules.
2. Photo voltaic modules.
3. Charge Controller and associated monitoring equipment.
4. Solar equipment cabinet.
    a. Provide sufficient space for SCADA equipment.
        1) Programmable logic controller.
        2) Communication equipment.
            a) Radio.
            b) Fiber optic bypass unit.
        3) Flow meter transmitter at NAPI Turnout.
5. Battery Enclosure.

6. Battery: From full charge, batteries must meet a system run-time of 72 hours minimum without recharge under full system load.

PART 2 PRODUCTS

2.01 PHOTO-VOLTAIC MODULE MOUNTS

A. Type: Contractor Design.

B. Material: Steel or aluminum. Corrosion proof.

C. Mounting Equipment: As necessary to mount on pole structure and meet wind load requirements.

2.02 PHOTO-VOLTAIC SOLAR MODULES

A. Suniva Optimus Series as manufactured by Suniva Inc, www.suniva.com; or equal, having the following essential characteristics:

B. Monocrystalline solar modules.

C. Total system array size shall be based on manufacture's recommended installation.

D. Warranty: 5 years minimum.

1. Efficiency:

   a. 90 percent original output at 10 years.

   b. 80 percent original output at 25 years.

E. Conforms to UL 1703.

2.03 CHARGE CONTROLLER

A. System voltage rating: 24 VDC.

B. System current rating: 10 Amperes continuous current, minimum.

C. Current Consumption:

1. Controller: 10 mA, maximum.

2. Meter: 8.5 mA, maximum.

D. Remote Temperature Sensor:

1. Same manufacturer as the charge controller.

2. Temperature range: minus 30 degrees C to 80 degrees C.

3. Accuracy: plus or minus 1.5 degrees C.

E. Discrete Alarm Outputs for SCADA:

1. Low Voltage Warning.

2. Low Voltage Disconnect.

2.04 SOLAR EQUIPMENT CABINET

A. Construction: Steel.

B. Enclosure: NEMA 250, Type 4.

C. Doors: Hinged door, lockable.

D. Finish: Manufacturer's standard powder coat.

2.05 BATTERY ENCLOSURE

A. Construction: Steel.

B. Enclosure: Type 3R in accordance with NEMA 250.

C. Doors: Hinged door, lockable.

D. Finish: Manufacturer's standard powder coat.

E. Spill containment tray.

F. Ventilation: Passive. Provide vent filters to minimize accumulation of dust.

G. Size: Able to accommodate batteries required, plus 20 percent spare.

2.06 BATTERY

A. Type: Sealed, maintenance free, lead acid battery.

1. Absorption glass mat (AGM), valve regulated, and specifically made for photovoltaic applications.

B. Terminal Voltage: 12 VDC nominal.

C. Temperature Range: minus 40 degrees C to 72 degrees C.

D. Self-Discharge: Less than 1 percent per month at 25 degrees C.

E. Use of flooded cell batteries is not permitted.

F. Conforms to UL 50.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide photovoltaic module output cables, module interconnect cables, grounding, and associated equipment required for a complete independent solar electrical supply system.

B. Install conduit in accordance with Section 26 05 33 - Electrical Conduit.

C. Install cable in accordance with Section 26 05 20 - Conductors and Cables.

D. Install grounding and bonding connections in accordance with Section 26 05 26 - Grounding and Bonding.

E. Installed structures and equipment must be suitable for installation in project conditions.

F. Government will provide estimated SCADA equipment power demand upon request to aid in solar system sizing.

G. Mount photovoltaic modules at the optimum angle for year round performance.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR, at least 3 days in advance of time of testing. Testing dates to be mutually agreeable between Contractor and COR.

B. Electrical testing in accordance with NFPA 70E.

C. To demonstrate the system is fully functional perform the tests below:

1. Continuity of conductors including module interconnection.
2. Insulation resistance of the electrical installation.
3. Resistance testing on grounded equipment to grounding electrode including mounting structure and combiner box grounding.
4. Measure the voltage between the positive and negative ends at the combiner box.

D. Testing Report:

1. Record date and time of testing as well as signatures from contractor personnel performing testing, and COR witness.
2. State resistance values from grounding tests.
3. Include the Voc, Isc, Vmp, and Imp for the modules from the manufacture’s data sheets.

4. State, if any, modifications that were necessary to pass testing.

END OF SECTION

SECTION 51 00 00
INFORMATION AVAILABLE TO OFFERORS

PART 1 GENERAL

1.01 ORDER OF PRECEDENCE

A. In case of differences between sections in Division 51 - Information Available to Offerors and sections in other divisions of the specifications, the requirements in the other divisions will govern.

B. The Government assumes no responsibility for deductions, interpretations, or conclusions made by the Contractor based on information made available by the Government, in accordance with the clause at FAR 52.236-3 “Site Investigations and Conditions Affecting the Work.”

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 52 00 00
DRAWINGS

PART 1 GENERAL

1.01 DISCREPANCIES, ERRORS, OR OMISSIONS

A. Inform the CO of discrepancies discovered on drawings in accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction.

B. In accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction, in case of discrepancies, written specifications take precedence over drawings unless otherwise specified.

1.02 PROJECT CONDITIONS

A. Where there are differences as determined by the CO between details and dimensions shown on drawings and details and dimensions of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.03 SPECIFICATION DRAWINGS

A. Some drawings show details of fabrication or other details and specifications which are not a part of work under this contract. Disregard specifications and details shown on these drawings which are not applicable to work under this contract.

B. Reference drawings referred to on specification drawings and not considered necessary for contract purposes are not included in specifications.

C. Parts of work for which dimensions are not shown have been drawn to scale as nearly to final dimensions as possible before purchase of machinery or equipment and development of final general and detailed designs.

1.04 TYPICAL DRAWINGS

A. Typical drawings show installations and details of construction which are similar to or approximate to those that are part of work under these specifications. Dimensions and details shown on typical drawings may vary from those shown on construction drawings to be furnished after award of contract.

B. Use typical drawings for bidding purposes only.

1.05 INFORMATION DRAWINGS

A. Drawings marked "For Information Only" in the drawing list are included to show existing features about which knowledge is required to perform work under this contract. These drawings do not show work to be performed under this contract.

B. If there are differences as determined by the CO between details and dimensions shown on these drawings and those of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.06 STANDARD DRAWINGS

A. Standard drawings may show details which are not a part of work under this contract. Disregard details shown on these drawings which are not applicable to work under this contract.

1.07 LIST OF DRAWINGS

A. Drawings listed in Table 52 00 00A - List of Drawings are made a part of Section C - Description/Specifications.

1.08 DRAWING NUMBERS IN NUMERICAL ORDER

A. Specification drawings are listed in numerical order in Table 52 00 00B - Drawings in Numerical Order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
General:		
1	1695-529-401	General Map
2	1695-529-60068	Cutter Lateral Reach 22B - Location Map
3	1695-529-60077	Reach 22B Staging Area
Civil:		
4	1695-D-60005	Pumping Plant No. 1 Site Plan - Plan
5	1695-D-60006	Pumping Plant No. 1 Site Plan - Sections Thru Yard and Sections
6	1695-D-60007	Pumping Plant No. 2 Site Plan - Plan
7	1695-D-60008	Pumping Plant No. 2 Site Plan - Sections Thru Yard and Sections
8	1695-D-60009	Regulating Tank No. 2 Site Plan - Plan
9	1695-D-60010	Regulating Tank No. 2 Site Plan - Sections Thru Yard and Detail
10	1695-D-60021	Regulating Tank No. 2 Overflow Apron - Concrete Outline and Reinforcement Design
11	1695-D-60022	Pumping Plant No. 1 and No. 2 - Switchgear Foundations and Enclosures - Plans and Sections
12	1695-D-60023	Pumping Plant No. 1 and No. 2 - Steel Pipe Encasements - Concrete Outline and Reinforcement Design
13	1695-D-60027	Line Pipe - Sheet Key General Notes Road Details - Sheet 1 of 18
14	1695-D-60028	Line Pipe - Plan and Profile - Beginning to Sta. 22300+00 - Sheet 2 of 18
15	1695-D-60029	Line Pipe - Plan and Profile - Sta. 22300+00 to Sta. 22350+00 - Sheet 3 of 18

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
16	1695-D-60030	Line Pipe - Plan and Profile - Sta. 22350+00 to Sta. 22400+00 - Sheet 4 of 18
17	1695-D-60031	Line Pipe - Plan and Profile - Sta. 22400+00 to Sta. 22450+00 - Sheet 5 of 18
18	1695-D-60032	Line Pipe - Plan and Profile - Sta. 22450+00 to Sta. 22500+00 - Sheet 6 of 18
19	1695-D-60033	Line Pipe - Plan and Profile - Sta. 22500+00 to Sta. 22550+00 - Sheet 7 of 18
20	1695-D-60034	Line Pipe - Plan and Profile - Sta. 22550+00 to Sta. 22600+00 - Sheet 8 of 18
21	1695-D-60035	Line Pipe - Plan and Profile - Sta. 22600+00 to Sta. 22650+00 - Sheet 9 of 18
22	1695-D-60036	Line Pipe - Plan and Profile - Sta. 22650+00 to Sta. 22700+00 - Sheet 10 of 18
23	1695-D-60037	Line Pipe - Plan and Profile - Sta. 22700+00 to Sta. 22750+00 - Sheet 11 of 18
24	1695-D-60038	Line Pipe - Plan and Profile - Sta. 22750+00 to Sta. 22800+00 - Sheet 12 of 18
25	1695-D-60039	Line Pipe - Plan and Profile - Sta. 22800+00 to Sta. 22850+00 - Sheet 13 of 18
26	1695-D-60040	Line Pipe - Plan and Profile - Sta. 22850+00 to Sta. 22900+00 - Sheet 14 of 18
27	1695-D-60041	Line Pipe - Plan and Profile - Sta. 22900+00 to Sta. 22950+00 - Sheet 15 of 18
28	1695-D-60042	Line Pipe - Plan and Profile - Sta. 22950+00 to Sta. 23000+00 - Sheet 16 of 18
29	1695-D-60043	Line Pipe - Plan and Profile - Sta. 23000+00 to Sta. 23050+00 - Sheet 17 of 18

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
30	1695-D-60044	Line Pipe - Plan and Profile - Sta. 23050+00 to End - Sheet 18 of 18
31	1695-D-60045	Line Pipe - Pipe Trench Installation - Sections and Details
32	1695-D-60046	Line Pipe - 2 inch Air Valve - Plan, Sections, and Details - Sheet 1 of 2
33	1695-D-60047	Line Pipe - 2 inch Air Valve Installation - Air Valve Data Table - Sheet 2 of 2
34	1695-D-60048	Line Pipe - Blowoffs - Sections and Details
35	1695-D-60049	Line Pipe - Miter Bend Thrust Restraint - Data Tables
36	1695-D-60050	Line Pipe - Plans, Sections, and Details - NAPI Turnout
37	1695-D-60051	Line Pipe - Bore and Jack - Sta. 22251+30 Sta. 22283+50 - Sheet 1 of 2
38	1695-D-60052	Line Pipe - Bore and Jack - Sta. 22415+40 Sta. 22938+50 - Sheet 2 of 2
38A	1695-D-60064	Line Pipe - Road to Pumping Plant 2 - Plan and Profile, Sheet 1 of 2
39	1695-D-60053	Line Pipe - Road to Pumping Plant 2 - Plan and Profile, Sheet 2 of 2
40	1695-D-60054	Line Pipe - Regulating Tank No. 2 Overflow Channel - Plan, Profile, and Section
41	1695-D-60055	Line Pipe - Wash Crossing - Sta. 22276+75 to Sta. 22279+25 - Sheet 1 of 9
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END OF SECTION

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SECTION 53 10 00
GEOLOGY

PART 1 GENERAL

1.01 GENERAL

A. This section describes surface and subsurface geologic conditions for the Reach 22B project area. Other sections of these specifications contain geological and geotechnical information important for understand the significance of the geologic conditions to the construction operations.

B. Project area foundation and site geology is discussed for each major project feature listed below:

1. Pipeline Station 22249+54 to 23151+10.
2. Pumping Plant 1.
3. Pumping Plant 2.
4. Regulating Tank 2.

C. The geologic drawings, sections, descriptions, groundwater-level data, logs of subsurface explorations, and geologic surface map data contained in these specifications include the geologic data on which design of the work are based and are considered. Selected samples recovered during subsurface exploration were laboratory tested to determine physical properties for the design of the project features. All information and data included in these specifications supersede any previous versions, which may be available for examination by bidders. Only the data that are specific to the needs of these specifications are included in these specifications. These data are contained in Section 53 20 00 - Records of Geologic and Subsurface Investigations. Bidders are encouraged to inspect the site and to obtain their own samples and perform tests on the materials to evaluate properties, which the bidder believes to be significant.

D. Unconsolidated soil materials recorded in all geologic exploration logs included in these specifications were classified under Unified Soil Classification System procedures as described in Reclamation standards USBR 5000-86 (laboratory classification) and USBR 5005-86 (visual classification). These two procedures are similar to ASTM D2487 and ASTM D2488, respectively. Copies of the above Reclamation procedures are available for review through the FCCO. Also refer to drawing 103-D-347.

E. Descriptions of bedrock materials, including weathering, fracturing, hardness, etc., have been standardized as shown and defined on standard drawings 40-D-7022 and 40-D-

7023. These standards are further explained and defined in the Reclamation Engineering Geology Field Manual.

F. Geologic data describes geologic conditions at the specific locations and dates collected. Encountered geologic conditions and contacts will differ from locations not investigated. All interpretive drawings are prepared to suggest general trends between data points and do not depict local irregularities. Details of important geologic considerations related to the excavation of the foundation for the proposed site are discussed in Geology and Engineering Geology Considerations sections below. Additional information is provided in the applicable Earthworks sections.

G. Select samples of unconsolidated soil deposits recovered during investigations were tested by the Reclamation FCCO Laboratory. Summaries of laboratory test results are contained in section 53 20 00, Records of Geologic and Subsurface Investigations. Additional information regarding Reclamation laboratory testing of soil materials is available by contacting the Reclamation, FCCO materials laboratory at telephone number 505-324-5035.

H. The geology site conditions, geologic investigation locations, and stick log information for the pipeline are shown plan and profile drawings within Section 52 00 00, Drawings. Additional geologic information for the regulating tanks and pumping plants are shown on drawings included in Section 53 20 00, Records of Geologic and Subsurface Investigations.

I. The bedrock surface as depicted on the plan and profile drawings and geologic sections may not indicate final foundation grade or define the limits of excavation.

1.02 REFERENCE REPORTS

A. Copies of the following reports and memoranda, which contain pertinent information on the area, site geology, and materials properties, may be examined at Bureau of Reclamation, FCCO, 2200 Bloomfield Highway, Farmington, New Mexico; or at the Technical Service Center, 6th and Kipling, Building 67, Room 1068, Denver, Colorado. Bidders wishing to inspect the reports and memoranda should make arrangements through the FCCO at (505) 325-1794.

1. Navajo Gallup Water Supply Project - Reach 22B Geologic Design Data Report; Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Four Corners Construction Office, Durango, Colorado; 2015.

2. Navajo Gallup Water Supply Project - Reach 21 Geologic Design Data Report; Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Four Corners Construction Office, Farmington, New Mexico; August 2015.

3. Navajo Gallup Water Supply Project - Reach 22A Cutter Canyon Alignment - Geologic Design Data Supplemental Report; Department of the Interior, Bureau

of Reclamation, Upper Colorado Region, Four Corners Construction Office, Durango, Colorado; 2014.

4. Navajo Gallup Water Supply Project - Reach 22A Cutter Canyon Alignment - Geologic Design Data Report; Department of the Interior, Bureau of Reclamation, Upper Colorado Region, Four Corners Construction Office, Durango, Colorado; September 2013.

1.03 REFERENCE STANDARDS

A. ASTM International (ASTM):

1.	ASTM D2487-11	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
2.	ASTM D2488-09a	Description and Identification of Soils (Visual-Manual Procedure)
3.	ASTM D7382-08	Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

B. Bureau of Reclamation Standards (USBR)

1. Earth Manual, Part 2, Third Edition (1990)

a.	USBR 5000	Determining Unified Soil Classification (Laboratory Method)
b.	USBR 5005	Determining Unified Soil Classification (Visual Method)
c.	USBR 5500	Performing Laboratory Compaction of Soils - 5.5-lbm Rammer and 18 inch Drop.
d.	USBR 7205	Determining Unit Weight of Soils In-place by the Sand-Cone Method.

2. Engineering Geology Field Manual, Second Edition (1998).

PART 2 GEOLOGIC INVESTIGATIONS

2.01 GEOLOGIC INVESTIGATIONS

A. Geologic investigations conducted for the Reach 22B project area are listed below and pertinent data are contained in Section 53 20 00 - Records of Geologic and Subsurface Investigations.

1. Previous Investigations. Geologic investigations were conducted for the Reach 22B project. Investigations near the terminal end of the Reach 22A pipeline (near Pumping Plant 1 at the start of Reach 22B) have been included in the discussion and data section of these specifications.

2. Current Investigations. Geologic investigations were conducted in phases and documented within the geologic reports cited within section 1.02. Only subsurface investigations within about 100 feet from pipeline alignment and from the project structures have been included in these specifications, unless otherwise noted. Geologic logs and laboratory data from investigations are included in Section 53 20 00 - Records of Geologic Investigations and Data. Locations of applicable subsurface investigations and stick log data are provided on drawings 1695-D-60027 through 1695-D-60044 located in section 52 00 00. Additional geologic information is included on geology drawings included in section 53 20 00. Relevant geologic investigations conducted by the FCCO in 2014 through 2015 include:

    a. Thirty drill holes, 64 test pits and 20 cone penetration test holes.

    b. In-place density testing using the sand cone replacement method, in accordance to USBR 7205, was conducted in most test pits.

    c. Laboratory testing included gradation and physical property testing for select soil samples from drill holes and test pits, and compaction testing of materials sampled from in-place density tests. Compaction testing, in accordance to USBR 5500, was conducted on cohesive soil materials. Vibratory hammer compaction tests, according to ASTM D7382, were conducted on select samples of non-cohesive soil materials.

    d. Geologic mapping at scale of 1 inch to 400 feet was conducted along the pipeline alignment.

3. Equipment:

    a. Drill holes were conducted with three different drill rigs: Central Mining Equipment (CME) 85 truck-mounted drill rig, CME 850 track-mounted drill rig, and a Gus Pech GP3000 Rotary drill rig. Drill holes were advanced using hollow stem augers that were 4.25 inch-outer-diameter and 3.25 inch-inner-diameter. Sampling through the augers was conducted using a 2.5 inch-inner-diameter split-barrel sampler and a Standard Penetration Test (SPT) sampler. SPT was conducted using a 2 inch-outer-diameter by 1-3/8 inch-inner-diameter by 2.5 foot-long split-barrel sampler and advanced using an automatic hammer system. Rock core was sampled using a HQ3 wireline coring system. Refer to drill hole logs for specific drilling equipment used.

    b. Test pits were excavated using two backhoes: Case 580M Rubber Tired Backhoe or a Case 680L Rubber Tire Backhoe. Each used a bucket that

was 2 foot-wide with teeth. Refer to test pit logs for specific equipment used.

c. All Cone Penetration Test (CPT) holes were conducted using an electronic cone penetrometer, pushed via a hydraulic push system. The cone penetrometer test push system was manufactured by Vertek/Applied Research Associates, Inc. in 2006. As the cone is pushed at a rate of approximately 2 centimeters per second (0.8 inches per second), tip, sleeve, and pore pressures are measured and recorded every 25 to 55 millimeters (approximately 1 to 2 inches). Testing was performed in accordance with ASTM D5778. A 10 cubic centimeter (cm^2) ten ton digital subtraction cone with area ratio of 0.8 was used for all testing. The digital data acquisition system was an Electronic Field Computer System (EFCS4) originally manufactured by Hogentogler (currently Vertek).

PART 3 GEOLOGY

3.01 REGIONAL GEOLOGY

A. Reach 22B is located entirely within the Navajo section of the San Juan Basin, a section characterized by young plateaus, mesas, and dry-wash canyons presently being eroded in an arid climate. The San Juan Basin is a structural depression on the order of about 5,000 feet and contains Tertiary age deposits, resting on bedrock of Cretaceous age, which crop out around the margins of the basin. Surface rocks in the central basin are of Cretaceous and Tertiary ages. These rocks consist primarily of sandstone, shale, conglomerate and coal laid down in continental, brackish and littoral environments.

B. Tertiary age Nacimiento Formation bedrock units are exposed in this area and consist of shale, siltstone, claystone, and sandstone. This unit is exposed near and along the pipeline alignment from the Largo Canyon area extending south and west toward Huerfano Mesa. Regionally, the Nacimiento Formation is about 1,450 feet in thickness. It generally contains more shale and siltstone and weathers to rough badland type topography. Bedrock throughout Reach 22B is often covered by a thin veneer of unconsolidated surficial soil deposits.

3.02 SITE GEOLOGY

A. Stratigraphy: The project area includes unconsolidated surficial soil deposits and Tertiary age sedimentary bedrock units.

1. Quaternary Alluvium (Qal) overlies bedrock through most of Reach 22B. All unconsolidated soil deposits in the project area, regardless of depositional origin, are referred to as Quaternary Alluvium (Qal). Quaternary Alluvium (Qal) will be referred to as “soil” within these specification descriptions. Soils range from

predominantly Silty Sand (SM) to Clayey Sand (SC), and occasionally Lean Clay with Sand (CL)s. Within the local drainages (sand washes), the soil generally is classified as a Poorly Graded Sand with Silt (SP-SM) and Silty Sand (SM). These deposits occasionally contain a component of fine gravel. For more detail, see specific geologic logs.

2. Tertiary Nacimiento Formation (Tn) consists predominately of sandstone with interbedded siltstone and claystone, and is exposed at the ground surface as topographical mesas.

   a. Sandstone is fine to coarse grained, soft to moderately hard, intensely weathered to slightly weathered, thinly to thickly bedded, with sporadic zones containing carbon inclusions and iron/manganese oxide staining. The color of the sandstone transitions between brown, orange, grey, and yellow. The sandstone can contain occasional conglomeratic zones with subrounded to subangular fine gravel, and mud ripup clasts.

   b. Siltstone is grey to brown in color, very soft to moderately hard, slightly weathered to intensely to moderately weathered. The siltstone is typically laminated to thinly bedded and can contain occasional carbon inclusions, gypsum and calcite veins with iron/manganese oxide staining.

   c. Claystone is dark grey to brown in color, very soft to soft, decomposed to intensely weathered. The claystone is typically laminated to thinly bedded and can contain occasional carbon inclusions, gypsum and calcite veins with iron/manganese oxide staining.

3.03 GENERAL DESCRIPTION INFORMATION FOR STATION TO STATION GEOLOGY AND FOUNDATION GEOLOGY

A. Not all investigations conducted in the project area are discussed in the following descriptions of geologic site conditions. Review of all geologic data included within section 53 20 00 is required for a more complete understanding of site conditions.

B. Depths listed within descriptions below are depths in feet below the ground surface unless stated otherwise.

C. Individual investigations described within the Pipeline Station to Station Geology are listed in the order that they occur along the pipeline.

D. Standard Penetration Testing (SPT) data discussed within this section and listed on the geologic logs are raw blow count values (uncorrected) and have not been normalized. Discussion within the Station to Station Geology and Foundation Geology sections list one SPT (uncorrected) value for the 1 foot-long test interval. SPT data is reported as uncorrected blows per foot (BPF). SPTs conducted within bedrock were generally omitted from discussion below.

E. In-place density tests were conducted at various starting depths including about 4, 6 and 8 feet. The depth listed for each in-place density test within the Station to Station Geology and Foundation Geology designates the top or starting depth for the ring-density test. Material is typically sampled from the starting depth (inside the ring) to an average depth of about 10 inches.

1. In-place density data is reported as dry density in pounds per cubic feet (lbs/ft^3) and moisture content.

F. Compaction tests were conducted on material collected from in-place density tests. Typically material with greater than or equal to 15 percent fines content was tested using compaction methods according to USBR 5500, with a 5 point compaction test conducted per sample. Typically material with less than 15 percent fines content was tested using vibratory hammer compaction methods according to ASTM D7382.

1. Compaction test data is reported as dry density in pounds per cubic feet (lbs/ft3) and optimum water content.

2. Vibratory hammer compaction test data is reported as dry density in pounds per cubic feet (lbs/ft3) without moisture content (as the test procedure does not include the addition of water).

3.04 PIPELINE STATION TO STATION GEOLOGY

A. Approximate Station 22249+54 to 22251+50: This section of pipeline is within and near the Pumping Plant 1. Refer to the Foundation Geology description for the Pumping Plant 1 for surface and subsurface geology.

B. Approximate Station 22251+50 to 22253+50: Bedrock is exposed at and just below the ground surface. Bedrock mapped at the ground surface consists of sandstone and siltstone. Sandstone is moderately weathered and moderately hard. Siltstone is moderately weathered and soft. No subsurface investigations were conducted along this segment of the pipeline.

C. Approximate Stations 22253+50 to 22327+75: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigation include: 1 drill hole, 5 test pits, and 2 CPTs.

1. Test pit TPR22B-14-22 encountered soil from 0 to 12.1 feet and bedrock from 12.1 to 12.6 feet. Clayey Sand (SC) from 0.0 to 3.3 feet, Poorly Graded Sand with Silt (SP-SM) from 3.3 to 6.3 feet, and Lean Clay (CL) from 6.3 to 12.1 feet. Fresh, very soft shale was encountered from 12.1 to 12.6 feet. Excavation was terminated at refusal within the bedrock.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 105.5 lbs/ft^3 with a moisture content of 7.0 percent. Compaction test results from material sampled from the in-place density

test had a maximum dry density of 117.2 lbs/ft^3 with an optimum water content of 14.4 percent.

2. CPT hole CPT22B-14-6 reached refusal at approximately 4.8 feet.

3. Test pit TPR22-23 encountered soil from 0 to 6.8 feet and bedrock from 6.8 to 10.0 feet. Silty Sand (SM) was encountered from 0.0 to 6.8 feet. Intensely weathered, very soft sandstone was encountered from 6.8 to 10.0 feet. Excavation was terminated at refusal within the bedrock.

   a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 105.2 lbs/ft^3 with a moisture content of 3.8 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.0 lbs/ft^3 with an optimum water content of 13.3 percent.

4. Test pit TPR22B-14-24 encountered soil from 0 to 16.0 feet. Silty Sand (SM) was encountered from 0.0 to 4.2 feet, and Poorly Graded Sand (SP) from 4.2 to 9.0 feet, and Silty Sand (SM) from 9.0 to 16.0 feet. Excavation was terminated at the limits of the equipment.

   a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 101.8 lbs/ft^3 with a moisture content of 1.0 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 111.6 lbs/ft^3.

5. Drill hole DHR22B-14-25 encountered soil from 0 to 25.5 feet. Silty Sand (SM) was encountered from 0.0 to 20.9 feet and Lean Clay (CL) from 20.9 to 25.5 feet. SPT data ranged from 6 to 39 BPF.

6. Test pit TPR22B-14-26 encountered soil from 0 to 15.0 feet. Silty Sand (SM) was encountered from 0.0 to 12.0 feet and Poorly Graded Sand (SP) from 12.0 to 15.0 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 95.4 lbs/ft^3 with a moisture content of 1.6 percent. Vibratory compaction test results from material sampled from the in-place density test had a maximum dry density of 107.5 lbs/ft^3.

7. CPT hole CPT22B-14-7 was advanced to 25.0 feet.

8. Test pit TPR22B-14-27 encountered Silty Sand (SM) from 0.0 to 17.0 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 96.1 lbs/ft^3 with a moisture content of 3.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 116.3 lbs/ft^3 with an optimum water content of 11.9 percent.

D. Approximate Stations 22327+75 to 22336+50: Bedrock is exposed at and just below the ground surface. Bedrock mapped at the ground surface consists of sandstone and siltstone. Sandstone is moderately weathered and moderately hard. Siltstone is moderately weathered and soft. No subsurface investigations were conducted along this segment of the pipeline.

E. Approximate Stations 22336+50 to 22346+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Bedrock outcrops at the ground surface on each side of the approximate stations designated and trench excavation is likely to encounter bedrock near the designated stations. Investigations include: 1 test pit.

1. Test pit TPR22B-14-28 encountered soil from 0 to 16.0 feet. Silty Sand (SM) was encountered from 0.0 to 4.2 feet and Poorly Graded Sand (SP) from 4.2 to 16.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 99.7 lbs/ft^3 with a moisture content of 0.6 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 114.1 lbs/ft^3.

F. Approximate Stations 22346+00 to 22350+00: Bedrock is exposed at and just below the ground surface. Bedrock mapped at the ground surface consists mostly of sandstone. No subsurface investigations were conducted along this segment of the pipeline.

G. Approximate Stations 22350+00 to 22358+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include: 1 CPT and 1 drill hole that was conducted greater than 400 feet from the alignment.

1. CPT hole CPT22B-14-8 reached refusal at approximately 11.9 feet.

2. Drill hole DHR22-29 was drilled over 400 feet from current alignment. Soil was encountered from 0 to 7.8 feet and bedrock from 7.8 to 26.3 feet. Silty Sand (SM) was encountered from 0.0 to 1.2 feet and Clayey Sand (SC) from 1.2 to 7.8 feet. One SPT was conducted with results of 15 BPF. Interbedded sandstone, siltstone and claystone were encountered from 7.8 to 26.3 feet.

H. Approximate Stations 22358+00 to 22362+00: Bedrock is exposed at and just below the ground surface. Bedrock mapped at the ground surface consists of very intensely weathered, soft sandstone. No subsurface investigations were conducted along this segment of the pipeline.

I. Approximate Stations 22362+00 to 22371+70: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include 1 CPT.

1. CPT hole CPT22B-14-9 reached refusal at approximately 6.2 feet.

J. Approximate Stations 22371+70 to 22376+40: Bedrock is exposed at and just below the ground surface. Investigations include 1 test pit.

1. Test pit TPR22B-14-30 encountered soil from 0 to 1.7 feet and bedrock from 1.7 to 4.0 feet. Silty Sand (SM) was encountered from 0.0 to 1.7 feet. Intensely weathered, moderately soft sandstone was encountered from 1.7 to 4.0 feet. Excavation was terminated at refusal within bedrock.

K. Approximate Stations 22376+40 to 22383+30: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. There is a small outcrop of intensely weathered, soft sandstone at the ground surface in the bottom of the drainage, near station 22379+75. Investigations include 1 test pit.

1. Test pit TPR22B-14-31 encountered soil from 0 to 5.8 feet and bedrock from 5.8 to 6.6 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0 to 4.7 feet and Poorly Graded Sand (SP) from 4.7 to 5.8 feet. Slightly weathered, moderately hard sandstone was encountered from 5.8 to 6.6 feet. Excavation was terminated at refusal within the bedrock.

L. Approximate Stations 22383+30 to 22391+90: Bedrock is exposed at and just below the ground surface. Bedrock mapped at the ground surface was moderately weathered, moderately hard sandstone and moderately weathered, soft siltstone. No subsurface investigations were conducted along this segment of the pipeline.

M. Approximate Stations 22391+90 to 22418+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include: 2 drill holes, 1 test pit and 1 CPT (due to the distance away from the pipeline alignment, drill hole DHR22-33 was omitted from discussion).

1. Test pit TPR22B-14-32 encountered soil from 0 to 3.3 feet and bedrock from 3.3 to 6.0 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 1.2 feet and Silty Sand (SM) from 1.2 to 3.3 feet. Moderately weathered, soft sandstone was encountered from 3.3 to 6.0 feet. Excavation was terminated at refusal within bedrock.
2. CPT hole CPT22B-14-10 was advanced to 25.0 feet.
3. Drill hole DHR22B-14-33B encountered soil from 0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 10.2 feet, Poorly Graded Sand with Silt (SP-SM) from 10.2 to 11.3 feet, and Clayey Sand (SC) from 11.3 to 25.0 feet, SPT data ranged from 4 to 10 BPF, with the exception of the last SPT conducted at bottom of the drill hole, which recorded 51 BPF.

N. Approximate Stations 22418+00 to 22430+00: Bedrock is exposed at and just below the ground surface. Sandstone is mapped on the ground surface from station 22426+00 to 22428+00. Investigations include 1 test pit.

1. Test pit TPR22B-14-34 encountered soil from 0 to 1.3 feet and bedrock from 1.3 to 3.0 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 1.3 feet. Intensely weathered, soft sandstone was encountered from 1.3 to 3.0 feet. Excavation was terminated at refusal within bedrock.

O. Approximate Stations 22430+00 to 22510+80 Qal: Mostly soil is likely to be encountered during trench excavation. Some zones of bedrock may be encountered at varying depths during trench excavation. Bedrock outcrops very close to the alignment near station 22508+00 and is likely to be encountered during pipeline trench excavation. Investigations include: 1 drill holes, 4 test pits and 2 CPT.

1. CPT hole CPTR22B-14-11 was advanced to 30 feet.

2. Test pit TPR22B-14-36 encountered soil from 0 to 16.5 feet. Poorly Graded Sand (SP) was encountered from 0.0 to 6.2 feet, Poorly Graded Sand with Silt (SP-SM) from 6.2 to 14.5 feet, and Poorly Graded Sand (SP) from 14.5 to 16.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test was conducted through a depth interval that included two soil types. Data may provide useful information as the geologic classifications for the two soil types are very similar; refer to the geologic log and laboratory data for more information.

3. Test pit TPR22B-14-38 encountered soil from 0 to 16.0 feet. Clayey Sand (SC) was encountered from 0.0 to 1.4 feet, Poorly Graded Sand with Silt (SP-SM) from 1.4 to 2.4 feet, and Silty Sand (SM) from 2.4 to 6.2 feet. Sandy Lean Clay s(CL) was encountered from 6.2 to 12.8 feet, and Poorly Graded Sand with Silt (SP-SM) from 12.8 to 16.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test was conducted through a depth that included two different soil types. This data should not be used for design or construction purposes.

4. Test pit TPR22B-14-39 encountered soil from 0 to 16.0 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 1.3 feet, Lean Clay (CL) from 1.3 to 9.6 feet, and Silty Sand (SM) from 9.6 to 16.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 83.7 lbs/ft^3 with a moisture content of 14.3 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 105.6 lbs/ft^3 with an optimum water content of 19.8 percent.

5. CPT hole CPTR22B-14-12 reached refusal at 19.7 feet.

6. Test pit TPR22B-14-40 encountered soil from 0 to 16.0 feet. Sand Lean Clay s(CL) was encountered from 0.0 to 1.4 feet and Silty Sand (SM) from 1.4 to 16.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 94.1 lbs/ft^3 with a moisture content of 2.7 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 118.5 lbs/ft^3 with an optimum water content of 10.7 percent.

7. Drill hole DHR22B-14-41 encountered soil from 0 to 18.5 feet and bedrock from 18.5 to 24.5 feet. Poorly Graded Sand (SP) was encountered from 0.0 to 18.2 feet and Clayey Sand (SC) from 18.2 to 18.5 feet. SPT data ranged from 7 to 35 BPF. Decomposed and very intensely weathered, very soft and soft claystone was encountered from 18.5 to 24.5 feet.

P. Approximate Stations 22510+80 to 22525+00: Bedrock is exposed at and just below the ground surface. Sandstone and shale are exposed along the ground surface. Shallow deposits of soil cover bedrock along portions of the pipeline alignment. Investigation includes 1 CPT. Test pit TPR22B-14-42 was excavated about 200 feet to the north of the alignment. The test pit was omitted from discussion because subsurface conditions at the test pit are different from subsurface conditions along the adjacent segment of pipeline alignment.

1. CPT hole CPT22B-14-13 reached refusal at 5.9 feet.

Q. Approximate Station 22525+00 to 22608+47: Mostly soil is likely to be encountered during trench excavation. Some zones of bedrock may be encountered at varying depths during trench excavation. Bedrock was encountered at about 13.7 feet within test pit TPR22B-14-46. Investigations include: 5 test pits and 1 CPT.

1. Test pit TPR22B-14-43 encountered soil from 0 to 15.8 feet. Poorly Graded Sand with Silt (SP-SM) from 0.0 to 6.7 feet, Poorly Graded Sand with Silt and Gravel (SP-SM)g from 6.7 to 9.9 feet, Poorly Graded Sand (SP) from 9.9 to 12.2 feet, and Poorly Graded Sand with Gravel (SP)g from 12.2 to 15.8 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 103.4 lbs/ft^3 with a moisture content of 2.0 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 116.9 lbs/ft^3.

2. Test Pit TPR22B-14-44 encountered soil from 0 to 12.0 feet. Silty Sand (SM) was encountered from 0.0 to 5.2 feet and Poorly Graded Sand with Silt (SP-SM)

from 5.2 to 12.0 feet. Excavation was terminated due to sloughing of the test pit side walls at about 10 feet.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 100.2 lbs/ft^3 with a moisture content of 4.0 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 106.4 lbs/ft^3.

3. Test pit TPR22B-14-46 encountered soil from 0 to 13.7 feet and bedrock from 13.7 to 14.7 feet. Silty Sand (SM) was encountered from 0.0 to 4.0 feet, Poorly Graded Sand (SP) from 4.0 to 8.8 feet, and Silty Sand (SM) from 8.8 to 13.7 feet. Moderately-to-slightly weathered, and very soft to moderately hard sandstone was encountered from 13.7 to 14.7 feet. Excavation was terminated at refusal within bedrock.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 107.0 lbs/ft^3 with a moisture content of 1.1 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 108.4 lbs/ft^3.

4. CPT hole CPT22B-14-14 reached refusal at 18.2 feet.

5. Test pit TPR22B-14-47 encountered Silty Sand (SM) from 0.0 to 15.4 feet. Excavation was terminated at the limit of the equipment.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 102.9 lbs/ft^3 with a moisture content of 1.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 111.9 lbs/ft^3 with an optimum water content of 11.3 percent.

6. Test pit TPR22B-14-48 encountered Silty Sand (SM) from 0.0 to 16.3 feet. Excavation was terminated at the limit of the equipment.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 100.3 lbs/ft^3 with a moisture content of 4.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.7 lbs/ft^3 with an optimum water content of 10.0 percent.

R. Approximate Station 22608+47 to 22610+23: The pipeline will not be constructed between the designated stations. Pumping Plant 2 is located between the approximate stations designated. Refer to the Pumping Plant 2 Foundation Geology section below for detailed geologic information.

S. Approximate Station 22610+23 to 22716+20: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include: 3 drill holes, 8 test pit and 3 CPT.

1. CPT hole CPT22B-14-15 reached refusal at 11.0 feet.

2. Drill hole DHR22B-14-50 encountered soil from 0 to 9.8 feet and bedrock from 9.8 to 24.0 feet. Silty Sand (SM) was encountered from 0.0 to 5.1 feet and Clayey Sand (SC) from 5.1 to 9.8 feet. Two SPTs were conducted with results of 27 and 38 BPF. Decomposed and intensely weathered, soft to moderately hard sandstone was encountered from 9.8 to 14.0 feet. Decomposed and intensely weathered, soft and moderately soft claystone was encountered from 14.0 to 15.4 feet. Decomposed and intensely weathered, soft and moderately soft sandstone was encountered from 15.4 to 24.0 feet.

3. Test pit TPR22B-14-50 encountered soil from 0 to 6.0 feet and bedrock from 6.0 to 6.8 feet. Silty Sand (SM) was encountered from 0.0 to 3.0 feet and Poorly Graded Sand with Silt (SP-SM) from 3.0 to 6.0 feet. Excavation was terminated at refusal within bedrock.

4. Test pit TPR22-14-51 encountered soil from 0 to 14.8 feet. Silty Sand (SM) was encountered from 0.0 to 13.0 feet, and Poorly Graded Sand with Silt (SP-SM) from 13.0 to 14.8 feet.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 98.1 lbs/ft^3 with a moisture content of 2.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 102.9 lbs/ft^3 with an optimum water content of 14.0 percent.

5. Test pit TPR22-52 was conducted about 150 feet west of the pipeline alignment. The test pit encountered Silty Sand (SM) from 0.0 to 14.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 97.8 lbs/ft^3 with a moisture content of 1.8 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 107.8 lbs/ft^3 with an optimum water content of 13.5 percent.

6. Test pit TPR22B-14-52B encountered Silty Sand (SM) from 0.0 to 16.2 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 99.1 lbs/ft^3 with a moisture content of 3.8 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 112.6 lbs/ft^3 with an optimum water content of 12.0 percent.

7. Drill hole DHR22-53 was conducted about 90 feet west of the pipeline alignment. The drill hole encountered soil from 0 to 3.0 feet and bedrock from 3.0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 3.0 feet. Decomposed and

very intensely weathered, soft sandstone was encountered from 3.0 to 13.3 feet. Moderately weathered, moderately soft sandstone was encountered from 13.3 to 25.0 feet.

8. Test Pit TPR22-54 was excavated about 70 feet west of the pipeline alignment. The test pit encountered Silty Sand (SM) from 0.0 to 14.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 99.2 lbs/ft^3 with a moisture content of 2.5 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 110.0 lbs/ft^3 with an optimum water content of 11.4 percent.

9. Test pit TPR22B-14-54B encountered Silty Sand (SM) from 0.0 to 14.9 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 110.1 lbs/ft^3 with a moisture content of 3.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 118.9 lbs/ft^3 with an optimum water content of 11.4 percent.

10. CPT hole CPT22B-14-16 reached refusal at 20.2 feet.

11. Test Pit TPR22-55 encountered soil from 0 to 14.0 feet. Silty Sand (SM) was encountered 0.0 to 7.1 feet, Clayey Sand from 7.1 to 8.3 feet, and Silty Sand (SM) from 8.3 to 14.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 96.4 lbs/ft^3 with a moisture content of 2.8 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 110.9 lbs/ft^3 with an optimum water content of 11.0 percent.

12. Test pit TPR22B-14-56 encountered Silty Sand (SM) from 0.0 to 14.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 97.7 lbs/ft^3 with a moisture content of 2.7 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 103.8 lbs/ft^3 with an optimum water content of 14.4 percent.

13. Drill hole DHR22-57 encountered soil from 0 to 25.3 feet. Silty Sand (SM) was encountered from 0.0 to 17.5 feet, Lean Clay with Sand (CL)s from 17.5 to 18.2 feet, and Poorly Graded Sand with Silt (SP-SM) from 18.2 to 25.3 feet. SPT data ranged from 10 to 40 BPF. An SPT was attempted at 7.8 to 9.3 feet and the SPT

sampler sank through initial 6 inch-depth interval and into the test interval without actuating the hammer.

14. CPT hole CPT22B-14-17 was advanced to 34.9 feet.

T. Approximate Stations 22716+20 to 22717+30: Bedrock is exposed at and just below the ground surface. Sandstone is fine to medium grained, tan in color, moderately weathered and moderately hard. Siltstone is fine grained, grey in color, moderately weathered, soft and moderately bedded. No subsurface investigations were conducted along this segment of the pipeline.

U. Approximate Stations 22717+30 to 22760+00: Mostly soil is likely to be encountered during trench excavation. Some zones of bedrock may be encountered at varying depths during trench excavation. Investigations include: 1 drill holes, 3 test pits and 1 CPT.

1. Test pit TPR22-58 encountered Poorly Graded Sand with Silt (SP-SM) from 0.0 to 14.0 feet. Trace amounts of gravels, cobbles and boulders were encountered. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 102.0 lbs/ft^3 with a moisture content of 5.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 113.5 lbs/ft^3 with an optimum water content of 11.8 percent. Excavation was terminated at the limit of the equipment.

2. Test pit TPR22-59 encountered soil from 0.0 to 13.0 feet. Silty Sand (SM) was encountered from 0.0 to 10.5 feet and Clayey Sand (SC) from 10.5 to 13.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 93.9 lbs/ft^3 with a moisture content of 2.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 104.6 lbs/ft^3 with an optimum water content of 14.3 percent. Excavation was terminated at the limit of the equipment.

3. Test pit TPR22-60 encountered soil from 0 to 13.6 feet. Poorly Graded Sand (SP) was encountered from 0.0 to 3.0 feet and Silty Sand (SM) from 3.0 to 13.6 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 101.6 lbs/ft^3 with a moisture content of 2.4 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.2 lbs/ft^3 with an optimum water content of 11.5 percent.

4. Drill hole DHR22-61 was drilled about 100 feet west of the pipeline alignment. The drill hole encountered soil from 0 to 21.7 feet and bedrock from 21.7 to 25.0

feet. Silty Sand (SM) with varying percentage of sand and fines was encountered from 0.0 to 21.7 feet. SPT data ranged from 8 to 32 BPF. Decomposed, very soft claystone bedrock was encountered from 21.7 to 25.0 feet. Manually broken down decomposed claystone was logged as a soil and classified as a Lean Clay with Sand (CL)s, with medium plasticity.

V. Approximate Stations 22760+00 to 22770+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Bedrock was mapped on the ground surface near Station 22764+50 and will likely be encountered in the pipe trench excavation in that vicinity. Investigations include 1 test pit and 1 CPT.

1. Test pit TPR22B-14-62 encountered Silty Sand (SM) from 0 to 11.6 feet and bedrock from 11.6 to 12.2 feet. Slightly weathered, soft shale was encountered from 11.6 to 12.0 feet. Slightly weathered, hard sandstone was encountered from 12.0 to 12.2 feet. Excavation was terminated at refusal within bedrock.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 98.7 lbs/ft^3 with a moisture content of 3.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 111.5 lbs/ft^3 with an optimum water content of 13.3 percent.

2. CPT hole CPTR22B-14-18 reached refusal at 2.4 feet.

W. Approximate Stations 22770+00 to 22872+00: Mostly soil is likely to be encountered during trench excavation. Some zones of bedrock may be encountered at varying depths during trench excavation. Investigations include: 1 drill holes, 6 test pits and 3 CPT.

1. Test pit TPR22-63 encountered Silty Sand (SM) from 0.0 to 13.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 103.9 lbs/ft^3 with a moisture content of 2.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.1 lbs/ft^3 with an optimum water content of 10.5 percent.

2. Test pit TPR22-64 encountered soil from 0 to 13.8 feet. Silty Sand (SM) was encountered from 0.0 to 4.0 feet, Clayey Sand (SC) from 4.0 to 5.3 feet, and Silty Sand (SM) from 5.3 to 13.8 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 97.0 lbs/ft^3 with a moisture content of 5.9 percent. Compaction test results from material sampled from the in-place density test had a

maximum dry density of 112.4 lbs/ft^3 with an optimum water content of 14.8 percent.

b. An in-place density test conducted at about 5.5 feet had a maximum dry density of 98.4 lbs/ft^3 with a moisture content of 3.1 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 106.4 lbs/ft^3 with an optimum water content of 13.4 percent.

3. Drill hole DHR22-65 encountered soil from 0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 3.5 feet, Poorly Graded Sand with Silt (SP-SM) from 3.5 to 11.9 feet, Sandy Lean Clay s(CL) from 11.9 to 12.6 feet, Silty Sand (SM) from 12.6 to 25.0 feet. SPT data ranged from 3 to 43 BPF.

4. CPT hole CPTR22B-14-19 was advanced to 30.0 feet.

5. Test pit TPR22-66 encountered soil from 0 to 12.8 feet. Clayey Sand (SC) is encountered from 0.0 to 4.0 feet, Silty Sand (SM) from 4.0 to 9.0 feet, and Clayey Sand (SC) from 9.0 to 12.8 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 101.8 lbs/ft^3 with a moisture content of 3.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 110.9 lbs/ft^3 with an optimum water content of 13.0 percent.

6. Test pit TPR22-67 encountered soil from 0 to 13.5 feet. Silty Sand (SM) was encountered from 0.0 to 12.0 feet, Poorly Graded Sand with Silt (SP-SM) from 12.0 to 13.0 feet, and Clayey Sand (SC) from 13.0 to 13.5 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 104.0 lbs/ft^3 with a moisture content of 3.4 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 112.3 lbs/ft^3 with an optimum water content of 11.8 percent.

7. Test pits TPR22-68 encountered soil from 0 to 13.5 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 2.0 feet, Silty Sand (SM) from 2.0 to 9.2 feet, Lean Clay with Sand (CL)s from 9.2 to 9.7 feet, and Clayey Sand (SC) from 9.7 to 13.5 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 101.3 lbs/ft^3 with a moisture content of 3.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 108.3 lbs/ft^3 with an optimum water content of 12.9 percent.

8. CPT hole CPTR22B-14-20 reached refusal at 7.1 feet.

9. Drill hole DHR22-69 was advanced about 100 feet west of the pipeline alignment. The drill hole encountered soil from 0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 12.5 feet, Clayey Sand (SC) from 12.5 to 15.0 feet, and Clayey Sand with Gravel (SC)g from 15.0 to 25.0 feet. SPT data ranged from 19 to 56 BPF.

10. Test pit TPR22-70 encountered soil from 0.0 to 13.3 feet. Silty Sand (SM) was encountered from 0.0 to 13.0 feet, and Clayey Sand (SC) from 13.0 to 13.3 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 96.8 lbs/ft^3 with a moisture content of 2.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 103.4 lbs/ft^3 with an optimum water content of 13.9 percent.

11. CPT hole CPTR22B-14-21 reached refusal at 16.8 feet.

X. Approximate Station 22872+00 to 22924+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include 1 drill holes, 3 test pits and 1 CPT.

1. Test pit TPR22-71 encountered soil from 0 to 4.5 feet and bedrock from 4.5 to 10.3 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 2.8 feet, and Silty Sand (SM) from 2.8 to 4.5 feet. Intensely-to-moderately weathered and moderately weathered, soft to moderately soft sandstone was encountered from 4.5 to 10.3 feet. Excavation was terminated at refusal within bedrock.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 112.1 lbs/ft^3 with a moisture content of 4.1 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 117.8 lbs/ft^3 with an optimum water content of 11.7 percent.

2. Test pit TPR22-72 encountered Clayey Sand (SC) from 0.0 to 2.2 feet and bedrock from 2.2 to 7.0 feet. Decomposed and very intensely weathered, very soft to soft sandstone was encountered from 2.2 to 7.0 feet. Excavation was terminated at refusal within bedrock.

3. CPT hole CPT22B-14-22 reached refusal at 6.6 feet.

4. Test pit TPR22-73 encountered Silty Sand (SM) from 0.0 to 4.3 feet and bedrock from 4.3 to 11.0 feet. Decomposed and intensely weathered, moderately soft and very soft sandstone was encountered from 4.3 to 11.0 feet. Excavation was terminated at refusal within bedrock.

5. Drill hole DHR22-74 encountered Silty Sand (SM) from 0.0 to 10.0 feet and bedrock from 10.0 to 24.0 feet. Two SPTs were conducted with results of 10 and 39 BPF. Decomposed and intensely weathered, very soft and soft sandstone was encountered from 10.0 to 15.0 feet. Decomposed and intensely weathered, very soft and soft claystone was encountered from 15.0 to 24.0 feet.

Y. Approximate Stations 22924+00 to 22988+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Mostly soil is likely to be encountered during excavation in the upper portions of the trench. Bedrock is likely to be encountered during excavation in the lower portions of the trench in a few areas. Investigations include: 1 drill hole, 6 test pits and 2 CPTs.

1. Test pit TPR22B-14-75 encountered soil from 0 to 15.0 feet and bedrock from 15.0 to 17.0 feet. Silty Sand (SM) was encountered from 0.0 to 6.2 feet and Poorly Graded Sand with Silt (SP-SM) from 6.2 to 15.0 feet. Very intensely weathered, very soft sandstone was encountered from 15.0 to 17.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test was conducted through a depth interval that included two soil types. Data may provide useful information as the geologic classifications for the two soil types are similar; refer to the geologic log and laboratory data for more information.

2. CPT hole CPT22B-14-24 reached refusal at 14.3 feet.

3. Test pit TPR22-76 encountered soil from 0 to 13.5 feet. Clayey Sand (SC) was encountered from 0.0 to 2.5 feet, Silty Sand from 2.5 to 6.2 feet, Sandy Lean clay s(CL) from 6.2 to 9.5 feet, and Poorly Graded Sand with Silt (SP-SM) from 9.5 to 13.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 104.8 lbs/ft^3 with a moisture content of 3.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 116.6 lbs/ft^3 with an optimum water content of 11.5 percent.

4. Test pit TPR22-77 encountered soil from 0 to 10.0 feet and bedrock from 10.0 to 13.5 feet. Silty Sand (SM) is encountered from 0.0 to 3.3 feet, and Lean Clay with Sand (CL)s from 3.3 to 10.0 feet . Decomposed, very soft sandstone was encountered from 10.0 to 13.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 93.3 lbs/ft^3 with a moisture content of 5.5 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.7 lbs/ft^3 with an optimum water content of 13.4 percent.

5. Drill hole DHR22-78 encountered soil from 0.0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 9.8 feet, Lean Clay with Sand (CL)s from 9.8 to 10.5 feet, Clayey Sand (SC) from 10.5 to 11.0 feet, and Silty Sand (SM) from 11.0 to 25.0 feet. SPT data ranged from 41 to 53 BPF with refusal encountered at the SPT interval 12.5 to 14.0 feet.

6. Test pit TPR22-79 was excavated about 220 feet to the northwest of the pipeline alignment. The test pit encountered Clayey Sand (SC) from 0.0 to 13.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 97.7 lbs/ft^3 with a moisture content of 5.1 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.3 lbs/ft^3 with an optimum water content of 12.7 percent.

7. Test pit TPR22B-14-79B encountered soil from 0 to 16.3 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 11.2 feet, and Silty Sand (SM) from 11.2 to 16.3 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 94.7 lbs/ft^3 with a moisture content of 5.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 112.5 lbs/ft^3 with an optimum water content of 13.8 percent.

8. Test pit TPR22-80 was excavated about 170 feet to the northwest of the pipeline alignment. Test pit TPR22-80 encountered soil from 0 to 13.5 feet. Clayey Sand (SC) was encountered from 0.0 to 6.0 feet, and Silty Sand (SM) from 6.0 to 13.5 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 92.7 lbs/ft^3 with a moisture content of 5.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 112.0 lbs/ft^3 with an optimum water content of 14.5 percent.

9. CPT hole CPT22B-14-25 reached refusal at 21.8 feet.

Z. Approximate Stations 22988+00 to 23025+00: Soil with bedrock occurring at varying depths will likely be encountered during trench excavation through this segment. Investigations include 3 test pits.

1. Test pit TPR22B-14-114 encountered soil from 0 to 9.8 feet and bedrock from 9.8 to 12.9 feet. Silty Sand (SM) was encountered from 0.0 to 2.0 feet, and Clayey Sand (SC) from 2.0 to 9.8 feet. Decomposed and very intensely weathered, very soft sandstone was encountered from 9.8 to 12.9 feet. Excavation was terminated at refusal within bedrock.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 89.5 lbs/ft^3 with a moisture content of 6.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 113.0 lbs/ft^3 with an optimum water content of 13.8 percent.

2. Test pit TPR22B-14-115 encountered Silty Sand (SM) from 0.0 to 9.6 feet, and bedrock from 9.6 to 10.0 feet. Decomposed and very intensely weathered, very soft sandstone was encountered from 9.6 to 12.9 feet. Excavation was terminated at refusal within bedrock.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 97.7 lbs/ft^3 with a moisture content of 5.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.4 lbs/ft^3 with an optimum water content of 13.0 percent.

3. Test pit TPR22B-14-116 encountered Silty Clayey Sand (SM/SC) from 0.0 to 14.2 feet, and bedrock from 14.2 to 14.9 feet. Decomposed and very intensely weathered, very soft sandstone was encountered from 9.8 to 12.9 feet. Excavation was terminated at refusal within bedrock.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 94.8 lbs/ft^3 with a moisture content of 5.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 111.9 lbs/ft^3 with an optimum water content of 14.5 percent.

AA. Approximately Stations 23025+00 to 23251+10 (Terminal End): Mostly soil is likely to be encountered during trench excavation. Some zones of bedrock may be encountered at varying depths during trench excavation. For a detailed description of station to station pipeline geology near stations 23092+42 to 23093+38, refer to the foundation geology description for Regulating Tank 2. Additional detailed site geology data for the terminal end of this pipeline are included in the previously referenced report “Reach 21 Supplemental Geologic Design Data Report”. Investigations include multiple drill holes, test pits and CPTs.

1. Test pit TR22B-14-118 encountered Silty Sand (SM) from 0.0 to 14.8 feet. Excavation was terminated at the limit of the equipment.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 99.0 lbs/ft^3 with a moisture content of 5.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 107.7 lbs/ft^3 with an optimum water content of 15.0 percent.

2. Test pits TPR22B-14-119 encountered soil from 0 to 13.8 feet. Sandy Lean Clay was encountered from 0.0 to 6.5 feet, and Clayey Sand (SC) from 6.5 to 13.8 feet. Clayey Sand (SC) from 10.2 to 13.8 feet included calcium carbonate deposits (referred to stringers within the geologic logs), which made the material difficult to excavate. Excavation was terminated at refusal on stiff clay.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 89.5 lbs/ft^3 with a moisture content of 6.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.8 lbs/ft^3 with an optimum water content of 13.6 percent.

3. Test pit TPR22B-14-120 encountered soil from 0 to 15.7 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 12.2 feet, and Clayey Sand (SC) from 12.2 to 15.7 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 94.4 lbs/ft^3 with a moisture content of 4.1 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 117.6 lbs/ft^3 with an optimum water content of 11.5 percent.

4. Drill hole DHR22B-14-121 encountered soil from 0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 10.1 feet, Clayey Sand (SC) from 10.1 to 20.1 feet, and Silty Sand (SM) from 20.1 to 25.0 feet. SPT data ranged from 4 to 44 BPF.

5. Two drill holes (DHRT2-1, -2) and 2 test pits (TPRT2-14-1 and -2) were conducted near station 23089+00 at an old, previously proposed location for water regulation tanks.

    a. Drill hole DHRT2-1 encountered soil from 0.0 to 49.2 feet and bedrock from 49.2 to 60.0 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 9.0 feet, Clayey Sand (SC) from 9.0 to 11.9 feet, Poorly Graded Sand with Silt (SP-SM) from 11.9 to 14.8 feet, and Clayey Sand (SC) from 14.8 to 20.7 feet. Alternating layers of fine grained and coarse grained soils are encountered below 20.7 to 49.2 feet; refer to the geologic log for detailed information. SPT data ranged from 13 to 48 BPF. Intensely-to-moderately weathered, soft sandstone was encountered from 49.2 to 60.0 feet.

    b. Drill hole DHRT2-2 encountered soil from 0 to 46.2 feet and bedrock from 46.2 to 50.0 feet. Silty Sand (SM) was encountered from 0.0 to 8.2 feet, Clayey Sand (SC) from 8.2 to 10.7 feet, and Poorly Graded Sand with Silt (SP-SM) from 10.7 to 11.3 feet. Poorly Graded Sand (SP) was encountered from 11.3 to 14.1 feet and Clayey Sand (SC) from 14.1 to 23.2 feet. Alternating layers of fine grained and coarse grained soils are encountered below 23.2 to 46.2 feet; refer to the geologic log for detailed

information. SPT data ranged from 9 to 40 BPF, with SPT refusal encountered at the depth interval 33.5 to 35.0 feet. Intensely weathered, very soft and soft sandstone was encountered from 46.2 to 50.0 feet.

c. Test Pit TPRT2-1 encountered soil from 0 to 15.7 feet. Clayey Sand (SC) was encountered from 0.0 to 2.3 feet, Silty Sand (SM) from 2.3 to 8.8 feet, Sandy Lean Clay s(CL) from 8.8 to 10.2 feet, and Silty Sand (SM) from 10.2 to 15.7 feet. Excavation was terminated at the limit of the equipment.

1) An in-place density test conducted at about 6.0 feet had a maximum dry density of 95.4 lbs/ft^3 with a moisture content of 3.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 106.0 lbs/ft^3 with an optimum water content of 11.4 percent.

d. Test Pit TPRT2-2 encountered soil from 0 to 14.8 feet. Sandy Lean Clay s(CL) was encountered from 0.0 to 3.4 feet and Silty Sand (SM) from 3.4 to 14.8 feet. Excavation was terminated at the limit of the equipment.

1) An in-place density test conducted at about 6.0 feet had a maximum dry density of 100.6 lbs/ft^3 with a moisture content of 2.9 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 104.7 lbs/ft^3.

6. For detailed information between stations 23092+42 to 23093+38, refer to the Regulating Tank 2 Foundation Geology discussion.

7. Test pit TPR22B-14-123 encountered soil from 0 to 13.6 feet. Lean Clay (CL) was encountered from 0.0 to 4.2 feet, Poorly Graded Sand with Silt from 4.2 to 13.6 feet. Soil is cemented below 12.0 feet. Excavation was terminated at refusal on cemented soil.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 97.3 lbs/ft^3 with a moisture content of 3.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 116.2 lbs/ft^3 with an optimum water content of 11.5 percent.

8. Test pit TPR22B-14-124 encountered soil from 0 to 11.7 feet. Clayey Sand (SC) was encountered from 0.0 to 7.2 feet and Silty Sand (SM) from 7.2 to 11.7 feet. Excavation was terminated at the limit of the equipment.

a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 96.8 lbs/ft^3 with a moisture content of 5.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 118.5 lbs/ft^3 with an optimum water content of 11.6 percent.

9. Drill hole DHR22B-14-125 encountered soil from 0 to 25.0 feet. Silty Sand (SM) was encountered from 0.0 to 6.6 feet, Clayey Sand (SC) from 6.6 to 14.2 feet, and Lean Clay with Sand (CL)s from 14.2 to 23.2 feet. Sandy Lean Clay s(CL) was encountered from 23.2 to 24.1 feet and Fat Clay (CH) from 24.1 to 25.0 feet. SPT data ranged from 7 to 42 BPF.

10. Test pit TPR22B-14-126 encountered soil from 0 to 14.6 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 5.5 feet, and Poorly Graded Sand with Silt and Gravel (SP-SM)g from 5.5 to 14.6 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 104.2 lbs/ft^3 with a moisture content of 2.7 percent. Vibratory hammer compaction test results from material sampled from the in-place density test had a maximum dry density of 113.1 lbs/ft^3.

11. Test pits TPR22B-14-127 encountered soil from 0 to 14.0 feet. Silty Sand (SM) was encountered from 0.0 to 3.1 feet, and Poorly Graded Sand with Silt (SP-SM) from 3.1 to 14.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 108.3 lbs/ft^3 with a moisture content of 3.4 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 119.2 lbs/ft^3 with an optimum water content of 11.7 percent.

12. Additional information is available for the terminal end of the Reach 22B pipeline in the referenced report for the Water Treatment Plant associated with Reach 21. Drill hole DHR21-14-G is the most near investigation to the terminal end of the pipeline.

    a. Drill hole DHR21-14-G encountered soil from 0 to 28.3 feet and bedrock from 28.3 to 53.5 feet. Silty Sand (SM) was encountered from 0.0 to 1.1 feet, Clayey Sand (SC) from 1.1 to 1.5 feet, Lean Clay with Sand (CL)s from 1.5 to 9.2 feet, and Poorly Graded Sand with Silt (SP-SM) from 9.2 to 28.3 feet. SPT data above 25 feet ranged from 18 to 42 BPF.

3.05 PUMPING PLANT 1 FOUNDATION GEOLOGY

A. Geological conditions at the Pumping Plant 1 consist of approximately 22.8 to 30.1 feet of soil above bedrock. Foundation investigations include: 3 drill holes and 3 test pits. Investigations are shown on drawing 1695-529-935 and sections are shown on drawing 1695-528-943.

1. Drill hole DHR22FBT-14-1 encountered soil from 0 to 28.2 feet and bedrock from 28.2 to 50.2 feet. The drill hole encountered Silty Sand (SM) from 0.0 to 17.2 feet and Sandy Lean Clay s(CL) from 17.2 to 28.2 feet. SPT data ranged

from 4 to 8 BPF. Moderately-to-intensely weathered, moderately hard sandstone was encountered from 28.2 to 50.2 feet.

2. Drill hole DHR22AC1-15-1 encountered soil from 0 to 30.1 feet and bedrock from 30.1 to 37.8 feet. The drill hole encountered Silty Sand (SM) from 0.0 to 8.9 feet, Poorly Graded Sand with Silt (SP-SM) from 8.9 to 14.2 feet, and Silty Sand (SM) from 14.2 to 14.4 feet. Lean Clay with Sand (CL)s was encountered from 14.4 to 18.9 feet, and Poorly Graded Sand with Gravel from 18.9 to 30.1 feet. SPT data ranged from 7 to 18 BPF, with SPT refusal encountered at the depth interval 23.5 to 25.0 feet. Decomposed sandstone was encountered from 30.1 to 31.8 feet; and moderately weathered and moderately hard sandstone from 31.8 to 37.8 feet. A thin coal interbred was encountered between 36.1 and 36.6 feet.

3. Drill hole DHR22PP1-15-1 encountered soil from 0 to 22.8 feet and bedrock from 22.8 to 29.8 feet. The drill hole encountered Silty Sand (SM) from 0.0 to 16.1 feet, and Sandy Lean Clay s(CL) from 16.1 to 22.8 feet. SPT data ranged from 8 to 12 BPF. Intensely-to-moderately weathered, soft sandstone was encountered from 22.8 to 29.8 feet.

4. TPR22FBT-14-1 encountered Silty Sand (SM) from 0 to 16.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 94.0 lbs/ft^3 with a moisture content of 2.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 111.7 lbs/ft^3 with an optimum water content of 13.6 percent.

    b. An in-place density test conducted at about 8.0 feet had a maximum dry density of 100.2 lbs/ft^3 with a moisture content of 2.8 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.7 lbs/ft^3 with an optimum water content of 10.9 percent.

5. TPR22FBT-14-2 encountered Silty Sand (SM) from 0 to 18.0 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 98.4 lbs/ft^3 with a moisture content of 1.6 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 111.6 lbs/ft^3 with an optimum water content of 12.7 percent.

    b. An in-place density test conducted at about 8.0 feet had a maximum dry density of 95.1 lbs/ft^3 with a moisture content of 2.8 percent. Compaction test results from material sampled from the in-place density test had a

maximum dry density of 112.5 lbs/ft^3 with an optimum water content of 11.5 percent.

6. TPR22FBT-14-3 encountered Silty Sand (SM) from 0 to 14.0 feet. Excavation was terminated at the limit of the equipment.

   a. An in-place density test conducted at about 4.0 feet had a maximum dry density of 93.0 lbs/ft^3 with a moisture content of 2.9 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.7 lbs/ft^3 with an optimum water content of 10.9 percent.

   b. An in-place density test conducted at about 8.0 feet had a maximum dry density of 92.2 lbs/ft^3 with a moisture content of 2.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 106.5 lbs/ft^3 with an optimum water content of 5.2 percent.

3.06 PUMPING PLANT 2 FOUNDATION GEOLOGY

A. Geological conditions at the Pumping Plant 2 site consist of approximately 13.1 to 31.1 feet of soil above bedrock. Foundation investigations included 5 drill holes and 2 test pits. Investigations are shown on drawing 1695-529-936 and sections are shown on drawing 1695-528-944.

1. Drill hole DHR22AC2-15-1 encountered Silty Sand (SM) from 0.0 to 13.1 feet and bedrock from 13.1 to 39.5 feet. SPT data ranged from 23 to 34 BPF. Very intensely and intensely weathered, soft sandstone was encountered from 13.1 to 38.5 feet. Intensely weathered, soft siltstone was encountered from 38.5 to 39.5 feet.

2. Drill hole DHR22PP2-14-1 encountered soil from 0 to 13.7 feet and bedrock from 13.7 to 42.5 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 8.0 feet, Clayey Sand (SC) from 8.0 to 13.2 feet, and Silty Sand (SM) from 13.2 to 13.7 feet. SPT data ranged from 12 to 50 BPF. Intensely-to-moderately weathered, moderately hard sandstone was encountered from 13.7 to 34.5 feet. Very intensely weathered, soft claystone was encountered from 34.5 to 41.4 feet. Moderately-to-intensely weathered, moderately soft sandstone was encountered from 41.4 feet to 42.5 feet.

3. Drill hole DHR22PP2-15-2 encountered Silty Sand (SM) from 0.0 to 31.1 feet and bedrock from 31.1 to 41.0 feet. SPT data ranged from 23 to 48 BPF. Intensely weathered and very intensely weathered, soft sandstone was encountered from 31.1 to 41.0 feet.

4. Drill hole DHR22RT1A-15-1 encountered soil from 0 to 19.3 feet and bedrock from 19.3 to 26.7 feet. Silty Sand (SM) was encountered from 0.0 to 8.5 feet,

Clayey Sand (SC) from 8.5 to 11.2 feet, and Silty Sand (SM) from 11.2 to 19.3 feet. SPT data ranged from 9 to 40 BPF with SPT refusal encountered near the bedrock contact at SPT interval 18.0 to 19.5 feet. Very intensely weathered and decomposed sandstone was encountered from 19.3 to 26.7 feet.

5. Drill hole DHR22RT1B-15-1 encountered soil from 0 to 22.3 feet and bedrock from 22.3 to 45.0 feet. Silty Sand (SM) was encountered from 0 to 15.6 feet and Poorly Graded Sand with Silt (SP-SM) from 15.6 to 22.3 feet. SPT data ranged from 10 to 43 BPF. Intensely weathered, very soft and soft sandstone was encountered from 22.3 to 45.0 feet. A very intensely weathered, very soft siltstone interbred was encountered from 36.1 to 38.3 feet.

6. Test Pit TPR22PP2-14-1 encountered soil from 0 to 16.1 feet. Silty Sand (SM) was encountered from 0 to 5.2 feet, Poorly Graded Sand (SP) from 5.2 to 6.0 feet, and Silty Sand (SM) from 6.0 to 16.1 feet. Excavation was terminated at the limit of the equipment.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 102.4 lbs/ft^3 with a moisture content of 3.0 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 115.8 lbs/ft^3 with an optimum water content of 12.0 percent.

7. Test pit TPR22PP2-14-2 encountered soil from 0 to 15.8 feet. Poorly Graded Sand with Silt (SP-SM) was encountered from 0.0 to 5.0 feet, Poorly Graded Sand (SP) from 5.0 to 5.9 feet, and Silty Sand (SM) from 5.9 to 15.6 feet. Moderately weathered, soft sandstone was encountered from 15.6 to 15.8 feet. Excavation was terminated at equipment refusal within bedrock.

    a. An in-place density test conducted at about 6.0 feet had a maximum dry density of 106.6 lbs/ft^3 with a moisture content of 5.1 percent. Compaction laboratory test results from the same depth had a maximum dry density of 114.9 lbs/ft^3 with an optimum water content of 13.2 percent. Compaction test results from material sampled from the in-place density test had a maximum dry density of 114.9 lbs/ft^3 with an optimum water content of 13.2 percent.

3.07 REGULATING TANK 2 FOUNDATION GEOLOGY

A. Geological conditions at the Regulating Tank No. 2 site consist of approximately 44.5 feet of soil above bedrock. Foundation investigations included 3 drill holes. Investigations are shown on drawing 1695-529-937 and sections are shown on drawing 1695-528-945.

1. Drill Hole DHR22RT2-15-2 encountered soil from 0 to 41.0 feet. Clayey Sand (SC) was encountered from 0.0 to 6.3 feet, Poorly Graded Sand with Silt (SP-SM) from 6.3 to 17.2 feet. Sandy Lean Clay s(CL) was encountered from 17.2 to 18.5

feet, and Poorly Graded Sand with Silt (SP-SM) from 18.5 to 23.1 feet. Mostly coarse grained soils were encountered below 23.1 to 41.0 feet; refer to the geologic log for detailed information. SPT data ranged from 16 to 55 BPF.

2. DHR22RT2-15-3 encountered soil from 0 to 44.5 feet and bedrock from 44.5 to 60.0 feet. Poorly Graded Sand (SP) was encountered from 0.0 to 9.0 feet, Poorly Graded Sand with Silt (SP-SM) from 9.0 to 17.0 feet, and Sandy Lean Clay s(CL) from 17.0 to 29.4 feet. Alternating layers of fine grained and coarse grained soils are encountered below 29.4 to 44.5 feet; refer to the geologic log for detailed information. SPT data ranged from 13 to 57 BPF. Decomposed and very intensely weathered, very soft sandstone was encountered from 44.5 to 45.0 feet. Intensely weathered, soft claystone was encountered from 45.0 to 59.6 feet. Decomposed and very intensely weathered, very soft sandstone was encountered from 59.4 to 60.0 feet.

3. Drill Hole DHR22RT2-15-4 encountered soil from 0 to 40.8 feet. Poorly Graded Sand (SP) was encountered from 0.0 to 8.0 feet, and Silty Sand (SM) from 8.0 to 25.3 feet. Alternating layers of fine grained and coarse grained soils are encountered below 25.3 to 40.8 feet; refer to the geologic log for detailed information. SPT data ranged from 16 to 55 BPF.

3.08 GROUNDWATER OCCURRENCE

A. The water-level data show the conditions at the particular time or times the information was obtained and may not indicate variations such as those caused by periods of drought, increased rainfall, seasonal fluctuations in precipitation, or application of irrigation water.

B. Sand washes and tributary intermittent streams that intersect the pipeline alignment may have intermittent surface water flow particularly after rain fall. Surface flow would have an adverse effect on excavation and construction of the pipeline and structures in close proximity. Surface flow is likely to increase groundwater elevation in the surrounding areas and would likely increase groundwater elevations in areas that are dry (relative to pipeline and structure foundations) when the streams do not have flowing surface water.

C. Groundwater levels were not encountered during any of the subsurface investigation for the Reach 22B pipeline and associated structures. Groundwater levels in 5 drill holes conducted near the terminal end of the Reach 22B pipeline (at the Reach 21 Water Treatment Plant site) measured water depths ranging from 38.1 to 43.5 feet.

PART 4 ENGINEERING GEOLOGY CONSIDERATIONS

4.01 ENGINEERING GEOLOGY

A. Temporary and Permanent Cut Slopes and Slope Stability: All cut slopes shall be constructed in accordance with the Reclamation Safety and Health Standards and OSHA standards. Recommendations are for dry or adequately drained materials. These recommendations are for all slopes with a vertical height less than 20 feet. Slopes with a vertical height of 20 feet or greater should be designed by a registered professional engineer in accordance with the Reclamation Safety and Health Standards and OSHA standards. Materials with excessive moisture will require further flattening for stability or other slope stability measures.

1. Temporary and permanent slopes excavated in fill, soil and bedrock shall conform to OSHA slope requirements.

2. Other specification sections detail slope requirements and shall be used for construction of the pipeline and structures.

B. Excavation Considerations:

1. Soil and fill can be excavated using common excavation methods.

2. Decomposed to intensely weathered sandstone, and decomposed to moderately weathered claystone and siltstone can be excavated using common methods. Less weathered sandstone, claystone and siltstone layers may require rock excavation methods.

3. Local, hard, moderately or less weathered zones and cemented zones may be encountered within decomposed and weathered bedrock. These zones are likely to require rock excavation. Excavation of these zones may generate large blocks that may have to be reduced to a manageable size by hydraulic hoe-ram, mechanical splitting, or other non-explosive methods.

4. Excavation of bedrock in confined areas with limited access for ripping with a bull dozer and single ripper shank may require rock excavation methods (such as excavation with a hydraulic hoe ram).

C. Constructability Considerations:

1. Access roads may become muddy and excessively slick with rain, surface run-off, or water applied for construction.

END OF SECTION