CORRECTIVE ACTION PLAN

May 2024

Clinton, AR - WWTP
NPDES Permit AR0048836 – ND Permit 5130-WR-2

PREPARED FOR:

CITY OF CLINTON, ARKANSAS

PREPARED BY:

SALT Engineers & Planners, Inc.
407 W. Arch Ave.
Searcy, AR 72143

SALT Project # 08-24-17

CERTIFICATE OF AUTHORIZATION
SALT ENGINEERS & PLANNERS, INC.
No. 4011
ARKANSAS

STATE OF ARKANSAS
LICENSED PROFESSIONAL ENGINEER
C. Kyle Breckenridge
No. 13831
C. KYLE BRECKENRIDGE

5/31/24

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INTRODUCTION

The Arkansas Division of Environmental Quality – Office of Water Quality (OWQ) conducted a review of the Clinton, AR East WWTP (NPDES Permit AR0048836 and Land Application Permit (5130-WR2) and found multiple compliance issues. The violations are summarized below:

- NPDES Permit Violations (2/21/23 – 1/17/24)
  - 20 - Total Recoverable Cadmium Permit Violations
  - 1 - Dissolved Oxygen Permit Violations
  - 2 - E. Coli Permit Violations
  - 2 - Fecal Coliform Permit Violations
- Land Application Permit Violations
  - No Permit Violations Reported

CAUSES OF VIOLATIONS

Total Recoverable Cadmium

The City of Clinton has conducted a large amount of sampling to prove that this parameter was placed on the permit due to invalid sampling techniques by the lab that conducted the Priority Pollutant Scan (PPS) and Form 2A Renewal Sampling. The same lab was responsible for the subsequent NPDES permit sampling, resulting in the reported violations. Since changing labs and requiring clean sampling techniques, no violations of this parameter have been reported. The City of Clinton has requested that this parameter be removed from their recent renewal permit with corroborating permit renewal sampling data confirming. The continued monitoring of the pollutant, apart from the permit renewal PPS, would seem to be requiring an unnecessary permit sampling expense due to the clean sampling techniques that must be followed for accurate sampling of this pollutant to the permitted concentration of 2.01 µg/L.

Dissolved Oxygen

This violation was a single occurrence and an error with the lab instrument is suspected. Typically, DO is not a problem parameter for this facility and this violation occurred without any corroborating violations, such as TSS, or BOD violations. Due to this, a corrective action does not appear to be warranted for this single violation.

E. Coli

These violations were due to inadequate cleaning of the UV sleeves. The staff at the WWTP understands the importance of maintaining clean sleeves to ensure adequate UV transmittance. The corrective action is to ensure that staff strictly follow the schedule cleaning cycles.

Fecal Coliform

These violations were due to inadequate cleaning of the UV sleeves. The staff at the WWTP understands the importance of maintaining clean sleeves to ensure adequate UV transmittance. The corrective action is to ensure that staff strictly follow the schedule cleaning cycles.

PROPOSED CORRECTIVE ACTIONS

Action 1: Clean Sampling Techniques

Proper sampling techniques will continue to be used to ensure that contamination of the heavy metals samples (Cd and Hg) is not occurring during collection.

Action 2: Correcting Sampling Location for Outfall 001

The prior testing lab's technicians have been seen testing DO from the top of the cascade aerator structure. WWTP staff will ensure that the new lab understands the importance of testing the DO at the proper location (the bottom of the cascade aerator structure).

Action 3: Installation of Area-Velocity Influent Flow Meter

An area-velocity flow meter will be installed near the bar screen structure to provide influent flow metering capabilities. The installation will be accomplished simultaneously with the addition of a mechanically cleaned bar screen, which is anticipated to occur in Spring/Summer of 2025, but may extend later due to equipment lead times. The Plans for these improvements are attached in Appendix A. The technical specifications for these improvements are attached in Appendix B.

Action 4: Collection System Rehabilitation to Reduce I/I

System wide manhole inspections have been completed and rehabilitation plans are currently being developed. The rehabilitation project will also include clay pipe replacement via pipe bursting, as budget allows.

PROPOSED CORRECTIVE ACTION SCHEDULE

The corrective actions will be completed as shown.

Corrective Action	Completion Date
Clean Sampling Techniques for Cadmium	Completed
Correcting Sampling Location – Outfall 001	Completed
Installation of Influent Flow Meter	December 31, 2025
Collection System Rehabilitation including MH Repair/Replacement and Clay Pipe Bursting Replacement	December 31, 2025

APPENDIX A
Plans

CITY OF CLINTON, AR
CLINTON WATER DEPARTMENT

WWTP IMPROVEMENTS

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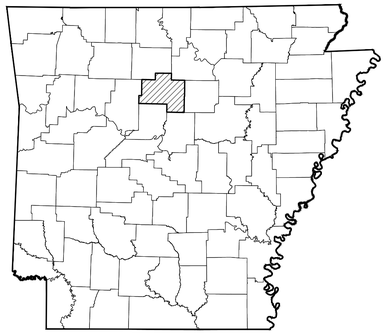
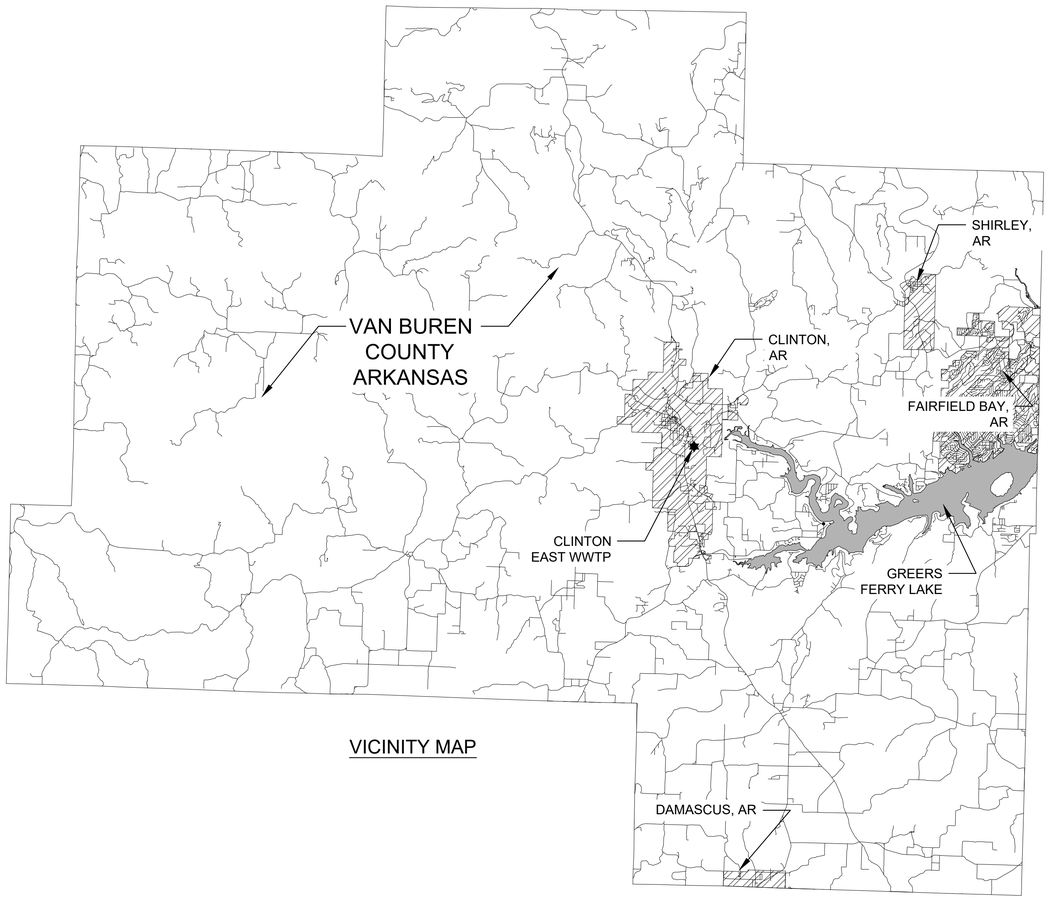


VAN BUREN COUNTY, AR



VICINITY MAP

SITE MAP

Arkansas One Call 811 Know what's below. Call before you dig.

SALT Engineers & Planners
saltengineers.com | 501-766-9832
kbreckenridge@saltengineers.com

THIS LINE MEASURES 1" WHEN PLOTTED FULL-SIZE

DATE: MAY 2024

CERTIFICATE OF AUTHORIZATION SALT ENGINEERS & PLANNERS, INC. No. 4011 ARKANSAS

STATE OF ARKANSAS KYLE BRECKENRIDGE LICENSED PROFESSIONAL ENGINEER No. 13831 5/23/24

CITY OF CLINTON
CLINTON WATER DEPT.

WWTP IMPROVEMENTS

COVER

PROJECT # 08-24-01

SHEET 1

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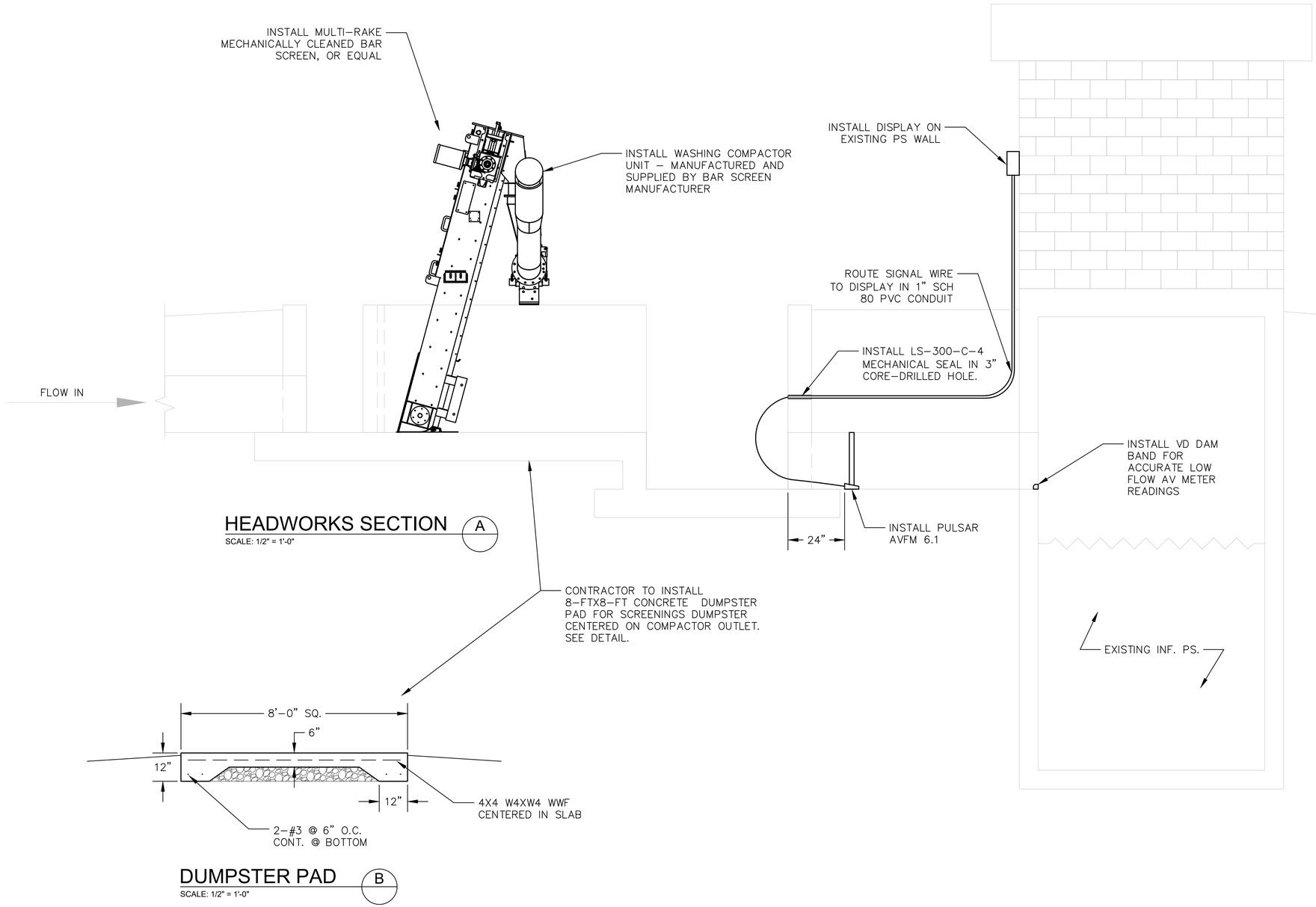
CLINTON WATER DEPT.

WWTP IMPROVEMENTS

SITE PLAN

PROJECT # 08-24-01

SHEET 2



HEADWORKS SECTION A

SCALE: 1/2" = 1'-0"

DUMPSTER PAD B

SCALE: 1/2" = 1'-0"

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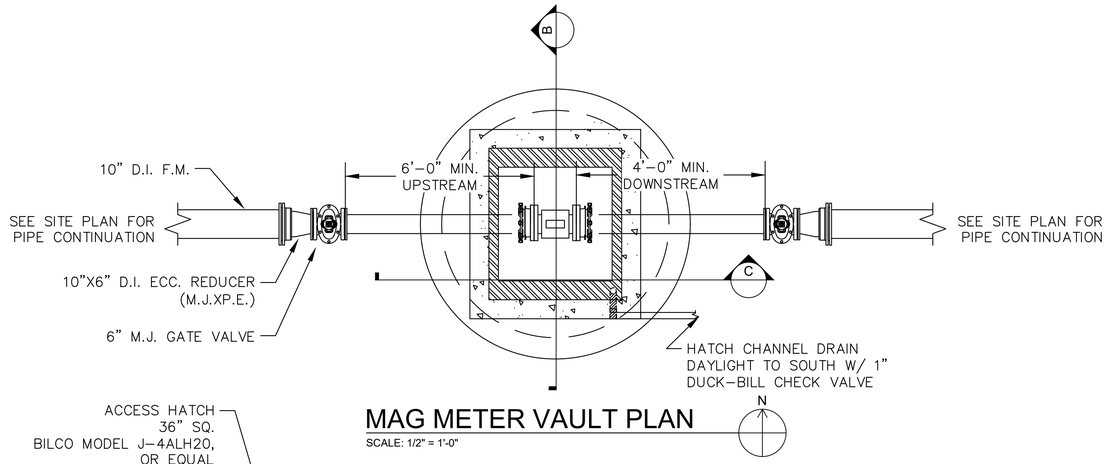
WWTP IMPROVEMENTS

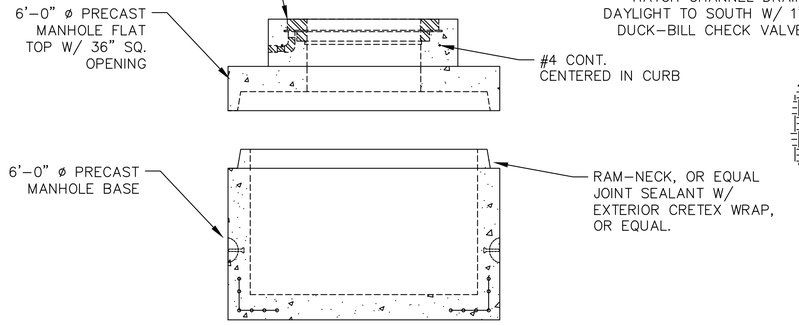
HEADWORKS IMPROVEMENTS

PROJECT #	SHEET
08-24-01	3



MAG METER VAULT PLAN

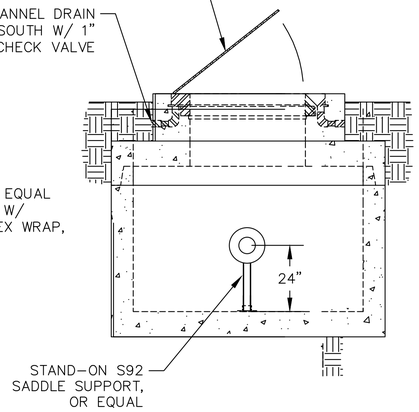
SCALE: 1/2" = 1'-0"



VAULT MH DETAILS

N.T.S.

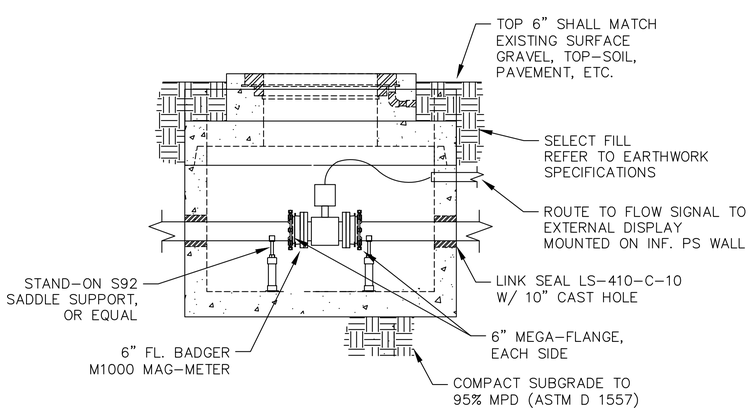
A



MAG-METER VAULT SECTION

SCALE: 1/2" = 1'-0"

B



MAG-METER VAULT SECTION

SCALE: 1/2" = 1'-0"

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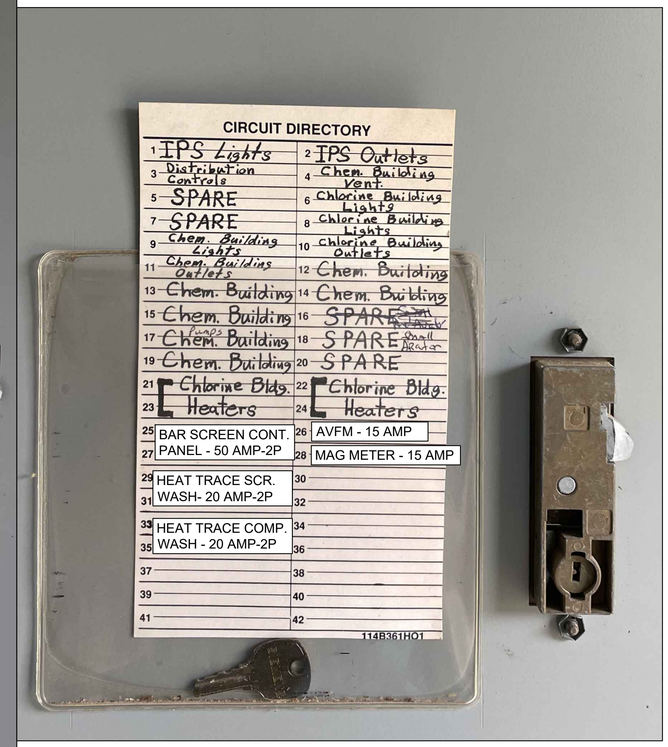
MAG-METER DETAILS

PROJECT # 08-24-01

SHEET 4



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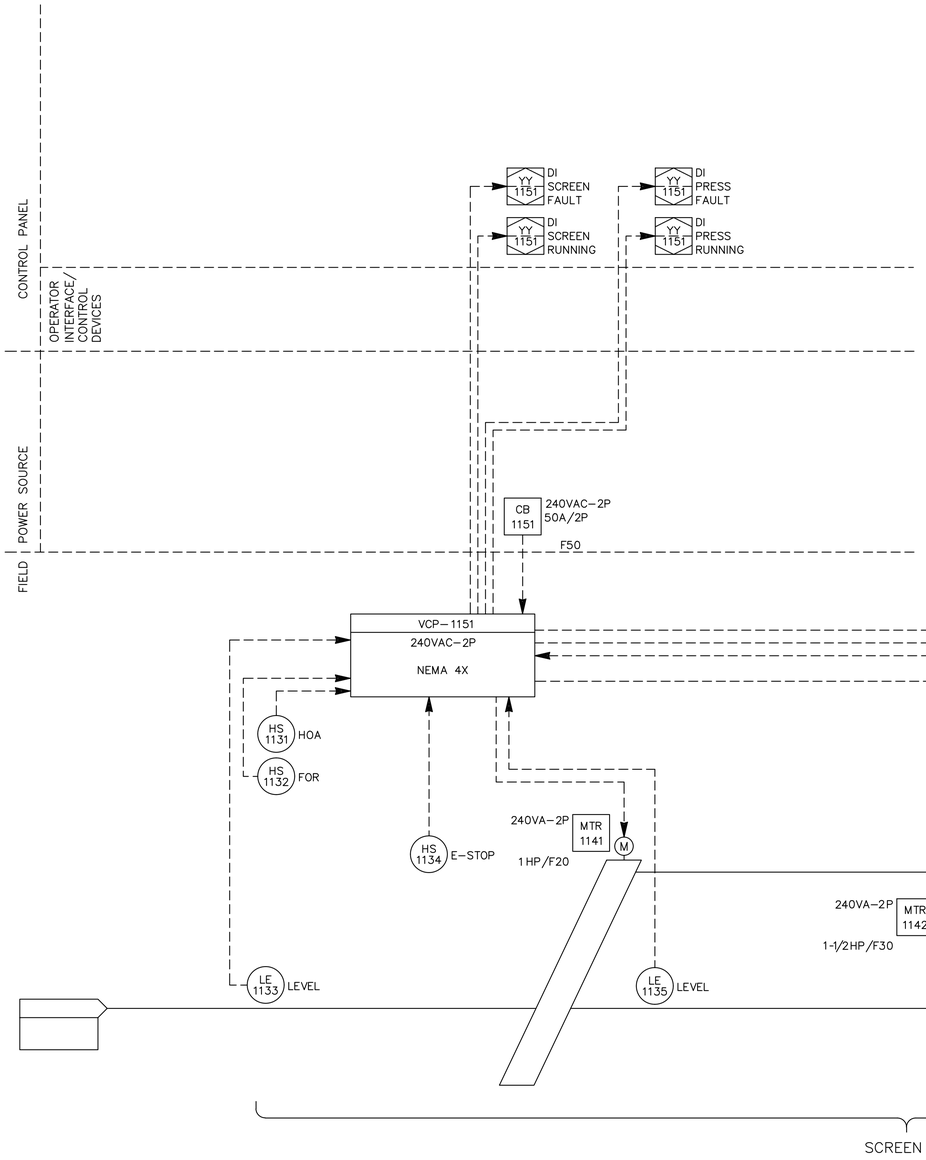
CITY OF CLINTON
CLINTON WATER DEPT.

WWTP IMPROVEMENTS

ELECTRICAL PLAN

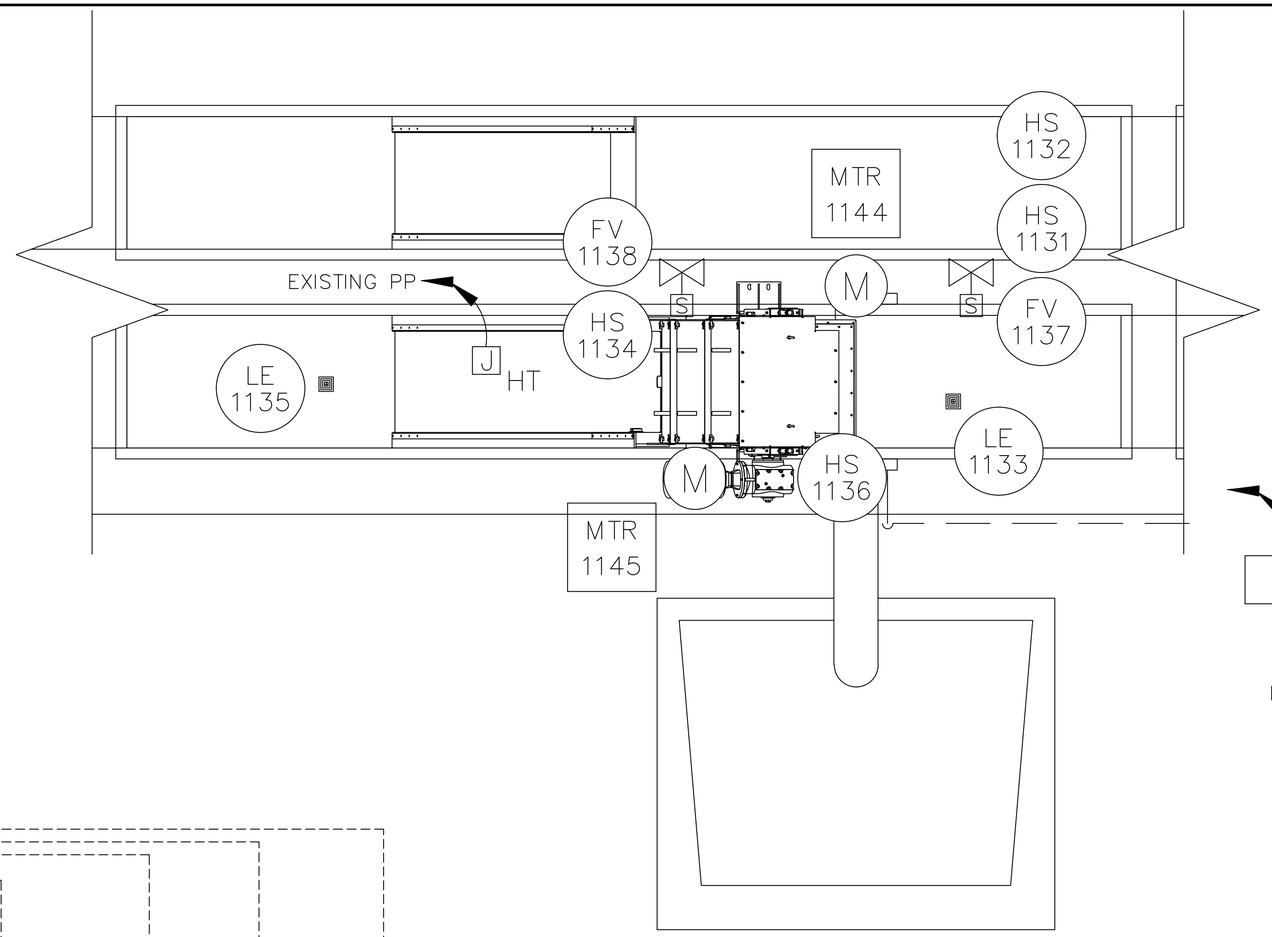
PROJECT # 08-24-01

SHEET 5



BAR SCREEN CONTROL SCHEMATIC

N.T.S.



BAR SCREEN ELECTRICAL PLAN

N.T.S.

N

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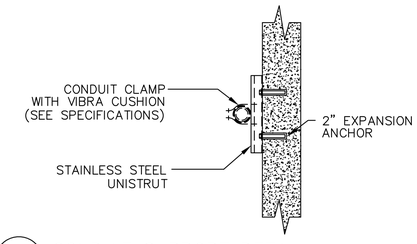
CITY OF CLINTON
CLINTON WATER DEPT.

WWTP IMPROVEMENTS

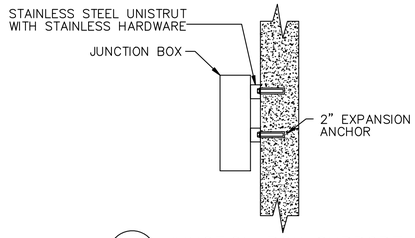
BAR SCREEN CONTROL PLAN

PROJECT # 08-24-01

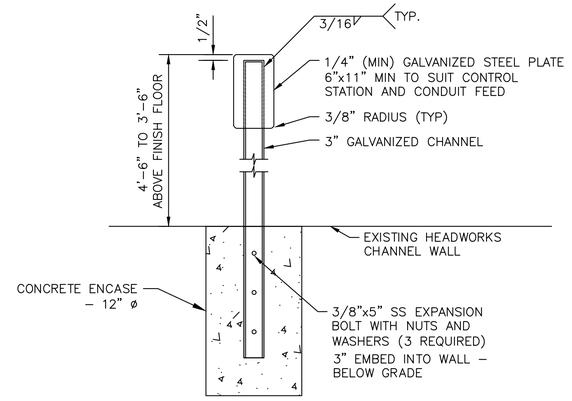
SHEET 6



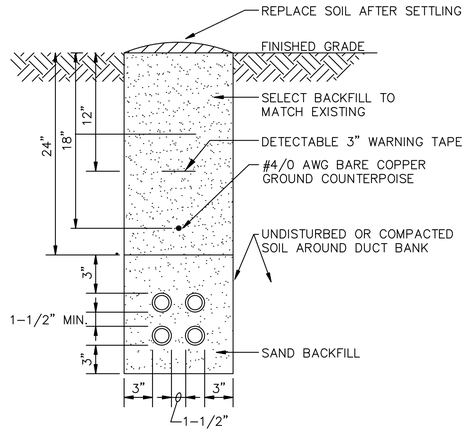
CONDUIT SUPPORT DETAIL
(SINGLE CONDUIT SHOWN, MULTIPLE CONDUIT SIMILAR)
SCALE: NONE



JUNCTION BOX SUPPORT DETAIL
SCALE: NTS



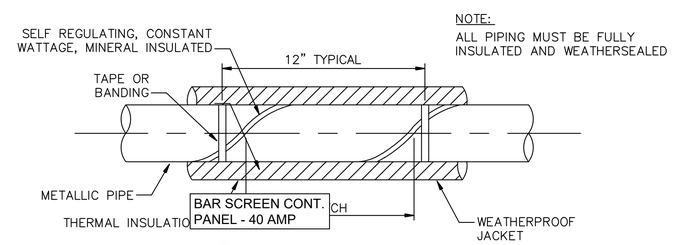
TYPICAL CONTROL STATION MOUNTING DETAIL
SCALE: NONE



TRENCH DETAIL
SCALE: NONE

ELECTRICAL DUCT NOTES:

1. CONTRACTOR SHALL STAKE THE DUCT INSTALLATION IN PLAN AND ELEVATION FOR NEW ELECTRICAL DUCTS TO AVOID EXISTING UTILITIES.
2. CONTRACTOR SHALL ADJUST THE DEPTH OF THE ELECTRICAL DUCTS AS REQUIRED TO MAINTAIN THE MINIMUM COVER REQUIREMENT INDICATED AND AVOID EXISTING UTILITIES.
3. SIMILAR CONSTRUCTION FOR OTHER DUCT SIZES. SEE DUCT BANK SCHEDULE FOR QUANTITY AND SIZES.
4. INSTALL DUCT CONDUIT SUPPORTS AT 5'-0" O.C. MAXIMUM SPACING (TYPICAL ALL DUCTS).
5. OFFSETS AND BENDS OVER 10 DEGREES AND ELBOWS IN PVC CONDUIT RUNS SHALL BE PVC COATED GALVANIZED RIGID STEEL CONDUIT.
6. NO PVC SHALL EMERGE FROM THE GROUND OR CONCRETE SLAB OR ENCASEMENT, PVC SHALL CONVERT TO PVC COATED GALVANIZED RIGID STEEL CONDUIT PRIOR TO ITS EMERGENCE.
7. INSTALL GROUND RODS AT ENDS OF ELECTRICAL DUCT OR CONNECT TO GROUND RING.
8. INSTALL CONDUCTORS AND CABLES AS NOTED ON DRAWING. INSTALL PULLWIRE IN ALL SPARE DUCTS.
9. MINIMUM COVER REQUIREMENT FOR DUCT BANKS UNDER ROADS, DRIVEWAYS AND PARKING LOTS SHALL BE 24".
10. MINIMUM COVER REQUIREMENTS FOR ELECTRICAL SECONDARY SERVICE DUCT BANKS SHALL BE 30".
11. MINIMUM COVER REQUIREMENTS FOR ELECTRICAL PRIMARY SERVICE DUCT BANKS SHALL BE 36".



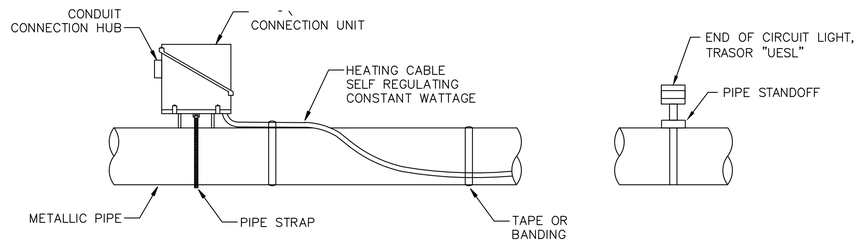
NOTE:
ALL PIPING MUST BE FULLY INSULATED AND WEATHERSEALED

HEAT TRACE DETAIL I
SCALE: NONE

GENERAL NOTES:

1. POWER MARKING TAPES SHALL BE DETECTABLE TYPE CONSTRUCTION WITH RED BACKGROUND AND BLACK LETTERING.
2. COMMUNICATION MARKING TAPES SHALL BE DETECTABLE TYPE CONSTRUCTION WITH ORANGE BACKGROUND AND BLACK LETTERING, "TELEPHONE LINE" OR "FIBER OPTIC LINE" RESPECTIVELY.
3. TAPE SHALL BE DETECTABLE, DURABLE, HIGHLY VISIBLE, RESISTANT TO ELEMENTS, MEETING AND/OR EXCEEDING ALL INDUSTRY STANDARDS.

UNDERGROUND DETECTABLE WARNING TAPE
SCALE: NONE



HEAT TRACE DETAIL II
SCALE: NONE

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STATE OF ARKANSAS KYLE BRECKENRIDGE LICENSED PROFESSIONAL ENGINEER No. 13831 5/23/24

CITY OF CLINTON
CLINTON WATER DEPT.

WWTP IMPROVEMENTS

ELECTRICAL DETAILS

PROJECT # 08-24-01

SHEET 7

APPENDIX B
Technical Specifications

PROJECT MANUAL

CITY OF CLINTON
WWTP Improvements
2024

PREPARED FOR:

CITY OF CLINTON, ARKANSAS

SALT ENGINEERS & PLANNERS

PROJECT NO. 08-24-01

MAY 2024

CERTIFICATE OF AUTHORIZATION
SALT ENGINEERS & PLANNERS, INC.
No. 4011
ARKANSAS

STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
C. Kyle Breckenridge
No. 13831
C. KYLE BRECKENRIDGE

5/23/24

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SECTION 01 1101

SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

A. The work of this Contract is located at 336 Pond Rd, Clinton, AR 72031, at the site of the existing Clinton East Wastewater Treatment Plant.

1.02 SCOPE OF WORK

A. These general and detailed specifications form a part of the Contract Documents and shall govern the handling and installation of the equipment, pipe, and appurtenances.

B. Furnish all labor, materials, equipment, and incidentals required and construct the improvements in their entirety as shown on the Plans and as specified herein.
The Work may include, but is not necessarily limited to, the following:

1. the installation of a mechanically cleaned bar screen in an existing headworks structure.

2. the installation of an area-velocity influent flow meter and ancillaries.

3. the installation of various sizes of D.I. fittings for meter insertion, yard piping, and appurtenances.

4. the construction of a concrete dumpster pad

5. the construction and installation of an effluent mag-meter in a pre-cast concrete vault

6. the construction of a gravel access road with associated grading

7. mobilization and demobilization

8. clearing, grubbing, earthwork, seeding, and erosion control

9. site grading

10. electrical and controls work

11. miscellaneous appurtenances

12. safety systems

13. items of construction work and/or materials not specifically addressed herein, but nonetheless required for a complete, operating, and acceptable installation of the work, shall be considered subsidiary to the lump sum bid item, and the cost thereof shall be considered to be included.

1.03 CONTRACTOR'S USE OF PREMISES

A. CONTRACTOR shall have use of the premises for the performance of the Work.

B. CONTRACTOR shall limit the use of the premises for his/her Work and for storage to allow for:

1. Access to the infrastructure and equipment of the OWNER

2. OWNER occupancy

C. Coordinate use of premises with the OWNER.

D. CONTRACTOR shall assume full responsibility for security of all his/her and his/her subcontractors' materials and equipment stored on the site.

E. If directed by the OWNER, move any stored items which interfere with operations of the OWNER or other contractors.

F. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

G. Provision of sanitary facilities for Contractor's use. See Specification Section 01-5000.

END OF SECTION

SECTION 01 3000

SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing, and transmitting submittals required for execution of the project.

B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:

1. **Action Submittal:** Written and graphic information submitted by the CONTRACTOR that requires the UTILITY's approval. The following are examples of action submittals:

a. Shop drawings (including working drawings and product data)

b. Samples

c. Operation & maintenance manuals

d. Site Usage Plan (CONTRACTOR’s staging - including trailer siting and material laydown area)

e. Schedule of values

f. Payment application format

2. **Informational Submittal:** Information submitted by the CONTRACTOR that does not require the UTILITY’s approval. The following are examples of informational submittals:

a. Shop drawing schedule

b. Construction schedule

c. Statements of qualifications

d. Health and Safety Plans

e. Construction photography and videography

f. Work plans

g. Maintenance of traffic plans

h. Outage requests

i. Proposed testing procedures

j. Test records and reports

k. Vendor training outlines/plans

l. Test and start-up reports

m. Certifications

n. Record Drawings

o. Record Shop Drawings

p. Submittals required by laws, regulations, and governing agencies

q. Submittals required by funding agencies

r. Other requirements found within the technical specifications

s. Warranties and bonds

t. As-built surveys

u. Contract close-out documents

1.02 RELATED WORK

A. Additional requirements may be specified in the General Conditions for the Contract.

B. Additional submittal requirements may be specified in the respective technical specification sections.

C. Operation and Maintenance manuals are included in Section 01 8823.

D. Contract closeout submittals are included in Section 01 7710.

E. Warranties and Bonds are included in Section 01 7836.

F. Applications for Payment are included in General and Supplementary Conditions.

G. Project Record Documents are included in Section 01 7839.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. All submittals shall be clearly identified as follows:

1. Date of submission

2. Project number

3. Project name

4. CONTRACTOR identification

a. Contractor

b. Supplier

c. Manufacturer

d. Manufacturer or supplier representative

5. Identification of the product

6. Reference to Contract drawing(s)

7. Reference to specification section number, page and paragraph(s)

8. Reference to applicable standards, such as ASTM or Federal Standards numbers

9. Indication of CONTRACTOR's approval

10. CONTRACTOR's Certification statement

11. Identification of deviations from the Contract Documents if any

12. Reference to previous submittal (for resubmittals)

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. SUBMITTAL LOG

Maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log should include the following items (as applicable):

1. Description

2. Submittal number

3. Date transmitted to the UTILITY

4. Date returned to CONTRACTOR (from UTILITY)

5. Status of Submittal (Approved/Not Approved/etc.)

6. Date of Resubmittal to UTILITY and Return from UTILITY (if applicable and repeat as necessary)

7. Date material released for fabrication

8. Projected (or actual) delivery date

D. NUMBERING SYSTEM

Utilize a 9-character submittal identification numbering system in the following manner:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.

2. The next six digits shall be the applicable Section Number.

3. The next two digits shall be the numbers 01 to 99 to sequentially number each separate item or drawing submitted under each specific Specification Section, in the order submitted.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc. A typical submittal number would be as follows:

   D-400550-008-B

   D = Shop Drawing
   40 0550 = Section for Valves
   08 = the eighth different submittal under this section
   B = the second submission (first resubmission) of that particular shop drawing.

E. VARIANCES

Notify the UTILITY in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

Notify the UTILITY in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the UTILITY.

F. ACTION SUBMITTALS

1. SHOP DRAWINGS, WORKING DRAWINGS, PRODUCT DATA AND SAMPLES

   a. SHOP DRAWINGS

      1) Shop drawings as defined in the General Conditions, and as specified in individual Sections include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, wiring diagrams, coordination drawings, equipment inspection and test reports, including performance curves and certifications, as applicable to the work.

      2) CONTRACTOR shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.

      3) All details on shop drawings shall show clearly the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.

      4) All shop drawings submitted by subcontractors and vendors shall be reviewed by the CONTRACTOR for field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and that it has been coordinated with other related shop drawings and the Contract requirements. Submittals directly from subcontractors or vendors will not be accepted by the UTILITY.

      5) The CONTRACTOR shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the CONTRACTOR's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor

or vendor to correct before submission to the UTILITY. All shop drawings shall be approved by the CONTRACTOR.

6) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor's control.

b. WORKING DRAWINGS

1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the UTILITY prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.

2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.

3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.

4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the CONTRACTOR's other working drawings.

c. PRODUCT DATA

Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

d. SAMPLES

1) Furnish, samples required by the Contract Documents for the UTILITY's approval. Samples shall be delivered to the UTILITY as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the UTILITY.

2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.

3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify Contract Requirements.

4) Approved samples not destroyed in testing shall be sent to the UTILITY or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the CONTRACTOR at his expense, if so requested at time of submission.

e. PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

If specifically required in any of the technical Specification Sections, submit a Professional Engineer (P.E.) Certification for each item required, using the form appended to this Section, signed and sealed by the P.E. licensed or registered in the state wherein the work is located.

2. CONTRACTOR'S CERTIFICATION

a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

"*Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements*."

b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.

3. The review and approval of shop drawings, working drawings, product data, or samples by the UTILITY shall not relieve the CONTRACTOR from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the CONTRACTOR and the UTILITY will have no responsibility therefor.

4. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.

5. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation or products or materials that do not conform to approved shop drawings shall be at the CONTRACTOR's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither the UTILITY nor UTILITY will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

6. OPERATION AND MAINTENANCE DATA

Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for UTILITY personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

7. SCHEDULE OF VALUES

On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items into reasonably small components – generally disaggregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the UTILITY, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other mis-distribution of the costs. If, in the opinion of the UTILITY, the schedule of values is unbalanced, CONTRACTOR shall reallocate components to achieve a balanced schedule acceptable to UTILITY.

8. PAYMENT APPLICATION FORMAT

If an application form is included in the **Contract Documents**, use that form unless otherwise approved by the UTILITY. If an application form is not included in the Contract Documents, CONTRACTOR may propose a form for approval.

9. SITE USAGE

Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

G. INFORMATIONAL SUBMITTALS

1. SHOP DRAWING SCHEDULE

Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

2. CONSTRUCTION SCHEDULE

Prepare and submit construction schedules and monthly status reports as specified.

3. STATEMENTS OF QUALIFICATIONS

Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.

4. HEALTH AND SAFETY PLANS

   When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

5. CONSTRUCTION PHOTOGRAPHY AND VIDEOGRAPHY

   Provide periodic construction photographs and videography as specified – including but not limited to preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.

6. WORK PLANS

   Prepare and submit copies of all work plans needed to demonstrate to the UTILITY that CONTRACTOR has adequately thought-out the means and methods of construction and their interface with existing facilities.

7. MAINTENANCE OF TRAFFIC PLANS

   Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If CONTRACTOR is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.

8. OUTAGE REQUESTS

   Provide sufficient notification of any outages required (electrical, flow processes, etc) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days notice shall be provided.

9. PROPOSED TESTING PROCEDURES

   Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

10. TEST RECORDS AND REPORTS

    Provide copies of all test records and reports as specified in the various technical specifications.

11. VENDOR TRAINING OUTLINES/PLANS

    At least two weeks before scheduled training of UTILITY's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

12. TEST AND START-UP REPORTS

    Manufacture shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.

13. CERTIFICATIONS

a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.

b. Certifications may include, but are not limited to:

1) Welding certifications and welders' qualifications

2) Certifications of Installation, Testing and Training for all equipment

3) Material Testing reports furnished by an independent testing firm

4) Certifications from manufacturer(s) for specified factory testing

5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

14. RECORD DRAWINGS

No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with specification on Project Record Documents.

15. SUBMITTALS REQUIRED BY LAWS, REGULATIONS AND GOVERNING AGENCIES

Prepare and submit all documentation required by state or local law, regulation, or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to UTILITY one copy of each submittal made in accordance with this paragraph.

16. SUBMITTALS REQUIRED BY FUNDING AGENCIES

Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay applications and change orders when required to properly allocate funds to different funding sources, and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the UTILITY.

17. OTHER REQUIREMENTS OF THE TECHNICAL SPECIFICATION SECTIONS

Comply with all other requirements of the technical specifications.

18. WARRANTIES AND BONDS

Assemble a book(let) of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds and provide to the UTILITY.

19. AS-BUILT SURVEYS

Engage the services of a licensed land surveyor in accordance with the Project Controls specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

20. CONTRACT CLOSE-OUT DOCUMENTS

Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Provide an initial submittal schedule at the pre-construction meeting for review by UTILITY. Incorporate comments from UTILITY into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by UTILITY. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: The CONTRACTOR's name and address, UTILITY's name, project name, project number, submittal number, description of submittal and number of copies submitted.

B. Submittals shall be transmitted or delivered directly to the office of the UTILITY, as indicated in the Contact Documents, or as otherwise directed by the UTILITY.

C. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

3.03 PROCEDURES

A. ACTION SUBMITTALS

1. CONTRACTOR'S RESPONSIBILITIES

a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the CONTRACTOR's failure to transmit submittals sufficiently in advance of the Work.

b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the UTILITY.

c. No less than thirty (30) calendar days will be required for UTILITY's review time for shop drawings and O&M manuals involving only one engineering discipline. No less than forty-five (45) calendar days will be required for UTILITY's review time for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review time.

d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).

e. Before submission to the UTILITY, review shop drawings as follows:

1) make corrections and add field measurements, as required

2) use any color for its notations except red (reserved for the UTILITY's notations) and black (to be able to distinguish notations on black and white documents)

3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the UTILITY on a previous submission

4) include the required CONTRACTOR's Certification statement

5) provide field measurements (as needed)

6) coordinate with other submittals

7) indicate relationships to other features of the Work

8) highlight information applicable to the Work and/or delete information not applicable to the Work

f. Submit the following number of copies:

1) Shop drawings (including working drawings and product data) – Submit no fewer than six, and no more than nine; five of which will be retained by the UTILITY.

2) Samples – two

3) Site Usage Plan – four copies

4) Schedule of values – four copies

5) Payment application format – four copies

6) Operation and Maintenance Manuals – six copies

g. If CONTRACTOR considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the UTILITY immediately; and do not release for manufacture before such notice has been received by the UTILITY.

h. When the shop drawings have been completed to the satisfaction of the UTILITY, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the UTILITY.

2. UTILITY'S RESPONSIBILITIES

a. UTILITY will not review shop drawings (including working drawings and product data) that do not include the CONTRACTOR's approval stamp. Such submittals will be returned to the CONTRACTOR, without action, for correction.

b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the UTILITY, a submittal is incomplete, that submittal will be returned to the CONTRACTOR for completion. Such submittals may be returned with comments from UTILITY indicating the deficiencies requiring correction.

c. If shop drawings (including working drawings and product data) meet the submittal requirements, UTILITY will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the CONTRACTOR without action - with the UTILITY retaining one copy.

d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the UTILITY within the time specified herein. The time for review will commence upon receipt of submittal by UTILITY.

3. REVIEW OF SHOP DRAWINGS (INCLUDING WORKING DRAWINGS AND PRODUCT DATA) AND SAMPLES

a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:

1) as permitting any departure from the Contract requirements

2) as relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials

3) as approving departures from details furnished by the UTILITY, except as otherwise provided herein

b. The CONTRACTOR remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the UTILITY are in the interest of the UTILITY and are so minor as not to involve a change in Contract Price or Contract Time, the UTILITY may return the reviewed drawings without noting an exception.

d. Only the UTILITY will utilize the color “RED” in marking submittals.

e. Shop drawings will be returned to the CONTRACTOR with one of the following codes.

Code 1 – “APPROVED” – This code is assigned when there are no notations or comments on the submittal. When returned under this code the CONTRACTOR may release the equipment and/or material for manufacture.

Code 2 - "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 - "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is required by the CONTRACTOR. The CONTRACTOR may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted.

Confirmation is to be received by the UTILITY within fifteen (15) calendar days of the date of the UTILITY's transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the UTILITY within thirty (30) calendar days of the date of the UTILITY's transmittal requiring the resubmittal.

Code 5 – "NOT APPROVED" – This code is assigned when the submittal does not meet the intent of the contract documents. The CONTRACTOR must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the contract documents.

Code 6 – "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the CONTRACTOR.

Code 7 – "RECEIPT ACKNOWLEDGED (Not subject to UTILITY's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the UTILITY's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

f. REPETITIVE REVIEWS: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the UTILITY's expense. All subsequent reviews will be performed at the CONTRACTOR's expense. Reimburse the UTILITY for all costs invoiced by UTILITY for the third and subsequent reviews.

4. ELECTRONIC TRANSMISSION

a. ACTION SUBMITTALS may be transmitted by electronic means provided the following conditions are met:

1) The above-specified transmittal form is included.

2) All other requirements specified above have been met including, but not limited to, coordination by the CONTRACTOR, review and approval by the Contactor, and the CONTRACTOR's Certification.

3) With the exception of the transmittal sheet, the entire submittal is included in a single file.

4) The electronic files are PDF format (with printing enabled).

5) In addition, transmit three hard-copy (paper) originals to the UTILITY.

6) For Submittals that require certification, corporate seal, or professional embossment (i.e. P.E.s, Surveyors, etc) transmit at least two hard-copy originals to the UTILITY. In addition, provide additional photocopied or scanned copies, as

specified above, showing the required certification, corporate seal, or professional seal.

B. INFORMATIONAL SUBMITTALS

1. CONTRACTOR'S RESPONSIBILITIES

a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections

b. Refer to individual technical Specification Sections for specific submittal requirements.

2. UTILITYS'S RESPONSIBILITIES

a. The UTILITY will review each informational submittal within fifteen (15) days. If the informational submittal complies with the Contract requirements, UTILITY will file for the project record. UTILITY may elect not to respond to CONTRACTOR regarding informational submittals meeting the Contract requirements.

b. If an informational submittal does not comply with the Contract requirements, UTILITY will respond accordingly to the CONTRACTOR within fifteen (15) days. Thereafter, the CONTRACTOR shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the UTILITY, is in conformance with the Contract Documents.

3. ELECTRONIC TRANSMISSION

a. INFORMATIONAL SUBMITTALS may be transmitted by electronic means providing all of the following conditions are met:

1) The above-specified transmittal form is included.

2) With the exception of the transmittal sheet, the entire submittal is included in a single file.

3) The electronic files are PDF format (printing enabled).

4) For Submittals that require certification, corporate seal, or professional embossment (i.e. P.E.s, Surveyors, etc)) transmit two hard-copy originals to the UTILITY.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional engineer registered in the [State] [Commonwealth] of _____ and that he/she has been employed by

_____ to design

(Name of CONTRACTOR)

_____

(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.

(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the City of Blytheville Water and Sewer Utility or their authorized representative, within seven days following written request therefor by the UTILITY.

_____	_____
P.E. Name	CONTRACTOR's Name
_____	_____
Signature	Signature
_____	_____
Address	Title
	_____
	Address

SECTION 01 3119

PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. The Engineer shall schedule and administer a pre-construction meeting, periodic progress meetings and specially called meetings throughout progress of the work.

1. Prepare agenda for meetings.

2. Make physical arrangements for meetings.

3. Preside at meetings.

4. Record the minutes; include significant proceedings and decisions.

5. Reproduce and distribute copies of minutes within 10 working days after each meeting.

a. To participants in the meeting.

b. To parties affected by decisions made at the meeting.

B. Representatives of Contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. Attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.02 RELATED REQUIREMENTS

A. Instructions to Bidders are included in Division 0.

B. Submittals are included in Section 01_3000.

D. Project Record Documents are included in Section 01_7839.

E. Operating and Maintenance Data is included in Section 01_8823.

1.03 PRE-CONSTRUCTION MEETING

A. Schedule a preconstruction meeting no later than ten (10) days after date of Notice to Proceed.

B. Location: A central site, convenient for all parties, designated by the Owner.

C. Attendance

1. UTILITY Representative.

2. Engineer and his/her professional consultants.

3. Resident Project Representative.

4. Contractor's Superintendent.

5. Major Subcontractors.

6. Major suppliers.

7. Utility Companies

8. Others as appropriate.

D. Suggested Agenda

1. Distribution and discussion of:

   a. List of major subcontractors and suppliers.

   b. Projected Construction Schedules.

2. Critical work sequencing.

3. Major equipment deliveries and priorities.

4. Project Coordination.

   a. Designation of responsible personnel.

5. Procedures and processing of:

   a. Field decisions.

   b. Proposal requests.

   c. Submittals.

   d. Change Orders.

   e. Applications for Payment.

6. Adequacy of distribution of Contract Documents.

7. Procedures for maintaining Record Documents.

8. Use of premises:

   a. Office, work, and storage areas.

   b. Owner's requirements.

9. Construction facilities, controls, and construction aids.

10. Temporary utilities.

11. Housekeeping procedures.

1.04 PROGRESS MEETINGS

A. Schedule regular periodic meetings. The progress meetings will be held every week with the first meeting no later than 11 calendar days after the pre-construction meeting.

B. Hold called meetings as required by progress of the work.

C. Location of the meetings: Project field office of Contractor or Engineer.

D. Attendance

1. Engineer and his/her professional consultants as needed.

2. Contractor’s Superintendent

3. Subcontractors as appropriate to the agenda.

4. Suppliers as appropriate to the agenda. For suppliers, a call-in to the meeting will be acceptable unless physical presence is required.

5. Others as appropriate.

E. Suggested Agenda

1. Review, approval of minutes of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems, and conflicts.

4. Problems which impede Construction Schedule.

5. Review of off-site fabrication, delivery schedules.

6. Corrective measures and procedures to regain projected schedule.

7. Revisions to Construction Schedule.

8. Progress, schedule, during succeeding work period.

9. Coordination of schedules.

10. Review submittal schedules; expedite as required.

11. Maintenance of quality standards.

12. Pending changes and substitutions.

13. Review proposed changes for:

a. Effect on Construction Schedule and on completion date.

b. Effect on other contracts of the project.

14. Other business.

15. Construction schedule.

16. Critical/long lead items.

F. Attend progress meetings and is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 4527

EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide a competent field services technician of the manufacturers of all equipment furnished, to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the equipment.

B. Perform specified equipment field performance tests, final acceptance tests and startup services.

1.02 RELATED WORK

A. Operation and Maintenance Data is included in Section 01 8823.

B. Performance and acceptance testing and startup requirements are included in the respective sections of the equipment specifications.

1.03 SUBMITTALS

A. Submit name, address and resume' of proposed field services technicians at least 30 days in advance of the need for such services.

B. Submit, in accordance with Section 01_3000, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:

1. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:

a. Name of equipment to be tested, including reference to specifications section number and title.

b. Testing schedule of proposed dates and times for testing.

c. Summary of power, lighting, chemical, water, sludge, gas, etc, needs and identification of who will provide them.

d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.

e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).

f. Samples of forms to be used to collect and record test data and to present tabulated test results.

2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:

a. Copy of all test data sheets and results of lab analyses.

b. Summary comparison of specified test and performance requirements vs actual test results.

c. Should actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the equipment.

3. Copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified herein.

1.04 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1. AWWA C653 - Disinfection for Water Treatment Plants.

B. American Society for Testing and Materials (ASTM)

C. Water Pollution Control Federation (WPCF)

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the equipment and systems being installed.

B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. After installation of the equipment has been completed and the equipment is presumably ready for operation, before it is operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the equipment. The inspection shall include at least the following points where applicable:

1. Soundness (without crack or otherwise damaged parts).

2. Completeness in all details, as specified and required.

3. Correctness of setting, alignment, and relative arrangement of various parts.

4. Adequacy and correctness of packing, sealing and lubricants.

B. The operation, testing and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.

C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments, and tests.

3.02 WITNESS REQUIREMENTS

A. Shop tests or factory tests may be witnessed by the Owner and/or Owner's representatives, as required by the various equipment specifications.

B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designed personnel and/or Owner's representatives.

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner

_____

Project

_____

Contract No.

_____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that

_____
(Print equipment name and model with serial no.)

_____

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date_____

Time_____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES

1. GENERAL

1.01 TEMPORARY SANITARY FACILITIES

A. Sanitary facilities are onsite. Contractor may use the Owners facilities. No temporary sanitary facilities are required.

1.02 PROTECTION OF INSTALLED WORK

A. Contractor is responsible for providing temporary and removable protection for installed products.

1.03 TEMPORARY ACCESS AND PARKING

A. Contractor shall provide adequate temporary access to working areas as approved by Owner/Engineer.
B. Contractor shall not park any vehicles on any street or private property without permission from the Owner.

1.04 PROGRESS CLEANING

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

1.05 REMOVAL OF FACILITIES AND FINAL CLEANUP

A. Remove all equipment, facilities, and materials prior to final inspection.
B. Restore existing facilities and area used during construction to original condition.

1.06 STAGING AREA/MATERIALS STORED

A. Contractor shall be responsible for location a site for materials stored, equipment, and staging area for construction.
B. Contractor shall provide owner written documentation between property owner and contractor as to the agreement to utilize property for staging area.

END OF SECTION 015000

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SECTION 015800

PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Furnish, install and maintain project identification signs.

B. Remove sign on completion of construction.

C. Allow no other signs to be displayed.

1.2 RELATED WORK

Not Used.

1.3 SUBMITTALS

A. Submit in accordance with the requirements of Section 013300 “Submittal Procedures”.

1.4 PROJECT IDENTIFICATION SIGNS

A. CWSRF - One painted sign, of not less than 32 square feet (8-ft long by 4-ft wide) area, with painted graphic content as shown below:

1. Title of Project & CWSRF #
2. Name of Owner
3. Project Cost
4. EPA logo
5. ANRC logo

B. Graphic design, style of lettering and colors: As required by law (CWSRF) and subject to the approval of the Owner or its equivalent and applicable local regulations for signs. Refer to graphics below:

C. Erect (A & B) on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the Engineer and the Owner.

1.5 INFORMATIONAL SIGNS

A. Painted signs with painted lettering, or standard products.

B. Size of signs and lettering: as required by regulatory agencies, or as appropriate to usage.

C. Colors: as required by regulatory agencies, otherwise of uniform colors throughout Project.

D. Erect at appropriate location to provide required information.

1.6 QUALITY ASSURANCE

A. Sign Painter: Professional Experience in type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

PART 2 - PRODUCTS

2.1 SIGN MATERIALS

A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to work and suitable for specified finish

B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.

1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles

C. Rough Hardware: Galvanized

D. Paint: Exterior quality, as specified in Division 9

1. Use Bulletin colors for graphics.
2. Colors for structure, framing, sign surfaces and graphics: As selected by the Engineer

PART 3 - EXECUTION

3.1 PROJECT IDENTIFICATION SIGNS

A. Paint exposed surfaces of supports, framing and surface material; one coat of primer and one coat of exterior paint.

B. Paint graphics in styles, sizes and colors selected.

3.2 MAINTENANCE

A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.

3.3 REMOVAL

A. Remove signs, framing, supports and foundations at completion of project.

END OF SECTION

SECTION 01 6610

DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 TRANSPORTATION AND DELIVERY

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

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the UTILITY.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. UTILITY, other Contractors), perform inspection in the presence of the UTILITY. Notify UTILITY verbally, and in writing, of any problems.

H. If any item has been damaged, such damage shall be repaired at no additional cost to the UTILITY.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the UTILITY by him/her. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

C. Cement and lime shall be stored under a roof and off the ground and shall always be kept completely dry. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking. Brick, block, and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking, and spalling to a minimum.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the UTILITY. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer. The UTILITY may offer existing spaces available to the Contractor for storage of these items but this is in no way guaranteed and the UTILITY does not accept any liability for theft, damage, or loss occurring while the material is stored in their space. The Contractor must coordinate with the UTILITY if space has been offered and the Contractor chooses to utilize said UTILITY space.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance, unless the period between installation and acceptance is less than ½ the time period between factory recommended lubricant changes.

4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

1.04 HANDLING PIPELINE MATERIALS

A. The CONTRACTOR shall handle the material with utmost care and in a manner to prevent damage to the materials, material coating, and lining, during loading, hauling, unloading, and installation operations. Damaged material shall be replaced or repaired by the CONTRACTOR at his/her expense.

B. Hooks shall not be in contact with the pipe exterior.

C. The interior of the pipeline materials shall always be kept free from dirt and foreign matter .

D. Pipeline materials, especially valves, hydrants, and fittings shall be drained and stored in a manner to protect them from damage by freezing.

END OF SECTION

SECTION 01 7710

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:

1. Operation and Maintenance Data (Section 01_8823).

2. Project Record Documents (Section 01_7839).

4. Spare parts and maintenance materials (spare paint, lubricants, special tools).

5. Record Shop Drawings (Section (01_3000).

6. Warranties and Bonds (Section (01_7836).

7. Reconciliation of final accounting, final change order, final payment application (General Conditions) and Contractor's releases.

8. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 RELATED WORK

A. Operation and Maintenance (O&M) data and manuals (Section 01_8823) and applicable Sections in Technical Divisions.

B. Project Record Documents (Section 01_7839).

1.03 CLOSEOUT PROCEDURES

A. Provide all deliverables as specified, prior to submitting the final payment application.

B. Provide submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.

C. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

D. Submit Contractor's Final Release and Release of Liens with final payment application.

1.04 FINAL CLEANING

A. CONTRACTOR to complete final cleaning prior to submittal of the final application for payment.

B. The CONTRACTOR shall remove all materials, equipment, tools, temporary structures, barricades, and trees and other vegetation that have been cut or have died as a result from the work, from both public and private property along the job site.

C. There shall be no burning on the job site unless approved, in advance, by the UTILITY.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01 7836

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01_7710 - Project Closeout.

C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. Submit written warranties to the OWNER prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the OWNER.

B. When a designated portion of the work is completed and occupied or used by the UTILITY, by separate agreement with the CONTRACTOR during the construction period, submit properly executed warranties to the OWNER within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the CONTRACTOR, or the CONTRACTOR and a subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the OWNER for approval prior to final execution.

D. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

1.04 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective work regardless of whether the OWNER has benefited from use of the work through a portion of its anticipated useful service life.

D. UTILITY's Recourse: Written warranties made to the OWNER are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the OWNER can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The OWNER reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.

F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the CONTRACTOR of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the CONTRACTOR.

1.05 MANUFACTURERS CERTIFICATIONS

A. Where required, the CONTRACTOR shall supply evidence, satisfactory to the Engineer, that the CONTRACTOR can obtain manufacturers' certifications as to the CONTRACTOR's installation of equipment.

1.06 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the UTILITY.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the UTILITY.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 7839

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

The CONTRACTOR shall keep and maintain, at the job site, a copy of contract documents, marked up to indicate all changes made during the course of a project, as specified herein.

1.02 RELATED REQUIREMENTS

A. Contract close-out submittals are included in Section 01_7710.

B. Warranties and bonds are included in Section 01_7836.

C. Record shop drawings are included in Section 01_3000.

1.03 REQUIREMENTS INCLUDED

A. CONTRACTOR shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings

B. CONTRACTOR shall assemble copies of the following documents for turnover to the Engineer at the end of the project, as specified.

1. Field Orders, Change Orders, Design Modifications, and RFIs

2. Field Test records

2. Permits and permit close-outs (final approvals)

3. Certificate of Occupancy or Certificate of Completion, as applicable

4. Laboratory test reports (e.g., bacteriological and primary & secondary water quality)

5. Certificates of Compliance for materials and equipment

6. Samples

C. RECORD DRAWINGS

1. The CONTRACTOR shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the WORK, as constructed.

2. These annotated Contract Drawings constitute The CONTRACTOR's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.

3. Record drawings shall be accessible to the OWNER and Engineer at all times during the construction period.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Store documents and samples in CONTRACTOR’s field office apart from documents used for construction.

1. Provide files and racks for storage of the record documents.

2. Provide locked cabinet(s) or secure storage space for storage of samples.

B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and sample available for inspection by the Engineer or OWNER at all times.

3.02 MARKING METHOD

A. Use the color *Red* (indelible ink) to record information on the Drawings.

B. Label each document “PROJECT RECORD” in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances

    a. Changes to existing structure, piping and appurtenance locations.

    b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.

    c. Record actual installed pipe material, class, size, joint type, etc

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.

2. Field changes of dimensions and/or details

    1) Interior equipment and piping relocations.

    2) Architectural and structural changes, including relocation of doors, windows, etc.

    3) Architectural schedule changes.

C. Changes made by Field Order, Change Order, design modification, and RFI.

D. Details not indicated on the original Contract Drawings.

3.04 SUBMITTAL

A. If requested by the Engineer or OWNER, CONTRACTOR shall provide a copy of the Record Drawings, or present them for review prior to processing monthly applications for payment.

B. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of Record Drawings to the ENGINEER conforming to the construction records of the CONTRACTOR. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the WORK. Unless specified otherwise elsewhere, Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

C. Upon substantial completion of the WORK and prior to final acceptance, the CONTRACTOR shall finalize and deliver a complete set of Record Documents to the ENGINEER conforming to the construction records of the CONTRACTOR. The set of documents shall consist of corrected and annotated documents showing the as-installed equipment and all other as-built conditions not indicated on the Record Drawings.

D. The information submitted by the CONTRACTOR into the Record Drawings and Record Documents will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.

E. Delivery of Record Drawings and Record Documents to the ENGINEER will be a prerequisite to Final payment.

F. The CONTRACTOR shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

SECTION 01 8823

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

A. Submittals are included in Section 01_3000.

B. Contract closeout is included in Section 01_7710

C. Warranties and Bonds are included in Section 01_7836.

1.03 OPERATING MANUALS

A. Provide operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.

B. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:

1. Format and Materials

a. Binders:

1) Commercial quality three ring binders with durable and cleanable plastic covers

2) Maximum ring width capacity: 3 inches

3) When multiple binders are used, correlate the data into related consistent groupings/volumes.

b. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:

1) Title of Project.

2) Identify the general subject matter covered in the manual

3) Identify structure(s) and/or location(s), as applicable

4) Specification Section number

c. 20 lb loose leaf paper, with hole reinforcement

d. Page size: 8-1/2 inch by 11 inch

e. Provide heavy-duty fly leafs (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.

f. Provide reinforced punched binder tab; bind in with text.

g. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents:

a. A table of contents/Index

b. Specific description of each system and components

c. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)

d. Specific on-site operating instructions (including starting and stopping procedures)

e. Safety considerations

f. Project specific operational procedures

g. Project specific maintenance procedures

h. Manufacturer's operating and maintenance instructions – specific to the project

i. Copy of each wiring diagram

j. Copy of approved shop drawing(s) and CONTRACTOR's coordination/layout drawing(s)

k. List of spare parts and recommended quantities

l. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.

m. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams

n. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.

o. Warranties and Bonds, as specified in the General Conditions

3. Transmittals

a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include al least the following: the CONTRACTOR’s name and address, OWNER’s name, project name, project number, submittal number, description of submittal and number of copies submitted.

b. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or otherwise directed by the Engineer.

c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Resident Project Representative.

C. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.

2. Panelboard circuit directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.

3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

4. Maintenance Requirements

a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions

b. Alignment, adjusting, balancing and checking instructions

c. Servicing and lubrication schedule and list of recommended lubricants

d. Manufacturer's printed operation and maintenance instructions

e. Sequence of operation by instrumentation and controls manufacturer

f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance

5. Control diagrams by controls manufacturer as installed (as-built)

6. CONTRACTOR's coordination drawings, with color coded piping diagrams, as installed (as-built)

7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage

9. Test and balancing reports, as required

10. Additional Requirements as specified in individual product specification

11. Design data for systems engineered by the CONTRACTOR or its Suppliers

D. Electronic Transmission of O&M Manuals

1. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than by CD-ROM. Electronic O&M manuals shall meet the following conditions:

a. The above-specified transmittal form is included.

b. All other requirements specified above have been met, including, but not limited to, coordination by the CONTRACTOR, review and approval by the Contactor.

c. The submittal contains no pages or sheets large than 11 x 17 inches.

d. With the exception of the transmittal sheet, the entire submittal is included in a single file.

e. Files are Portable Document Format (PDF) – with the printing function enabled.

2. When electronic copies are provided, transmit two hard-copy (paper) originals to the Engineer with an electronic copy on CD-ROM.

3. The electronic copy of the O&M manual must be identical in organization, format and content to the hard copies of the manual.

1.04 SERVICES OF MANUFACTURERS' REPRESENTATIVE

A. All electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment; and, to instruct the OWNER's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods to suit the CONTRACTOR's schedule and/or the OWNER's personnel availability.

B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.

C. The manufacturer's representative shall certify that the installation of the equipment is satisfactory; that the unit has been satisfactorily tested; that the equipment is ready for operation; and, that the operating personnel have been suitably instructed in the operation, maintenance, care, and safe operation of the equipment. The *Equipment Manufacturer's Certificate of Installation, Testing, and Instruction* attached to this Section shall be used for this certification.

D. For other materials furnished under other specification Sections, furnish the services of approved representative(s) of the manufacturer when, in the opinion of the Engineer, some evident product failure or malfunction makes such services necessary.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Operation and maintenance manuals shall be delivered directly to the office of the Engineer, as follows:

1. Preliminary copies of manuals shall be submitted to the office of the Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide one (1) hard copy and six (6) electronic copies on separate labeled CD's of complete manuals prior to testing and start-up.

B. The Engineer will review Operation and Maintenance manuals submittals on operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the *O&M Manual Review Checklist* appended to this Section.

C. If during test and start-up of equipment, any changes were made to the equipment, provide copies (the number specified in paragraph 3.01.A.2) of as-built drawings or any other amendments for insertion in the final manuals. Submit the required number within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER's PERSONNEL)

A. Before final initiation of operation, CONTRACTOR's vendors shall train/instruct OWNER's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems at times convenient to the OWNER.

B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of two hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of OWNER's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the CONTRACTOR's "normal working hours" or the OWNER's normal day shift.

C. Use operation and maintenance manuals as basis for instruction. Train/instruct the OWNER's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.

D. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.

E. Vendor's training/instruction will be considered acceptable based on the completed *OWNER's Acknowledgement of Manufacturer's Instruction* as indicated on the Equipment Manufacturer's Certification of Installation, Testing, and Instruction appended to this Section.

END OF SECTION

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION, TESTING AND INSTRUCTION

OWNER: _____

Project: _____

Contract No. _____

CDM Project No. _____

EQUIPMENT SPECIFICATION SECTION_____

EQUIPMENT DESCRIPTION_____

I_____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that_____
(Print equipment name and model with serial No.)

installed for the subject project [has] [have] been installed in a satisfactory manner, [has] [have] been satisfactorily tested, [is] [are] ready for operation, and that OWNER assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit[s] on Date: _____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

[I] [We] the undersigned, authorized representatives of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and [am] [are] prepared to assume normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal: _____

General Data

_____ 1. Are the area representative's name, address, e-mail address and telephone number included?

_____ 2. Is the nameplate data for each component included?

_____ 3. Are all associated components related to the specific equipment included?

_____ 4. Is non-pertinent data crossed out or deleted?

_____ 5. Are drawings neatly folded and/or inserted into packets?

Operations and Maintenance Data

_____ 6. Is an overview description of the equipment and/or process included?

_____ 7. Does the description include the practical theory of operation?

_____ 8. Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?

_____ 9. Are alarm and shutdown conditions clearly identified? Does it describe possible causes and recommended remedies?

_____ 10. Are step procedures for starting, stopping, and troubleshooting the equipment included?

_____ 11. Is a list of operational parameters to monitor and record for specific equipment included?

_____ 12. Is a proposed operating log sheet included?

_____ 13. Is a spare parts inventory list included for each component?

_____ 14. Is a lubrication schedule for each component included - or does it clearly state “No Lubrication Required"?

_____ 15. Is a maintenance schedule for each component included?

_____ 16. Is a copy of the warranty information included?

Review Comments

Is the submittal fully approved (yes/no)?

If not, see the following are the points of rejection that must be addressed and require resubmittal by the CONTRACTOR:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14, _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

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SECTION 036000
GROUT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Non-shrink grout for leveling column base plates, steel beams bearing on masonry, machinery and other equipment and/or accessories.

1.2 REFERENCES

A. ASTM C33 - Concrete Aggregates.

B. ASTM C109 - Compressive Strength of Hydraulic Cement Mortars.

C. ASTM C230 - Flow Table for Use in Test of Hydraulic Cement.

D. CRD-C-611 - Methods of Test for Flow of Grout Mixtures (Flow-Cone Method).

E. CRD-C-621 - Specification for Non-Shrink Grout.

1.3 SUBMITTALS

A. Procedures for Submittals: Section 013300 “Submittal Procedures”.

B. Product Data: Manufacturers product data sheets.

C. Quality Control Submittals: For information only.

1. Certification: Manufacturer's certification, or certified laboratory test reports, confirming that materials meet specification requirements.
2. Installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver non-shrink grout to project site in unopened containers with manufacturer's labels intact.

B. Store non-shrink grout material in dry shelter and protect from moisture.

C. Containers that are torn or damaged such that non-shrink grout material has been exposed to elements shall be discarded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products of following manufacturers are acceptable subject to meeting specification requirements:

1. Cormix Construction Chemicals (Gifford-Hill).
2. Dayton Superior Corp.
3. Euclid Chemical Co.

4. Five Star Products, Inc.
5. L&M Construction Chemicals.
6. Master Builders.
7. Symons.
8. Approved equal.

2.2 NON-SHRINK GROUT

A. Qualities: Premixed non-metallic non-shrink grout material manufactured under rigid quality control, specially for use in transferring heavy loads.

1. Nonmetallic natural aggregate, non-staining and noncorrosive.
2. Resist attack by oil and water.
3. Minimum initial setting time of approximately one hour at 70F.
4. Minimum compressive strength of 8,500 psi at 28 days when placed at a fluid consistency.
5. Free of gas-producing or gas-releasing agents.
6. Not greater than .04 expansion at 3, 14 and 28 days. Expansion at 28 days not less than expansion at 3 and 14 days.

B. Standards:

1. Overall Product: CRD-C-621.
2. Compressive Strength: ASTM C109, 2 inch cubes.
3. Bleed Performance: CRD-C-611
4. Flow Factor: ASTM C230.

2.3 RELATED MATERIALS

A. Water: Potable.

B. Pea Gravel: ASTM Size 8, Size 89

C. Sand: ASTM C33

2.4 MIXING

A. Mix materials in accordance with manufacturer's instructions.

B. Mix as close to area to be grouted as possible. Provide adequate means to transport mixed grout as quickly as possible, and in manner to prevent segregation.

C. No more grout shall be mixed at one time than can be placed in a period of 15 minutes. After grout has been mixed, do not re-temper by adding additional water.

D. For less than a 4-inch clearance, or where size or shape of space makes grouting difficult, grout mix shall consist of grout material and water.

E. For greater than 4-inch clearances where coarse aggregate will not obstruct free passage of grout, grout may be extended by adding clean pea gravel if allowed or recommended by the grout manufacturer. Follow manufacturer's recommendation for maximum amount of pea gravel that may be added to mixture.

F. Use minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.

PART 3 - EXECUTION

3.1 PROCEDURES

A. Installation methods and procedures shall conform to the printed instructions of the grout manufacturer and these Specifications. Where there is a conflict between these Specifications and the printed instructions of the grout manufacturer, the printed instructions of the grout manufacturer shall take precedence.

3.2 PREPARATION

A. Remove defective concrete, dirt, oil, grease, and other foreign material from concrete surfaces by bush-hammering, chipping or other similar means, until a sound clean concrete surface is achieved.

B. Lightly roughen concrete, but not enough to interfere with proper placement of grout.

C. Remove foreign materials from surfaces in contact with grout.

D. Align, level and maintain final positioning of components to be grouted. Coat shim with a thin film of grease or wax to facilitate removal.

E. Provide relief holes to avoid trapping air beneath base plates.

F. Take special precautions during extreme weather conditions according to the manufacturer's written instructions.

G. Saturate concrete surfaces with clean water for period of time specified by manufacturer. Remove excess water just prior to grouting.

H. Immediately prior to grouting, clean surfaces free of contaminates.

3.3 FORMWORK

A. Build leak proof forms that are strong and securely anchored and shored to withstand grout pressures. Build forms high enough to provide a "head" of grout where it is required to force grout into difficult locations.

B. Provide enough clearance between formwork and areas to be grouted to permit proper placement of grout.

3.4 PLACING

A. Place grout in accordance with manufacturer's instructions.

B. Place non-shrink grouting material quickly and continuously by most practical means permissible; pouring, pumping or under gravity pressure. Do not use either pneumatic-pressure or dry packing methods without authorization of Engineer.

C. When practical, apply grout from one side only to avoid entrapping air.

D. Final installation shall be thoroughly compacted and free from air pockets. To facilitate placement, a 2 to 1 inch chain or metal strap may be pulled back and forth under the equipment during grouting. Remove chain or strap before initial set takes place.

E. Do not vibrate, place grout mixture, or allow it to be placed if area is being vibrated by nearby equipment, except when approved by grout manufacturer.

F. Do not remove leveling shims for at least 48 hours after grout has been placed. After shims have been removed, fill voids with non-shrink grout.

3.5 CURING

A. Cure grout for three (3) days at temperatures greater than 50°F after placing by keeping wet and covering with curing paper, by coating with a concrete membrane-forming curing compound, or by other approved methods.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General requirements applicable to all Electrical Work.

2. General requirements for electrical submittals.

3. Interfaces to equipment, instruments, and other components:

4. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

5. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:

   a. Make all changes necessary to meet the manufacturer's wiring requirements.

   b. Submit all such changes and additions to the Engineer for acceptance.

6. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appear on the Drawings or in the Specifications from another discipline in the scope of Work:

   a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

7. Loop drawings:

   a. Provide all electrical information required in the preparation of loop drawings including, but not limited to:

      1) Conduit numbers and associated signal(s) contained within each conduit.

      2) Wire numbers.

      3) Equipment terminal numbers.

      4) Junction boxes and signal(s) contained within each junction box.

      5) Equipment power sources, and associated circuit numbers.

      6) As-built drawings detailing wiring.

B. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections.

2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.

3. Owner is not responsible for any additional costs due to the failure of Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

C. Contract Documents:

1. General:

a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.

2. Specifications:

a. The General and Supplementary Conditions of the Contract Documents govern the Work.

b. These requirements are in addition to all General Requirements.

3. Contract Drawings:

a. The Electrical Drawings show desired locations, arrangements, and components of the Electrical Work in a diagrammatic manner.

b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:

c. The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

d. The Contractor has the freedom to select any of the named manufacturers identified in the individual specification sections; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer’s equipment fits in the allotted space. It is the Contractor’s responsibility to ensure that the equipment being furnished fits within the defined space.

e. Installation details:

1) The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.

2) Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.

4. Schematic diagrams:

a. All controls are shown de-energized.

b. Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

c. Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

d. Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

e. Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

1.2 REFERENCES

A. Code compliance:

1. As specified in the section for Regulatory Requirements.
The publications are referred to in the text by the basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of the bid governs.

2. The standards listed are hereby incorporated into this Section.

a. American National Standards Institute (ANSI).

b. American Society of Civil Engineers (ASCE):

c. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

d. ASTM International (ASTM).

e. Illuminating Engineering Society (IES).

f. Institute of Electrical and Electronics Engineers (IEEE).

g. Insulated Cable Engineers Association (ICEA).

h. International Code Council (ICC):

i. International Code Council Evaluation Service (ICC-ES).

j. AC 156 - Acceptance Criteria for Seismic Certification by Shake Table Testing of Non-Structural Components (ICC-ES AC 156).

k. International Society of Automation (ISA).

l. National Electrical Manufacturers Association (NEMA):

m. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

n. National Fire Protection Association (NFPA):

o. 70 - National Electrical Code (NEC).

p. National Institute of Standards and Technology (NIST).

q. Underwriters' Laboratories, Inc. (UL).

r. Compliance with laws and regulations: As specified in Document 00700 - General Conditions.

1.3 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth by:

1. IEEE.
2. NETA.
3. IES.
4. ISA.
5. NEC.
6. NEMA.
7. NFPA.
8. NIST.
9. Specific definitions:
10. FAT: Factory acceptance test.
11. LCS: Local Control Station
12. ICSC: Instrumentation and controls subcontractor.
13. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
14. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
15. PCIS: Process control and instrumentation system.
16. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
17. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide all standoffs, bus, and hardware, as part of the space.
18. Spare: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that physically contains a device with no load connections to be made.
19. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
20. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

1.4 SYSTEM DESCRIPTION

A. General requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:
    a. The Electrical Drawings are schematic in nature; use the Structural, Architectural, Mechanical, and Civil Drawings for all dimensions and scaling purposes.

2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.

3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work.

4. Coordinate all aspects of the Work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the electrical subcontractor, the other subcontractors or suppliers.

5. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:

    a. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work. Determine all information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.

    b. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.

    c. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the Electrical Work and installation:

        1) As specified in the Contract Documents.

B. Operating facility:

1. The Facility is an operating facility. Portions of this facility must remain fully functional throughout the entire construction period. In consideration of this requirement, comply with the following guidelines:

    a. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction schedule to meet the requirements of the Owner. All changes in schedule and any needs to reschedule are included in the Work.

    b. As weather and water demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.

    c. Coordinate the construction and power renovation, bear all costs, so that all existing facilities can continue operation throughout construction.

    d. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.

    e. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.

1.5 SUBMITTALS

A. General:

1. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.
2. Furnish the submittals required by each section in the Electrical Specifications.
3. Adhere to the wiring numbering scheme specified in the section for Identification for Electrical Systems throughout the Project:
4. Uniquely number each wire.
5. Wire numbers must appear on all Equipment Drawings.
6. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

B. Seismic requirements:

1. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site seismic loads based on the seismic design criteria in Specifications.
2. For equipment installed in structures designated as seismic design category C, D, E or F, prepare and submit the following:
    a. Statement of seismic qualification, and special seismic certification:
        1) “Statement of seismic qualification:” Provide manufacturer’s statement that the equipment satisfies the seismic design requirements of the building code indicated in the section for Regulatory Requirements, including the requirements of ASCE 7, Chapter 13.
        2) “Special seismic certification:” Provide manufacturer’s certification that the equipment, when subjected to shake table testing in accordance with ICC-ES AC 156, meets the “Post-Test Functional Compliance Verification” requirements of ICC-ES AC 156 for “Components with Ip = 1.5.” Compliance shall include both operability and containment of hazardous materials as appropriate to the unit being tested.
    b. Substantiating test data: With seismic qualification and special seismic certification statements, submit results of testing in accordance with ICC-ES AC 156.
    c. Anchoring design calculations and details:
        1) Submit project-specific drawings and supporting calculations, prepared and sealed by a professional engineer licensed in the state where the Project is being constructed, and showing details for anchoring electrical equipment to its supports and for anchoring supports provided with the equipment to the structure. Prepare calculations in accordance with the requirements of the section for Seismic Design Criteria.
        2) Exemptions: A “statement of seismic qualification” and a “special seismic certification” are not required for the following equipment:
    d. Temporary or moveable equipment.
        1) Equipment anchored to the structure and having a total weight of 20 pounds or less.
        2) Distribution equipment anchored to the structure and having a total unit weight of 3 pounds per linear foot, or less.

C. Submittal organization:

1. First page:
    a. Specification section reference.

b. Name and telephone number of individual who reviewed submittal before delivery to Engineer.

c. Name and telephone number of individual who is primarily responsible for the development of the submittal.

d. Place for Contractor's review stamp and comments.

2. Next pages:

a. Provide confirmation of specification compliance:

1) Specification section: Include with each submittal a copy of the relevant specification section.

2) Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).

3) Provide a list of all numbered deviations with a clear explanation and reason for the deviation.

b. Include a response in writing to each of the Engineer's comments or questions for submittal packages which are re-submitted:

1) In the order that the comments or questions were presented throughout the submittal.

2) Referenced by index section and page number on which the comment appeared.

c. Acceptable responses to Engineer's comments are either:

1) Engineer's comment or change is accepted and appropriate changes are made.

2) Explain why comment is not accepted or requested change is not made.

3) Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.

d. Any re-submittal, which does not contain responses to the Engineer's previous comments shall be returned for Revision and Re-submittal.

e. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Remaining pages:

a. Actual submittal data:

1) Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

2) For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is intended to be used.

D. Submittal requirements:

1. Furnish submittals that are fully indexed with a tabbed divider for every component.

2. Sequentially number pages within the tabbed sections. Submittals and operation and maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

3. Edit all submittals and operation and maintenance manuals so that the submittal specifically applies to only the equipment furnished.

4. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

5. Submit copies of shop drawings, and product data:

    a. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

6. Where submittals are required, provide a separate submittal for each specification section. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:

    a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section. (For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.)

7. Exceptions to Specifications and Drawings:

    a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.

    b. If there is insufficient explanation for the exception or deviation, the submittal will be returned requiring revision and re-submittal.

    c. Acceptance of any exception is at the sole discretion of the Engineer.

    d. Provide all items (materials, features, functions, performance, etc.) required by the Contract Documents that are not accepted as exceptions.

    e. Replace all items that do not meet the requirements of the Contract Documents, which were not previously accepted as exceptions, even if the submittals contained information indicating the failure to meet the requirements.

8. Specific submittal requirements:

    a. Shop drawings:

        1) Required for materials and equipment listed in this and other sections.

        2) Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

        3) Shop drawings requirements:

            a) Front, side, and, rear elevations, and top and bottom views, showing all dimensions.

            b) Locations of conduit entrances and access plates.

            c) Component layout and identification.

            d) Schematic and wiring diagrams with wire numbers and terminal identification.

            e) Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.

            f) Anchoring method and leveling criteria, including manufacturer’s recommendations for the Project site seismic criteria.

            g) Weight.

h) Finish.

b. Nameplates:

1) As specified in the section for Identification for Electrical Systems.

2) Temperature limitations, as applicable.

c. Product data:

1) Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.

2) Include:

a) Catalog cuts.

b) Bulletins.

c) Brochures.

d) Quality photocopies of applicable pages from these documents.

e) Identify on the data sheets the Project name, applicable specification section, and paragraph.

f) Identify model number and options for the actual equipment being furnished.

g) Neatly cross out options that do not apply or equipment not intended to be supplied.

h) Detailed sequence of operation for all equipment or systems.

E. Operation and maintenance manuals:

1. As specified in the section for Operation and Maintenance Data.

2. Furnish the Engineer with a complete set of written operation and maintenance manuals 8 weeks before Functional Acceptance Testing.

F. Material and equipment schedules:

1. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:

2. Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

G. Schedule of values:

1. In addition to completing all items referred to in the schedule of values, submit per unit material and labor costs used in developing the final bid for the electrical system, for the express purpose of pricing and cost justification for any proposed change orders. In addition to the items shown on the schedule of values, provide per unit material and labor costs for conduit and wire installation for specific types, sizes, and locations as indicated on the Drawings. It is the responsibility of the electrical subcontractor to prove to the Engineer's satisfaction that said per unit costs were used in the development of the final Bid amount.

H. Roof penetrations:

1. Submit details of all portions of the electrical installation that penetrate the roof. Include details showing support of the penetrating component, and the sealing means to be utilized.

I. Record Documents:

1. Provide Record Documents of all Electrical Drawings.
2. Record Drawing requirements:
    a. Update Record Drawings weekly.
    b. Record Drawings must be fully updated as a condition of the monthly progress payments.
    c. Submit Record Drawings upon completion of the Work for final review.
    d. Clearly and neatly show all changes including the following:
        1) All existing pipe, conduit, wire, instruments or other structures encountered or uncovered during construction.
3. Shop drawings:
    a. Upon completion of the Work, update all shop drawings to indicate the final as-built configuration of the systems:
    b. Provide as-built shop drawings for all electrical equipment on 11-inch by 17-inch paper.
    c. Size all drawings to be readable and legible on 11-17-inch media.
    d. Provide electronic copies of these documents on CD-ROM or DVD disks in PDF format.
4. Review and corrections:
    a. Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.
    b. Promptly correct and re-submit record documents returned for correction.

J. Test reports:
1. Include the following:
    a. A description of the test.
    b. List of equipment used.
    c. Name of the person conducting the test.
    d. Date and time the test was conducted.
    e. All raw data collected.
    f. Calculated results.
2. Each report signed by the person responsible for the test.
3. Additional requirements for field acceptance test reports are specified in the section for Field Electrical Acceptance Tests.

K. Calculations:
1. Where required by specific Electrical Specifications:
    a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

1.6 QUALITY ASSURANCE

A. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the section for Product Requirements.

B. Shipping precautions:

1. After completion of shop assembly and successful factory testing, pack all equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.

2. Place dehumidifiers, when required, inside the polyethylene coverings.

3. Skid-mount the equipment for final transport.

4. Provide lifting rings for moving without removing protective covering.

5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

C. Delivery and inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

D. Special instructions:

1. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

1.8 PROJECT OR SITE CONDITIONS

A. Site conditions:

1. Provide an electrical, instrumentation and control system, including all equipment, raceways, and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.

2. Seismic load resistance:

a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site seismic loads as specified in Specifications.

3. Wind load resistance:

a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site wind loads as specified in Specifications.

4. Altitude, temperature and humidity:

a. As specified in Specifications.

b. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.

c. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:

d. Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.

5. Outdoor installations:

a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.

b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:

c. Provide all wiring necessary to power these devices.

d. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:

1) NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.

2) NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing.

3) NEMA Type 4X: Made from corrosion resistant materials and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion. Provide specific materials as specified or indicated on the Drawings.

4) NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.

5) NEMA Type 7: Intended for installation in locations where explosive or combustible gas or vapors may be present (Class I Division 1 or Class I Division 2) meeting the requirements outlined in the section for Hazardous Classified Area Construction.

6. Plant area Electrical Work requirements:

a. Provide all Electrical Work in accordance with the following table, unless otherwise specifically indicated on the Drawings:

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Indoor Conditioned Spaces	NEMA 1	Galvanized rigid steel	C	Stainless steel
Above lay-in ceilings	NEMA 1	EMT	C	Stainless steel
Indoor Non-Conditioned Spaces	NEMA 1	Galvanized rigid steel	C	Stainless steel
Below Grade/Vault	NEMA 3R	Galvanized rigid steel	X	Stainless steel
Outdoor	NEMA 3R	Galvanized rigid steel	W	Stainless steel

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Classified Areas	NEMA Type 7	Galvanized rigid steel	H	Stainless steel

Modify exposed conduit runs as specified in the section for Conduits.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING

A. General:

1. Testing requirements are specified in the section for Field Electrical Acceptance Tests and other sections.

B. Pre-submittal conference:

1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, control philosophy, schedules, and submittal requirements.

2. Contractor, electrical subcontractor, all suppliers, and individual equipment manufacturers furnishing major pieces of equipment must attend.

C. Factory acceptance testing (FAT):

1. Where FAT is required for equipment covered by these Specifications, notify the Engineer in writing when the equipment is completed and ready for factory inspection and testing:

2. Indicate the desired dates for inspection and testing.

3. Schedule the FAT after approval of the FAT procedures submittal:

a. Submit a copy of the test procedures including all forms at least 21 days before any scheduled test date.

b. Notify the Engineer of the scheduled tests a minimum of 15 days before the date of the test.

1.11 WARRANTY

A. Warrant the Electrical Work as specified in General Conditions:

B. Provide additional warranty as specified in the individual Electrical Specifications.

1.12 SYSTEM START-UP

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

B. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

B. Furnish all spare parts as required by other sections of the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide similar items of same manufacturer throughout the electrical and instrumentation portion of the Project.

B. Allowable manufacturers are specified in individual Electrical Specifications.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in General Conditions.

C. Stainless steel:

1. Where stainless steel is indicated or used for any portion of the Electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.

2. Provide exposed screws of the same alloys.

3. Provide finished material free of any burrs or sharp edges.

4. Use only stainless steel hardware, when chemically compatible, in all areas that are or could be in contact with corrosive chemicals.

5. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.

6. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.

2.4 MANUFACTURED UNITS (NOT USED)

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES (NOT USED)

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The electrical subcontractor is encouraged to visit the site to examine the premises completely before bidding.

B. **Review the site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.**

C. It is the electrical subcontractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

D. Comply with pre-bid conference requirements as specified in Instructions to Bidders.

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:

B. Verify all dimensions indicated on the Drawings:

1. Actual field conditions govern all final installed locations, distances, and levels.

C. Review all Contract Documents and approved equipment shop drawings and coordinate Work as necessary to adjust to all conditions that arise due to such changes.

D. Make minor changes in location of equipment before rough in, as directed by the Owner or Engineer.

E. Provide a complete electrical system:

1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical system.

2. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

F. Cutting and patching:

1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:

2. Secure the permission of the Engineer before performing any operation likely to affect the strength of a structural member such as drilling, cutting or piercing:

3. Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:

a. Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.

b. Use tone-locate system or X-ray to ensure that area is clear of obstructions.

c. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.

4. Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:
    a. 3M: CP 25WB+: Caulk.
    b. 3M: Fire Barrier: Putty.
5. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear:
    a. Install all conduits and equipment in accordance with working space requirements in accordance with the NEC.
    b. This includes any panel, disconnect switch or other equipment that can be energized while open exposing live parts regardless of whether it is likely to require examination or has serviceable parts.
    c. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.
    d. Adjust equipment locations as necessary to avoid any obstruction or interferences.
    e. Where an obstruction interferes with equipment operation or safe access, relocate the equipment.
    f. Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

G. Earthwork and concrete:
1. Install all trenching, shoring, concrete, backfilling, grading and resurfacing associated with the Electrical Work:
    a. Requirements as specified in the Contract Documents.

H. Roof penetrations:
1. Seal conduit penetrations in accordance with roofing manufacturer’s instructions.

I. Terminations:
1. Provide and terminate all conductors required to interconnect power, controls, instruments, panels, and all other equipment.

J. Miscellaneous installation requirements:
1. In case of interference between electrical equipment indicated on the Drawings and the other equipment, notify the Engineer as specified in General Conditions.
2. Location of manholes and pullboxes indicated on the Drawings are approximate. Coordinate exact location of manholes and pullboxes with Mechanical and Civil Work.
3. Provide additional manholes or pullboxes to those shown where they are required to make a workable installation.
4. Circuits of different service voltage:
    a. Voltage and service levels:
    b. Medium voltage: greater than 1.0 kV.
    c. Low voltage: 120 V to 480 V.
    d. Instrumentation: Less than 50 VDC.

e. Install different service voltage circuits in separate raceways, and junction boxes.

5. In manholes, install all cables operating at less than 50 VDC in PVC coated flexible metallic conduit, with corrosion resistant fittings.

6. Labeling:

K. Equipment tie-downs:

1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing criteria, which apply to the Site.

2. **ALL CONTROL PANELS MUST BE PERMANENTLY MOUNTED AND TIED DOWN TO STRUCTURES IN ACCORDANCE WITH THE PROJECT SEISMIC CRITERIA.**

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 FIELD QUALITY CONTROL

A. Inspection:

1. Provide any assistance necessary to support inspection activities.

2. Engineer inspections may include, but are not limited to, the following:

3. Inspect equipment and materials for physical damage.

4. Inspect installation for compliance with the Drawings and Specifications.

5. Inspect installation for obstructions and adequate clearances around equipment.

6. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

7. Inspect equipment nameplate data to verify compliance with design requirements.

8. Inspect raceway installation for quality workmanship and adequate support.

9. Inspect cable terminations.

10. Inspection activities conducted during construction do not satisfy inspection or testing requirements specified in the section for Field Electrical Acceptance Tests.

B. Field acceptance testing (Functional Testing):

1. Notify the Engineer when the Electrical Work is ready for field acceptance testing.

2. Perform the field acceptance tests as specified in the section for Field Electrical Acceptance Tests.

3. Record results of the required tests along with the date of test:

4. Use conduit identification numbers to indicate portion of circuit tested.

C. Workmanship:

1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:

2. Neatly coil and label spare wiring lengths.

3. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the Engineer.

3.8 ADJUSTING (NOT USED)

3.9 CLEANING

A. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.

B. Clean and vacuum all enclosures to remove all metal filings, surplus insulation and any visible dirt, dust or other matter before energization of the equipment or system start-up:

C. Use of compressors or air blowers for cleaning is not acceptable.

D. As specified in other sections of the Contract Documents.

3.10 PROTECTION

A. Protect all Work from damage or degradation until Substantial Completion.

B. Maintain all surfaces to be painted in a clean and smooth condition.

3.11 SCHEDULES (NOT USED)

END OF SECTION

SECTION 260600

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Grounding materials and requirements.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

D. Underwriters Laboratories, Inc. (UL):
   1. 467 - Ground and Bonding Equipment.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

1.4 SUBMITTALS

A. Furnish submittals as specified in the Submittal Procedures section and the Common Work Results for Electrical section.

B. Product data:
   1. Catalog cut sheets.

1.5 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. All grounding components and materials shall be UL listed and labeled.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.7 PROJECT/SITE CONDITIONS (NOT USED)

1.8 SEQUENCING (NOT USED)

1.9 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in the Common Work Results for Electrical.

1.11 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Exothermic connectors: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Burndy.
   4. Thomas & Betts.

B. Ground rods: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Nehring.
   4. Thomas & Betts.

C. Ground cable: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Nehring.
   4. Southwire.

D. Precast ground well boxes: One of the following or equal:
   1. Brooks Products, 3-RT Valve Box.
   2. Christy Concrete Products, G12 Valve Box.

2.2 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:
   1. Grounding electrodes.
   2. Bonding jumpers.
   3. Ground connections.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.

D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 16950 - Field Electrical Acceptance Tests, shall be:
   1. 5 ohms or less for industrial systems.

2.3 EXISTING PRODUCTS (NOT USED)

2.4 MATERIALS

A. Ground rod:
   1. Minimum: 3/4-inch diameter, 10 feet long.
   2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
      a. The copper-to-steel bond shall be corrosion resistant.
   3. In accordance with UL 467.
   4. Sectional type joined by threaded copper alloy couplings.
   5. Fit the top of the rod with a threaded coupling and steel-driving stud.

B. Ground cable:
   1. Requirements:
      a. Soft drawn (annealed).
      b. Concentric lay, coarse stranded in accordance with ASTM B8.
   2. Size is as indicated on the Drawings, but not less than required by the NEC.

C. Exothermic welds:
   1. Current carrying capacity equal to that of the conductor.
   2. Permanent molecular bond that cannot loosen or corrode over time.
   3. Will not deteriorate with age.
   4. Use low emission welds for indoor installations.

D. Equipment grounding conductors:
   1. Conductors shall be the same type and insulation as the load circuit conductors:
      a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
   2. Minimum size in accordance with the NEC.

E. Grounding electrode conductors:
   1. Minimum size in accordance with the NEC.

F. Main bonding jumpers and bonding jumpers:
   1. Minimum size in accordance with the NEC.

2.5 MANUFACTURED UNITS (NOT USED)

2.6 EQUIPMENT (NOT USED)

2.7 COMPONENTS (NOT USED)

2.8 ACCESSORIES

A. Precast ground well boxes:
   1. Minimum 10-inch interior diameter.
   2. Traffic-rated cast iron cover.

3. Permanent “GROUND” marking on cover.

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
   1. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
   2. Provide a separate grounding conductor in each individual raceway for parallel feeders.

C. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:
   1. When grounding motors driven by variable frequency drives (VFD) comply with the requirements of the VFD manufacturer.

D. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
   1. Individually bond these raceways to the ground bus in the equipment.

E. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

F. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

G. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

H. Duct bank ground system:
   1. Provide a bare copper grounding conductor the entire length of each duct bank.
   2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

I. Grounding at service (600 V or Less):
   1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

J. Ground connections:
   1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using exothermic welds as indicated on the Drawings, UL listed, and labeled for the application.
   2. Make ground connections in accordance with the manufacturer's instructions.

K. Grounding electrode system:
   1. Ground ring:
      a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.
      b. Ground ring conductor shall be in direct contact with the earth.
      c. Minimum burial depth 36 inches or as indicated on the Drawings.
      d. Re-compact disturbed soils to original density in 6-inch lifts.
   2. Ground rods:
      a. Locations as indicated on the Drawings.
      b. Length of rods forming an individual ground array shall be equal in length.
      c. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.
   3. Metal underground water pipe:
      a. Bond metal underground domestic water pipe to grounding electrode system.
   4. Metal frame of building or structure:
      a. Bond metal frame of building or structure to grounding electrode system.
   5. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
   6. Where grounding conductors are not concrete-encased or direct buried, install in Schedule 40 PVC conduit for protection.
   7. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

L. Shield grounding:
   1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
   2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable run.
   3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
   4. Terminate the signal cable shield on a dedicated grounding terminal block.

M. Where indicated on the Drawings, install ground rods in precast ground wells.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

B. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.9 ADJUSTING

A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
   1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in Section 16050 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 260700

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Mounting and supporting electrical equipment and components.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

1.4 SYSTEM DESCRIPTION

A. Design requirements:
   1. Demonstrate the following using generally accepted engineering methods:
      a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
      b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.
   2. Design loading and anchoring requirements:
      a. As indicated in the Building Code unless otherwise specified.
      b. Seismic loading requirements:
         1) Freestanding, suspended, or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in the Common Work Results for Electrical section.
      c. Wind loading requirements:
         1) All exterior equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in the Common Work Results for Electrical section.
      d. Minimum safety factor against overturning: 1.5.
      e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
   1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.5 SUBMITTALS

A. Furnish submittals as specified in the Submittal Procedures section and the Common Work Results for Electrical section.

B. Product data:
   1. Supports:
      a. Materials.
      b. Geometry.
      c. Manufacturer.
   2. Hardware:
      a. Materials.
      b. Manufacturer.

C. Shop drawings:
   1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
   2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, and wall supports for all equipment:
      a. For free standing supports and wall supports supporting equipment weight in excess of 200 pounds:
         1) Stamped by a professional engineer licensed in the state where the Project is being constructed.
      b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.
   3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

D. Installation instructions:
   1. Furnish anchorage instructions and requirements based on the seismic and wind conditions of the Site:
      a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM STARTUP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:
   1. Preformed channel:
      a. Thomas & Betts.
      b. Power-Strut.
      c. Unistrut.
      d. Cooper B-Line.
      e. Robroy.
      f. Tyco.

B. Nonmetallic cable rack:
   1. Underground Devices Inc.
   2. Hubbell.
   3. Unistrut.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

A. Use materials appropriate for the area as specified in the Common Work Results for Electrical section.

B. Preformed channel:
   1. Stainless steel:
      a. Supports:
         1) In accordance with ASTM A240.
         2) ANSI Type 316 material.
      b. Hardware:
         1) ANSI Type 316 material.

C. Non-metallic cable rack:
   1. Consists of stanchions and cable support arms.
   2. Stanchions:
      a. 50 percent glass reinforced nylon or other non-metallic material.
      b. Capable of supporting multiple arms.
      c. Recessed bolt mounting holes.
      d. Length as required.
   3. Arms:
      a. 50 percent glass reinforced nylon or other non-metallic material.
      b. Size the arms based on the length and weight of the cable to be supported.
   4. Stainless steel mounting hardware.

2.4 MANUFACTURED UNITS (NOT USED)

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES (NOT USED)

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. Preformed Channel:
   1. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings.
      a. Provide the necessary sway bracing to keep trapeze type structures from swaying under seismic events or wind loading.
   2. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
      a. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.
   3. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
      a. Fabricate pedestals out of welded angle, tube sections, or preformed channel.
      b. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
      c. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
   4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
      1) Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.
   5. Corrosion protection:
      a. Isolate dissimilar metals, except where required for electrical continuity.
         1) Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.
   6. Raceway:
      a. Furnish all racks and trapeze structures needed to support the raceway from the structure.
         1) Group raceway and position on racks to minimize crossovers.
         2) Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.
   7. Anchoring methods:

a. Solid concrete: Anchor bolts, anchor rods or post-installed anchors.
b. Metal surfaces: Machine screws or bolts.
c. Hollow masonry units: Post-installed anchors.

8. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.
9. Recoat or seal all drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

C. Non-metallic cable rack:
1. Install the non-metallic cable rack in accordance with the manufacturer's recommendations.
2. Provide at least 2 stanchions and 2 arms at each installation.
3. Mount the cable rack so that the supported cable does not interfere with access to manhole or handhole and so that the supported cable does not lie on the floor.
4. Do not exceed the cable manufacturer's minimum bending radius.
5. Use nylon cable ties to secure the cable to the supports.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 261230

600-VOLT OR LESS WIRES AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. 600 volt class or less wire and cable.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. CSA International (CSA).

D. Insulated Cable Engineers Association (ICEA):
   1. NEMA WC 70/ICEA S-95-658-1999 - Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   2. NEMA WC 57/ICEA S-73-532 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.

E. National Fire Protection Association (NFPA):
   1. 72 - National Fire Alarm and Signaling Code.
   2. 101 - Life Safety Code.

F. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):
   1. 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.
   2. 569-B – Commercial Building Standards for Telecommunications Pathways and Spaces.
   3. 1005 – Industrial Cabling Standard.

G. Underwriter's Laboratories Inc., (UL):
   1. 44 - Thermoset-Insulated Wires and Cables.
   2. 1277 - Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
   3. 1424 - Standard for Cables for Power-Limited Fire-Alarm Circuits.
   4. 1569 - Standard for Metal-Clad Cables.
   5. 2196 - Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
   6. 2225 - Standard for Cables and Cable-Fittings for Use in Hazardous (Classified) Locations.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. Specific definitions and abbreviations:
   1. AWG: American wire gauge.
   2. BCCS: Bare copper-covered steel.
   3. CPE: Chlorinated polyethylene.
   4. FEP: Fluorinated ethylene propylene.
   5. FHDPE: Foam high-density polyethylene.
   6. FPE: Foam polyethylene.
   7. OD: Outside diameter.
   8. PVC: Polyvinyl chloride.
   9. XHHW: Cross-linked high heat water resistant insulated wire.

C. Definitions of terms and other electrical considerations as set forth in the:
   1. ASTM.
   2. ICEA.

1.4 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.5 SUBMITTALS

A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:
   1. Manufacturer of wire and cable.
   2. Insulation:
      a. Type.
      b. Voltage class.
   3. AWG size.
   4. Conductor material.
   5. Pulling compounds.

C. Shop drawings:
   1. Show splice locations.
      a. For each proposed splice location provide written justification describing why the splice is necessary.

D. Test reports:
   1. Submit test reports for meg-ohm tests.

E. Calculations:
   1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:
      a. Provide a table showing the manufacturer’s recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
      b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. All wires and cables shall be UL listed and labeled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS (NOT USED)

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER`S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:
   1. 600 volt class wire and cable:
      a. General Cable.
      b. Okonite Co.
      c. Southwire Co.
      d. Service Wire.
   2. Instrumentation class wire and cable:
      a. Alpha Wire Co.
      b. Belden CDT.
      c. General Cable.
      d. Okonite Co.
      e. Rockbestos Surprenant Cable Corp.
   3. Network cables:
      a. General Cable.
      b. Belden.
      c. CommScope.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS

A. Conductors:
   1. Copper in accordance with ASTM B3.

2.4 MANUFACTURED UNITS

A. General:
   1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
   2. Permanently mark each wire and cable with the following at 24-inch intervals:
      a. AWG size.
      b. Voltage rating.
      c. Insulation type.
      d. UL symbol.
      e. Month and year of manufacture.
      f. Manufacturer's name.
   3. Identify and mark wire and cable as specified in the Identification for Electrical Systems section:
      a. Use integral color insulation for #2 AWG and smaller wire.
      b. Wrap colored tape around cable larger than #2 AWG.

B. 600 volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings:
      a. When not indicated on the Drawings, size wire as follows:
         1) In accordance with the NEC:
            a) Use 75 degree Celsius ampacity ratings.
            b) Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
         2) Provide #12 AWG minimum for power conductors.
         3) Provide #14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. XHHW-2.
      b. 90 degree Celsius rating.
   4. Multiconductor cables:
      a. Number and size of conductors as indicated on the Drawings.
      b. Individual conductors with XHHW-2 insulation.
      c. Overall PVC jacket.
      d. Tray cable rated.
      e. Color-coding for control wire in accordance with ICEA Method 1, E-2 in accordance with NEMA WC 57/ICEA S-73-532.
      f. Ground conductor: Insulated, green:
         1) Sized in accordance with NEC.

C. Instrumentation class cable:
   1. Type TC.
   2. Suitable for use in wet locations.
   3. Voltage rating: 600 volts.
   4. Temperature rating:
      a. 90 degree Celsius rating in dry locations.
      b. 75 degree Celsius rating in wet locations.
   5. Conductors:
      a. Insulation:
         1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.

b. #16 AWG stranded and tinned.
c. Color code: ICEA Method 1:
1) Pair: Black and white.
2) Triad: Black, white and red.
3) Multiple pairs or triads:
a) Color-coded and numbered.

6. Drain wire:
a. #18 AWG.
b. Stranded, tinned.
7. Jacket:
a. Flame retardant, moisture and sunlight resistant PVC.
b. Ripcord laid longitudinally under jacket to facilitate removal.
8. Shielding:
a. Individual pair/triad:
1) Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.
b. Multiple pair or triad shielding:
1) Group shield: Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.
2) Completely isolate group shields from each other.
3) Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.
c. All shielding to be in contact with the drain wire.

D. Network cables:
1. Category 5e:
a. General:
1) Provide Cat 5e cables meeting the standards set by TIA/EIA-568-C.2 and verified by third-party testing laboratory.
b. Conductors:
1) #24 AWG solid bare annealed copper.
c. Insulation:
1) Polyolefin.
2) 4 non-bonded twisted pair cables formed into a cable core.
d. Shielding: None.
e. Color code (T568B):
1) Pair 1: White/blue stripe and blue.
2) Pair 2: White/orange stripe and orange.
3) Pair 3: White/green stripe and green.
4) Pair 4: White/brown stripe and brown.
f. Outer jacket:
1) PVC with ripcord.
g. Electrical characteristics
1) Voltage rating: 600VAC.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

A. Wire ties:

1. One of the following or equal:
    a. T&B, "Ty-Rap" cable ties.
    b. Panduit, cable ties.

B. Wire markers:
    1. As specified in the Identification for Electrical Systems section.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of ICEA S-95-658-1999.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. Color-coding:
    1. Color-coding shall be consistent throughout the facility.
    2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
        a. Phase A: Black.
        b. Phase B: Red.
        c. Phase C: Blue.
        d. Single phase system: Black for 1 hot leg, red for the other.
        e. Neutral: White.
        f. High phase or wild leg: Orange.
        g. Equipment ground: Green.
    3. The following color code shall be followed for all 480/277 volt systems:
        a. Phase A: Brown.
        b. Phase B: Orange.
        c. Phase C: Yellow.
        d. Neutral: Gray.
        e. Equipment ground: Green.
    4. The following color code shall be followed for all 120 VAC control wiring:
        a. Power: Red.
        b. Neutral: White.
    5. The following color code shall be followed for all general purpose DC control circuits:
        a. Grounded conductors: White with blue stripe.

b. Ungrounded conductors: Blue.
6. Switch legs shall be violet. 3-way switch runners shall be pink.
7. Wires in intrinsically safe circuits shall be light blue.
8. Wire colors shall be implemented in the following methods:
   a. Wires manufactured of the desired color.
   b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
      1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
   1. Install wires only in approved raceways.
   2. Do not install wire:
      a. In incomplete conduit runs.
      b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:
   1. For all #4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
      a. Ideal Products.
      b. Polywater Products.
      c. 3M Products.
      d. Greenlee Products.
      e. Or equal as recommended by cable manufacturer.
      f. Do not use oil, grease, or similar substances.

E. Cable pulling:
   1. Prevent mechanical damage to conductors during installation.
   2. For cables #1 AWG and smaller, install cables by hand.
   3. For cables larger than #1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
   4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
   5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
   6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:
      a. Make splices in manholes or pull boxes only.
      b. Leave sufficient slack to make proper connections.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer's recommendations.

H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
   1. Do not lace wires in gutter or panel channel.
   2. Install all wire ties with a flush cutting wire tie installation tool:
      a. Use a tool with an adjustable tension setting.
   3. Do not leave sharp edges on wire ties.

I. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
   1. Use ring type lugs if box lugs are not available on the equipment.

J. Lighting circuits:
   1. Each circuit shall have a dedicated neutral.

K. Splices:
   1. Provide continuous circuits from origin to termination whenever possible:
      a. Obtain Engineer's approval prior to making any splices.
   2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
   3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
      a. Splice box NEMA rating requirements as specified in the Common Work Results for Electrical section.
      b. Make splices in labeled junction boxes for power conductors.
      c. Make splices for control and instrument conductors in terminal boxes:
         1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
   4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
   5. Clearly label junction and terminal boxes containing splices with the word "SPLICE LOCATED WITHIN".
   6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
   7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
      a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
   8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
      a. A heat shrink insulating system listed for submersible applications.
      b. Or an epoxy resin splicing kit.

L. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

M. Instrumentation class cable:
   1. Install instrumentation class cables in separate raceway systems from power cables:
      a. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
      b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.
   2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.
   3. Shield grounding requirements as specified in the Grounding and Bonding section.

N. Copper Ethernet cables:
   1. Comply with TIA/EIA-568-C.2.
   2. Pathways:

a. For initial installation, the maximum fill capacity for pathways (i.e. conduit, raceways, trays, baskets) is 40 percent. The maximum fill capacity of 60 percent is allowed to accommodate future additions after initial installation.
b. Conduit should be run in the most direct route possible with no more than two 90 degree bends between pull boxes and serve no more than 3 outlet boxes.

3. Cable bend radius:
   a. Proper cable bend radius control must be maintained throughout the pathways. The bend radius needs to be at a minimum 10 times the cable diameter.
4. Cable pulling:
   a. Provide cable pulling swivel system to prevent winding and tangling of rope and cables during pull.
   b. The maximum pulling tension is not to exceed manufacturer recommendations. Cable installation should not in any way deform the cable jacket.
   c. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
5. Cable management:
   a. Organize and manage cables for quick and easy moves, adds and changes.
6. Testing:
   a. All cables and termination hardware shall be 100 percent tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of TIA/EIA-568-C.1 Section 11.
      1) All pairs of each installed cable shall be verified prior to system acceptance.
      2) Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100 percent useable conductors in all cables installed.
   b. All twisted-pair copper cable links shall be tested for compliance to the requirements in TIA/EIA/568-C.2 for the appropriate Category of cabling installed.
   c. All cables shall be tested in accordance with the contract documents, TIA/EIA standards, and best industry practice.
   d. The field test equipment shall meet the requirements of TIA/EIA-568-C. The appropriate level III tester shall be used to verify Category 6 cabling.
   e. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.1.
   f. Visually inspect cable placement, cable termination, grounding and bonding, equipment and labeling of all components.
   g. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors.
      1) Test operation of shorting bars in connection blocks.
      2) Test cables after termination but not cross-connection.
         a) Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2.
            (1) Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex.
            (2) Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
7. Separation from EMI sources:

a. Comply with TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches
c. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
d. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
    2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
e. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

O. Multi-conductor cable:
1. Where cable is not routed in conduit with a separate ground conductor, use 1 conductor in the cable as a ground conductor:
    a) Use an internal ground conductor, if it is no smaller than as indicated on the Drawings and in accordance with NEC requirements for equipment ground conductor size.
    b) Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with one of the full-sized conductors serving as ground.

P. Armored cable:
1. Where 2 parallel cables are used, and the internal ground conductor in each cable does not meet NEC requirements for the combined circuit, use 4-conductor cable, with 1 of the full-sized conductors serving as ground.
2. The cable armor is not acceptable as a ground conductor.
3. Where armored cable terminates at a device, switchboard, panel, etc., use armored cable connector.
4. Where armored cable run continues in conduit, strip jacket and armor for portions in conduit, and terminate cable and jacket with an armored cable connector threaded into a coupling or conduit box.

Q. Telephone cable:
1. Install telephone cables in dedicated metallic raceways, including raceways in duct banks, manholes, and pull boxes.

R. Fire alarm cable:
1. Install fire alarm cable in dedicated metallic raceways as indicated on the Drawings.

S. Signal cable:

1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

T. Submersible cable in wet wells:
   1. Provide Kellem's grip or stainless steel wire mesh to support cable weight and avoid stress on insulation.

U. Wiring allowances:
   1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.
   2. Locations for pull boxes, manholes, and duct banks may vary slightly from the drawings. Include an allowance for necessary conductors and related materials to provide conductors to all pull boxes, manholes and duct banks within 20 linear feet of locations indicated on the Drawings.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

B. Grounding:
   1. As specified in the Grounding and Bonding section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16130

CONDUITS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Metallic conduits.
2. Nonmetallic conduits.
3. Conduit bodies.
4. Conduit fittings and accessories.
5. Conduit installation.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. American National Standards Institute (ANSI):
1. C80.1 - Electrical Rigid Steel Conduit.
2. C80.3 - Steel Electrical Metallic Tubing.
3. C80.5 - Electrical Rigid Aluminum Conduit.
4. C80.6 - Electrical Intermediate Metal Conduit.

C. National Electrical Manufacturer's Association (NEMA):
1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
4. TC7 - Smooth-Wall Coilable Electrical Polyethylene Conduit.
5. TC13 - Electrical Nonmetallic Tubing.
6. TC14 - Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

D. Underwriters Laboratories (UL):
1. 1 - Standard for Flexible Metal Conduit.
2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
3. 6A - Standard for Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
4. 360 - Standard for Liquidtight Flexible Steel Conduit.
5. 651 - Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
6. 651B - Standard for Continuous Length HDPE Conduit.
7. 797 - Standard for Electrical Metallic Tubing - Steel.
8. 1242 - Standard for Electrical Intermediate Metal Conduit - Steel.
9. 1653 - Standard for Electrical Nonmetallic Tubing.
10. 1660 - Standard for Liquidtight Flexible Nonmetallic Conduit.
11. 1684 - Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. Specific definitions and abbreviations:

1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, Shapes C, E, LB, T, X, etc.
2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.
3. GRC: Galvanized rigid steel conduit.
4. PCS: Polyvinyl chloride (PVC) coated rigid steel conduit.
5. EMT: Electrical metallic tubing.
6. PVC: Polyvinyl chloride rigid nonmetallic conduit.
7. SLT: Sealtight-liquidtight flexible conduit.
8. EFLX: Explosion proof flexible conduit.
9. RAC: Rigid aluminum conduit.
10. NPT: National pipe thread.

1.4 SUBMITTALS

A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:
1. Furnish complete manufacturer's catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.
2. Furnish complete manufacturer's recommended special tools to be used for installation if required.

C. Certifications:
1. Furnish PVC-coated conduit manufacturer's certification for each installer.

D. Record Documents:
1. Incorporate all changes in conduit routing on electrical plan drawings.
2. Dimension underground and concealed conduits from building lines.
3. Furnish hard copy drawings.

1.5 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. All conduits, conduit bodies, and fittings shall be UL listed and labeled.

C. Every installer of PVC-coated metallic conduit shall be certified by the manufacturer for installation of the conduit.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

B. Do not expose non-metallic conduit to direct sunlight.

C. Do not store conduit in direct contact with the ground.

D. Do not store aluminum conduit in contact with concrete.

1.7 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.8 SEQUENCING

A. Before installing any conduit or locating any device box:
   1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.
   2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

1.9 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.11 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Galvanized rigid steel conduit:
   1. One of the following or equal:
      a. Western Tube and Conduit.
      b. Allied Tube and Conduit.
      c. Wheatland Tube Co.

B. PVC-coated rigid steel conduit:
   1. One of the following or equal:
      a. Robroy Ind.
      b. Ocal, Inc.
      c. Calbond.
      d. Allied.
      e. NEC, Inc. BlackGuard.

C. Sealtight-liquidtight flexible conduit:
   1. One of the following or equal:
      a. Southwire.
      b. AFC Cable Systems.
      c. Electri-Flex Co.
      d. Anaconda.

D. Explosion proof flexible conduit:
   1. One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
      c. Hubbell Killark.

E. Conduit bodies:

1. One of the following or equal:
    a. Crouse-Hinds.
    b. Appleton.
    c. O-Z/Gedney.
    d. Ocal, Inc.
    e. Robroy Ind.
    f. Calbond.
    g. Carlon.

F. Joint compound:
    1. The following or equal:
        a. Thomas and Betts.

G. Galvanized rigid steel conduit expansion fittings:
    1. One of the following or equal:
        a. Crouse-Hinds.
        b. Appleton.
        c. O-Z/Gedney.

H. PVC-coated rigid steel conduit expansion fittings:
    1. One of the following or equal:
        a. Ocal, Inc.
        b. Robroy Ind.
        c. NEC, Inc. BlackGuard.

I. Conduit sleeve:
    1. One of the following or equal:
        a. Crouse-Hinds.
        b. Appleton.
        c. O-Z/Gedney.

J. Conduit seals:
    1. One of the following or equal:
        a. Appleton.
        b. Crouse-Hinds.
        c. O-Z/Gedney.

K. Conduit hangers and supports:
    1. As specified in the Hangers and Supports section.

L. Conduit through wall and floor seals:
    1. The following or equal:
        a. O-Z/Gedney:
            1) Type "WSK."
            2) Type “CSM.”

2.2 SYSTEM DESCRIPTION

A. Provide conduits, conduit bodies, fittings, junction boxes, and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

2.3 EXISTING PRODUCTS (NOT USED)

2.4 MATERIALS (NOT USED)

2.5 MANUFACTURED UNITS (NOT USED)

2.6 EQUIPMENT (NOT USED)

2.7 COMPONENTS

A. GRC:
   1. All threads: NPT standard conduit threads with a 3/4-inch taper per foot:
      a. Running conduit threads are not acceptable.
   2. Hot-dip galvanized inside and out:
      a. Ensures complete coverage and heats the zinc and steel to a temperature that ensures the zinc alloys with the steel over the entire surface.
      b. Electro-galvanizing is not acceptable.
   3. Manufactured in accordance with:
      a. UL-6.
      b. ANSI C80.1.

B. PCS:
   1. The steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, conforming to the requirements for Type GRC.
   2. Coated conduit NEMA Standard RN-1:
      a. The galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.
   3. Factory-bonded PVC jacket:
      a. The exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.
      b. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictates otherwise.
      c. PVC coating on conduits and associated fittings shall have no sags, blisters, lumps, or other surface defects and shall be free of holes and holidays.
      d. The PVC adhesive bond on conduits and fittings shall be greater than the tensile strength of the PVC plastic coating:
         1) Confirm bond with certified test results.
   4. A urethane coating shall be uniformly and consistently applied to the interior of all conduits and fittings:
      a. Nominal thickness of 0.002 inch.
      b. Conduits having areas with thin or no coating are not acceptable.
      c. All threads shall be coated with urethane.
   5. The PVC exterior and urethane interior coatings applied to the conduits shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).
   6. PCS conduit bodies and fittings:
      a. Malleable iron.
      b. The conduit body, before PVC coating, shall be new, unused material and shall conform to appropriate UL standards.
      c. The PVC coating on the outside of conduit bodies shall be 0.040-inch thick and have a series of ribs to protect the coating from tool damage during installation.
      d. 0.002-inch interior urethane coating.
      e. Utilize the PVC coating as an integral part of the gasket design.
      f. Stainless steel cover screw heads shall be encapsulated with plastic to ensure corrosion protection.

g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.
    1) The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.
    2) The sleeve shall provide a vapor- and moisture resistant seal at every connection.

C. SLT:
1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:
    a. General purpose:
        1) Temperature range: -20 degrees Celsius to +80 degrees Celsius.
    b. Oil-resistant:
        1) Temperature range: -20 degrees Celsius to +60 degrees Celsius.
2. Sunlight-resistant, weatherproof, and watertight.
3. Manufactured from single strip steel, hot-dip galvanized on all 4 sides before conduit fabrication.
4. Strip steel spiral wound resulting in an interior that is smooth and clean for easy wire pulling.
5. Overall PVC jacket.
6. With integral copper ground wire, built in the core, in conduit trade sizes 1/2 inch through 1-1/4 inch.

D. EFLX:
1. Suitable for the hazardous Class and Group where installed:
    a. As specified in the Common Work Results for Electrical section.
2. Metallic braid shall provide continuous electrical path.
3. Stainless steel construction.
4. Provide fittings and unions as required for the installation.

E. PVC:
1. Extruded from virgin PVC compound:
    a. Schedule 40 unless otherwise specified.
    b. Schedule 80 extra-heavy wall where specified.
2. Rated for 90 degrees Celsius conductors or cable.
3. Rated for use in direct sunlight.

F. Conduit bodies:
1. Material consistent with conduit type:
    a. Malleable iron bodies and covers when used with Type GRC.
    b. Cast aluminum bodies and covers when used with Type RAC.
    c. PVC bodies and covers when used with Type PVC.
    d. PVC-coated malleable iron bodies and covers when used with Type PCS.
2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design:
    a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire-bending space.
3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.8 ACCESSORIES

A. Connectors and fittings:
1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:

1. Construction:
    a. Malleable iron or zinc-plated steel when used with steel conduit.
    b. Aluminum when used with aluminum conduit.
    c. Positive metallic conduit end stop.
    d. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
    e. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated grounding bushings:
1. Construction:
    a. Malleable iron or steel, zinc-plated, with a positive metallic end stop.
    b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
    c. Tin-plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical unions (Erickson Couplings):
1. Construction:
    a. Malleable iron for use with steel conduit.
    b. Aluminum for use with aluminum conduit.
    c. Concrete tight, 3-piece construction.
    d. Rated for Class I Division 1 Group D in hazardous areas.

E. SLT fittings:
1. Construction:
    a. Malleable iron.
    b. Furnished with locknut and sealing ring.
    c. Liquidtight, raintight, oiltight.
    d. Insulated throat.
    e. Furnish as straight, 45-degree elbows, and 90-degree elbows.
    f. Designed to prevent sleeving:
        1) Verify complete bonding of the raceway jacket to the plastic gasket seal.
    g. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if inserted into raceway and directly in contact with conductors, shall have rolled-over edges for sizes under 5 inches.
    h. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture-resistant/oil-resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.
2. Corrosion-resistant and outdoor SLT fittings:
    a. Construction:
        1) PVC-coated liquidtight fittings with a bonded 0.040-inch thick PVC coating on the metal connector to form a seal around the SLT conduit.
        2) Insulated throat and an integral sealing ring.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
1. Construction:
    a. Insulated throat.
    b. PVC-coated when used in corrosive areas.
    c. Bonding locknut.
    d. Recessed neoprene o-ring to ensure watertight and dusttight connector.
    e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
    f. 1-1/2-inch through 6-inch malleable iron zinc plated.
    g. Aluminum with aluminum conduit.
2. Usage:

a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

G. Sealing fittings:
1. Construction:
a. 40-percent wire fill capacity.
b. PVC-coated when used in corrosive areas.
c. Malleable ductile iron with steel conduit.
d. Aluminum with aluminum conduit.
e. Type EYDX where drains are required.
f. Type EYSX where drains are not required.
g. UL listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; and Class II, Divisions 1 and 2, Groups E, F, and G.
2. Sealing compound:
a. Fiber filler and cement as recommended by the sealing fitting manufacturer.
b. Approved for the conditions and use.
1) Not affected by surrounding atmosphere or liquids.
c. Melting point shall be 200 degrees Fahrenheit minimum.

H. PVC fittings:
1. Materials:
a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.
b. All metal hardware shall be stainless steel.

I. Through wall and floor seals:
1. Materials:
a. Body: Casting of malleable or ductile iron with a hot-dip galvanized finish Aluminum.
b. Grommet: Neoprene.
c. Pressure rings: PVC-coated steel.
d. Disc material: PVC-coated steel.

J. Expansion/deflection couplings:
1. Use to compensate for movement in any directions between 2 conduit ends where they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.
5. Materials:
a. End couplings: Bronze or galvanized ductile iron.
b. Sleeve: Neoprene.
c. Bands: Stainless steel.
d. Bonding jumper: Tinned copper braid.

K. Expansion couplings:
1. Shall allow for expansion and contraction of conduit:
a. Permitting 8-inch movement, 4 inches in either direction.
2. Constructed to maintain electrical continuity of the conduit system.
3. Materials:
a. Head: Malleable or ductile iron.
b. Sleeve: Steel.
c. Insulating bushing: Phenolic.
d. Finish: Hot-dip galvanized.
e. Aluminum when used with Type RAC.

f. PVC-coated when used with Type PCS.

L. Conduit markers:
1. As specified in the Identification for Electrical Systems section.

2.9 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. General:
1. Conduit routing:
a. The electrical drawings are diagrammatic in nature:
1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.
2) Modify conduit runs to suit field conditions, as accepted by the Engineer:
a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
b) Make changes in conduit routing due to the relocation of equipment.
3) The electrical drawings do not indicate all required junction boxes and pull boxes:
a) Provide junction boxes and pull boxes to facilitate wire pulling as required:
(1) To meet cable manufacturer’s pulling tension requirements.
(2) To limit total conduit bends between pull locations.
b) Install junction boxes and pull boxes at locations acceptable to the Engineer.
b. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:
1) The Engineer is the sole source in determining whether the change is constituted as a deviation:
2) Perform any changes resulting in additional conduits, or extra work from such deviations.
3) Incorporate any deviations on the Record Documents.
2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.

3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:
    a. Clearance of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.
    b. Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
    c. Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
    d. Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:
    a. Do not run conduits within water-bearing walls unless otherwise indicated on the Drawings.
5. Do not install 1-inch or larger conduits in or through structural members unless approved by the Engineer.
6. Run conduits exposed to view parallel with or at right angles to structural members, walls, or lines of the building:
    a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.
    b. Make changes in direction with long radius bends or with conduit bodies.
7. Install conduits with total conduit bends between pull locations less than or equal to 270 degrees.
8. Route all exposed conduits to preserve headroom, access space and work space, and to prevent tripping hazards and clearance problems:
    a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment-removal hatches.
    b. Route conduits to avoid drains or other gravity lines. Where conflicts occur, relocate the conduit as required.
9. When installing conduits through existing slabs or walls, make provisions for locating any possible conflicting items where the conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into the existing conduits, piping, cables, post-tensioning cables, etc.
10. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.
11. Install conduits through wall and floor seals where indicated on the Drawings.
12. For existing and new 2-inch and larger conduit runs, snake conduits with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of the conduit:
    a. Remove and replace conduits through which mandrel will not pass.
13. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.
14. Install complete conduit systems before conductors are installed.
15. Provide metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.
16. Underground conduits:
    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:
        1) As specified in the Duct Banks section.
    b. Make underground conduit size transitions at handholes and manholes.
    c. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and handholes.

d. Seal around conduit penetrations of below grade walls with a mechanical seal.

C. Lighting and receptacle conduits:
1. Provide conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:
2. Install conduits in accordance with the requirements of this Section unless otherwise indicated.
3. Minimum conduit size:
   a. 3/4-inch for exposed conduits.
   b. 1-inch for underground or in-slab conduits.
4. Provide conduit materials for the installed location as specified in the Common Work Results for Electrical section.

D. Hazardous areas:
1. As specified in the Common Work Results for Electrical section for hazardous areas and specific Class and Division.
2. As specified in the Hazardous Classified Area Construction section for hazardous area conduit installation requirements.

E. Conduit usage:
1. Exposed conduits:
   a. Rigid conduit:
      1) Install the rigid conduit type for each location as specified in the Common Work Results for Electrical section.
      2) Minimum size: 3/4-inch.
   b. Flexible conduit:
      1) Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment, or where required for equipment servicing:
         a) Use Type SLT with rigid metallic conduit.
         b) Use Type EFLX in Class I Division 1 locations.
      2) Minimum size: 3/4-inch:
         a) 1/2 when required for connection to instruments.
      3) Maximum length:
         a) Fixed equipment:

Conduit Trade Size	Flexible Conduit Length (inch)
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

         b) Removable instruments or hinged equipment:
            (1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
    a. Straight runs and bends less than 45 degrees:
        1) Type PVC Schedule 40.
    b. Bends with total deflection greater than 45 degrees;
        1) PCS,
    c. Entering and exiting duct bank, underground or embedded conduit runs a minimum 12 inches above and below grade, finished floor, or entering equipment:
        1) PCS.
    d. Minimum size:
        1) 2-inch in duct banks.
        2) 1-inch for in-slab conduits.
        3) Provide conduit fittings to enlarge the conduit from the exposed size in the conduit schedule as required.
3. Direct-buried and sand-bedded duct bank conduits:
    a. Type PCS.
    b. Minimum size: 1-inch.
4. Below-slab conduits:
    a. Type PCS.
    b. Minimum size: 1-inch.
5. PVC-coated rigid metallic conduit:
    a. Use specifically manufactured or machined threading dies to manufacturer's specifications to accommodate the PVC jacket.
6. GRC:
    a. Conduit shall be cut square and reamed before threading.

F. Conduit joints and bends:
1. General:
    a. Where conduit is underground, under slabs on grade, exposed to the weather, or in NEMA Type 4 or NEMA Type 4X locations, make joints liquidtight.
    b. Keep bends and offsets in conduit runs to an absolute minimum.
    c. All bends shall be symmetrical.
    d. The following conduit systems shall use large-radius sweep elbows:
        1) Underground conduits.
        2) Conduits containing fiber optic cables.
    e. Provide large-radius factory-made bends for 1-1/4-inch trade size or larger.
    f. Make field bends with a radius of not less than the requirements found in the NEC:
        1) The minimum bending radius of the cable must be less than the radius of the conduit bend.
        2) Make all field bends with power bending equipment or manual benders specifically intended for the purpose:
            a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.
            b) For the serving utilities, make bends to meet their requirements.
    g. Replace all deformed, flattened, or kinked conduit.
2. Threaded conduit:
    a. Cut threads on rigid metallic conduit with a standard conduit-cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
    b. Thoroughly ream conduit after threads have been cut to remove burrs.
    c. Use bushings or conduit fittings at conduit terminations.

d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing “Galvabar™,” or CRC “Zinc It.”
e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
1) Apply to the male threads and tighten joints securely.
2) Clean excess sealant from exposed threads after assembly.
f. Securely tighten all threaded connections.
g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.

3. PVC:
a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.
b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at all bends:
1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

G. Conduit sealing and drainage:
1. Conduit drainage and sealing other than required for hazardous and classified areas:
a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above-grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
b. Provide seal fittings with drains in vertical drops directly above grade for exterior and above-grade conduit runs that are extended below grade.
c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
1) Where portions of an interior raceway pass through walls, ceilings, or floors that separate adjacent areas having widely different temperatures.
d. Provide conduit seals similar to O-Z/Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.
e. Seal one end only of all underground conduits at highest point with O-Z/Gedney sealing (non-hazardous) filling, or equal.
2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of the conduit.

H. Conduit supports:
1. General:
a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:
1) As specified in the Hangers and Supports section.
2) Provide support materials consistent with the type of conduit being installed as specified in the Common Work Results for Electrical section.
b. Support conduit at the intervals required by the NEC.
c. Perforated strap and plumbers tape are not acceptable for conduit supports.
2. Conduit on concrete or masonry:
a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.
b. Use preset inserts in concrete when possible.
c. Use pipe spacers (clamp backs) in wet locations.
3. Suspended conduit:
a. Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.

b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2-feet long, provide rigid sway bracing.

4. Supports at structural steel members:
   a. Use beam clamps.
   b. Drilling or welding may be used only as specified or with approval of the Engineer.
5. PVC-coated rigid metal systems:
   a. Provide right-angle beam clamps and “U” bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC-encapsulated nuts that cover the exposed portions of the threads.
   b. Securely fasten exposed conduits with Type 316 stainless steel clamps or straps.

I. Expansion or expansion/deflection fittings:
1. General:
   a. Align expansion coupling with the conduit run to prevent binding.
   b. Follow manufacturer’s instructions to set the piston opening.
   c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.
   d. Furnish fittings of the same material as the conduit system.
2. For metallic conduit, provide expansion or expansion/deflection couplings, as appropriate, where:
   a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.

J. Empty conduits:
1. Provide a polyethylene rope rated at 250 pounds tensile strength in each empty conduit more than 10 feet in length.
2. Seal ends of all conduits with approved, manufactured conduit seals, caps, or plugs immediately after installation:
   a. Keep ends sealed until immediately before pulling conductors.

K. Miscellaneous:
1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer’s instructions and as indicated on the Drawings.
2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
   a. Running threads and threadless couplings are not allowed.
3. Replace any conduits installed that the Engineer determines do not meet the requirements of this Specification.

3.4 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 261340

BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Device boxes.
   2. Raceway system boxes.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
   3. D495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
   4. D570 - Standard Test Method for Water Absorption of Plastics.
   5. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

D. Joint Industry Conference (JIC).

E. Underwriters Laboratories, Inc. (UL):
   1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. Specific definitions:
   1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.4 SYSTEM DESCRIPTION

A. Provide outlet boxes for devices such as switches, receptacles, telephone and computer jacks, security systems, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes as indicated on the Drawings or as needed to complete the raceway installation.

1.5 SUBMITTALS

A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:
   1. Manufacturer.
   2. Materials.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
      e. NEMA rating.
   4. Conduit entry locations.
   5. Catalog cut sheets.
   6. Installation instructions.

C. Shop drawings:
   1. Include identification and sizes of pullboxes.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. Regulatory requirements:
   1. Outlet boxes shall comply with all applicable standards of:
      a. JIC.
      b. NEC.
      c. NEMA.
      d. UL.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING

A. As specified in the Common Work Results for Electrical.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:
   1. Cast device boxes:
      a. Appleton.
      b. Crouse - Hinds.
      c. OZ/Gedney.
   2. Stainless steel enclosures:
      a. Hoffman.
      b. Stahlin.
      c. Rittal.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS

A. Cast device boxes:
   1. Construction:
      a. With internal green ground screw.
      b. Furnished with a suitable gasketed cover.
      c. With integral cast mounting lugs when surface mounted.
      d. Conduit sizes range from 3/4 inch to 1 inch.
      e. Tapered threaded hubs with integral bushing.
   2. Malleable iron boxes:
      a. Conforming to ASTM A47 Grade 32510.

B. Plastic coated cast device boxes:
   1. Construction:
      a. With internal green ground screw.
      b. Furnished with a suitable gasketed cover.
      c. With integral cast mounting lugs when surface mounted.
      d. Conduit sizes range from 3/4 inch to 1 inch.
      e. Double coated with a nominal 0.002-inch (2 mil) urethane on both the interior and exterior before application of PVC coating.
      f. With a minimum 0.040-inch (40 mil) PVC coating bonded to exterior.
      g. With pressure sealing sleeve to protect the connection with conduit.

C. Class I Division 1 areas:
   1. Provide boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
      a. The approval ratings must be permanently marked on each item.

D. Class I, Division 2 areas:
   1. For boxes not containing arcing parts:
      a. As specified in the Common Work Results for Electrical section.
      b. Pressed metal boxes are not allowed.
   2. For boxes containing arching parts provide:
      a. Boxes designed and listed for Class I Division 1 locations and group type atmosphere in which they will be used:
         1) The approval ratings must be permanently marked on each item.

3. Cast iron Cast copper - free aluminum box and cover.
4. Precision machined flame path between box and cover with neoprene o-ring.
5. For applications requiring hinged cover, provide flexible hinge mounting either left or right side.
6. External flange.
7. Provisions for mounting pan.
8. Ground lug.
9. Stainless steel:
    a. NEMA Type 4X:
        1) Boxes in locations subject to flooding or temporary submersion:
            a) NEMA Type 6.
    b. Fabricated from 14-gauge Type 316 stainless steel.
    c. All seams continuously welded.
    d. Door:
        1) Rolled lip around 3 sides.
        2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
    e. Neoprene door gasket to provide a watertight seal:
        1) Attached with an adhesive.
        2) Retained by a retaining strip.
    f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:
        1) With a hasp and staple for padlocking.
    g. Provide large enclosures with door and body stiffeners for extra rigidity.
    h. No holes or knockouts.
    i. Finish:
        1) Brushed.
    j. Stainless steel external mounting brackets when surface mounted.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

A. Fasteners:
    1. Electroplated or stainless steel in boxes with wiring devices.
    2. Screws, nuts, bolts, and other threaded fasteners:
        a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
    1. Provide internal panels where required for mounting of terminal strips or other equipment.
    2. With plated steel shoulder studs.
    3. Steel with white polyester powder finish.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. General:
1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in the Common Work Results for Electrical section.
2. Provide outlet box materials to match the conduit system:
   a. GRC - Cast ferrous boxes.
   b. PCS - PVC coated cast ferrous boxes.
   c. PVC - PVC boxes.
3. Solid type gang boxes:
   a. For more than 2 devices.
   b. For barriered outlets.
4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
   a. Use machined spacers to maintain air space; built-up washers are not acceptable.
   b. Use stainless steel or nylon materials for spacers.
5. Use cast malleable iron boxes when box must support other devices.
6. Boxes serving luminaires or devices:
   a. Use as pullboxes wherever possible.
7. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.
8. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 50 percent spare terminals:
   a. Furnish wireways for discrete and analog/DC wiring.
   b. Separate analog wiring from 120 V discrete or power wiring.
9. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.
10. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

C. Outlet boxes:
1. Locate outlet boxes as indicated on the Drawings:
   a. Adjust locations so as not to conflict with structural requirements or other trades.
2. Use deep threaded-hub malleable iron or aluminum boxes:
   a. In hazardous areas.
   b. Where exposed to the weather.
   c. In unheated areas.
   d. Where subject to mechanical damage:
      1) Defined as exposed boxes less than 10 feet above the floor.
   e. To act as a pullbox for conductors in a conduit system.
   f. Accommodate wiring devices.
3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the conduit system is PVC coated steel.
4. Outlet boxes may be used as junction boxes wherever possible.

D. Pullboxes and junction boxes:
1. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.

2. Install pullboxes such that access to them is not restricted.

E. For boxes not indicated:
   1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in the Common Work Results for Electrical section.
   2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
      a. One-piece, galvanized, pressed steel.
   3. Ceiling boxes for flush mounting in concrete:
      a. Deep, galvanized, pressed steel.
   4. Outlet, switch, and junction boxes where surface mounted in exposed locations:
      a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
   5. Outlet, control station, and junction boxes for installation in corrosive locations:
      a. Fiberglass reinforced polyester, stainless steel, or plastic coated steel to match the conduit system.
      b. Furnished with mounting lugs.

F. Hazardous locations:
   1. All metallic boxes, fittings, and joints shall utilize threaded connections to the conduit system.
   2. All threaded connections shall be wrench tightened so that at least 5 threads are fully engaged.
   3. Conduits entering and exiting metallic boxes in Class I Division 2 areas shall utilize approved grounding bushings to bond the conduits together.
   4. Provide the following types of conduit bodies and boxes:
      a. Malleable iron bodies and boxes with GRC or IMC conduit systems.
      b. PVC coated conduit bodies and boxes with PCS conduit systems.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 REINSTALLATION (NOT USED)

3.7 COMMISSIONING

A. As specified in the Commissioning section.

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 264110

DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Fusible and non-fusible disconnect switches.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. National Electric Manufacturer's Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment.
   2. KS 1-2001 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. Underwriters Laboratories Inc. (UL):
   1. 20 - General-Use Snap Switches.
   2. 98 - Enclosed and Dead-Front Switches.
   3. 508 - Standard for Industrial Control Equipment.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. Specific definitions:
   1. Safety switches and disconnect switches are to be considered synonymous.

1.4 SYSTEM DESCRIPTION

A. Provide heavy-duty type disconnect switches as indicated on the Drawings and specified in the Contract Documents.

B. Provide disconnect switches with the number of poles, voltage, current, short circuit, and horsepower ratings as required by the load and the power system.

1.5 SUBMITTALS

A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:
   1. Manufacturer.
   2. Manufacturer's specifications and description.
   3. Ratings:
      a. Voltage.
      b. Current.
      c. Horsepower.
      d. Short circuit rating.
   4. Fused or non-fused.
   5. NEMA enclosure type.

6. Dimensions:
    a. Height.
    b. Width.
    c. Depth.
7. Weight.
8. Cross-referenced to the disconnect schedule indicated on the Drawings.

C. Shop drawings:
1. Manufacturer's installation instructions:
    a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance, Regulatory Requirements below.
    b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
2. Identify motor or equipment served by each switch; indicate nameplate inscription.

D. Installation instructions:
1. Provide anchorage instructions and requirement based on the seismic requirements at the Project Site as specified in the Common Work Results for Electrical section and calculations:
    a. Stamped by a professional engineer registered in the state where the Project is being constructed.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. Regulatory requirements:
1. NEMA KS1- Enclosed and Miscellaneous Distribution Switches (600 V Maximum).
2. UL 98 - Enclosed and Dead-Front Switches.

C. Disconnect switches shall be UL listed and labeled.

1.7 DELIVERY, STORAGE, AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING

A. After successful review of the initial fault current study, submit complete equipment submittal.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:
   1. Schneider Electric.
   2. Eaton.
   3. General Electric.
   4. Siemens.
   5. Appleton.
   6. Crouse-Hinds.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS (NOT USED)

2.5 EQUIPMENT

A. Switch mechanism:
   1. Quick-make, quick-break heavy-duty operating mechanisms:
      a. Provisions for padlocking the switch in the Off position.
      b. A minimum of 90-degree handle travel position between Off and On positions:
         1) Provide handle position indicators to identify the handle position.
      c. Full cover interlock to prevent opening of the switch door in the On position and to prevent closing the switch mechanism with the door open:
         1) With an externally operated override.

B. Switch interior:
   1. Switch blades visible when the switch is Off and the cover is open.
   2. Lugs:
      a. Front accessible.
      b. Removable.
      c. UL listed for 60/75-degree Celsius copper conductors.
   3. Current carrying parts completely plated to resist corrosion.
   4. Removable arc suppressors to facilitate easy access to line side lugs.
   5. Furnish equipment ground kits for every switch.

C. Fused switches:
   1. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:
      a. Ratings 100 amperes through 600 amperes at 240 volts.
      b. Ratings 30 amperes through 600 amperes at 600 volts.
      c. Provide spring reinforced and plated fuse clips.

D. Ratings:
   1. UL horsepower rated for AC or DC with the rating not less than the load served.
   2. Current:
      a. 30 to 1,200 amperes.
   3. Voltage:

a. 250 volts AC, DC.
b. 600 volts (30 A to 200 A, 600 volts DC).

4. Poles:
   a. 2, 3, 4, and 6 poles.
5. UL listed short circuit ratings:
   a. 10,000 RMS symmetrical amperes when used with or protected by Class H or K fuses (30-600 amperes).
   b. 200,000 RMS symmetrical amperes when used with or protected by Class R or J fuses (30-600 amperes employing appropriate fuse rejection).
   c. 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (800-1,200 amperes).
6. Where not indicated on the Drawings, provide switches with the NEMA ratings specified in Section 16050 - Common Work Results for Electrical for the installed location.

E. Size, fusing and number poles as indicated on the Drawings or as required:
   1. Provide solid neutral where indicated on the Drawings.

2.6 COMPONENTS (NOT USED)

2.7 ACCESSORIES

A. Disconnect switches to have provisions for a field installable “B” type electrical interlock for position indication as indicated on the Drawings.

B. Disconnect switches to have provisions for a field installed insulated groundable neutral kit as indicated on the Drawings.

C. NEMA Type 7 and 9 enclosures furnished with drain and breather kit when used in outdoor applications.

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. As specified in the Common Work Results for Electrical section.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA Type 12, Type 4, and Type 4X enclosures.

2. Provide all mounting brackets, stands, supports and hardware as required:
    a. Match finish and materials for all brackets, stands, and hardware with the switch installed.
    b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.
3. When possible, mount switches rigidly to exposed building structure or equipment structural members:
    a. For NEMA Type 4 and Type 4X locations, maintain a minimum of 7/8 inch air space between the enclosure and supporting surface.
    b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.
4. Provide a nameplate for each disconnect switch:
    a. Provide per requirements specified in the Identification for Electrical Systems section.
    b. Identify voltage, circuit, fuse size, and equipment served on the nameplate.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING

A. As specified in the Commissioning section.

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in the Common Work Results for Electrical section.

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26412

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Low voltage molded case circuit breakers.

1.2 REFERENCES

A. As specified in the Common Work Results for Electrical section.

B. National Electrical Manufacturers Association (NEMA):
   1. AB 3. - Molded Case Circuit Breakers and Their Application.

C. Underwriter's Laboratories (UL):
   1. 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
   2. 943 - Ground Fault Circuit Interrupters.

1.3 DEFINITIONS

A. As specified in the Common Work Results for Electrical section.

B. In accordance with UL 489.

1.4 SYSTEM DESCRIPTION

A. Molded case thermal magnetic or motor circuit protector type circuit breakers as indicated on the Drawings and connected to form a completed system.

1.5 SUBMITTALS

A. Furnish submittals as specified in the Common Work Results for Electrical section.

B. Product data:
   1. Catalog cut sheets.
   2. Manufacturer's time-current curves for all molded case circuit breakers furnished.

1.6 QUALITY ASSURANCE

A. As specified in the Common Work Results for Electrical section.

B. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. As specified in the Common Work Results for Electrical section.

1.8 PROJECT OR SITE CONDITIONS

A. As specified in the Common Work Results for Electrical section.

1.9 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in the Common Work Results for Electrical section.

1.12 SYSTEM START-UP

A. As specified in the Common Work Results for Electrical section.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:
   1. Eaton.
   2. General Electric Co.
   3. Schneider Electric.
   4. ABB.

2.2 EXISTING PRODUCTS (NOT USED)

2.3 MATERIALS (NOT USED)

2.4 MANUFACTURED UNITS

A. General:
   1. Conforming to UL 489.
   2. Operating mechanism:
      a. Quick-make, quick-break, non-welding silver alloy contacts.
      b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
      c. Mechanically trip free from the handle.
      d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.
      e. Lockable in the "OFF" position.
   3. Arc extinction:
      a. In arc chutes.
   4. Voltage and current ratings:
      a. Minimum ratings as indicated on the Drawings.
      b. Minimum frame size 100A.
   5. Interrupting ratings:
      a. Minimum ratings as indicated on the Drawings.
      b. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).

B. Motor circuit protectors:
   1. Instantaneous only circuit breaker as part of a listed combination motor controller.
   2. Each pole continuously adjustable in a linear scale with ‘LO’ and ‘HI’ settings factory calibrated.

2.5 EQUIPMENT (NOT USED)

2.6 COMPONENTS

A. Terminals:
   1. Line and load terminals suitable for the conductor type, size, and number of conductors in accordance with UL 489.

B. Case:
   1. Molded polyester glass reinforced.
   2. Ratings clearly marked.

C. Trip units:
   1. Provide thermal magnetic or solid-state trip units as indicated on the Drawings.
   2. Thermal magnetic:
      a. Instantaneous short circuit protection.
      b. Inverse time delay overload.
      c. Ambient or enclosure compensated by means of a bimetallic element.
   3. Solid state:
      a. With the following settings as indicated on the Drawings.
         1) Adjustable long time current setting.
         2) Adjustable long time delay.
         3) Adjustable short time pickup.
         4) Adjustable short time delay.
         5) Adjustable instantaneous pickup.
         6) Adjustable ground fault pickup as indicated on the Drawings.
         7) Adjustable ground fault delay as indicated on the Drawings.

D. Molded case circuit breakers for use in panelboards:
   1. Bolt-on type:
      a. Plug-in type breakers are not acceptable.
   2. Ground fault trip devices as indicated on the Drawings.

2.7 ACCESSORIES(NOT USED)

2.8 MIXES (NOT USED)

2.9 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Test breakers in accordance with:
   1. UL 489.
   2. Manufacturer’s standard testing procedures.

PART 3 EXECUTION

3.1 EXAMINATION (NOT USED)

3.2 PREPARATION (NOT USED)

3.3 INSTALLATION

A. Install breakers to correspond to the accepted shop drawings.

3.4 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.5 REPAIR/RESTORATION (NOT USED)

3.6 RE-INSTALLATION (NOT USED)

3.7 COMMISSIONING (NOT USED)

3.8 FIELD QUALITY CONTROL

A. As specified in the Common Work Results for Electrical section.

3.9 ADJUSTING

A. Adjust trip settings in accordance with Protective Device Coordination Study as accepted by the Engineer and in accordance with manufacturer's recommendations.

B. Adjust motor circuit protectors in accordance with NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in the Common Work Results for Electrical section.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 31 1100

SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required and perform all site preparation, complete as shown on the Drawings and as specified herein.

B. Obtain all permits required for site preparation work prior to proceeding with the work, including clearing, burning.

1.02 RELATED WORK

A. Earthwork is included in Section 31_2000.

B. Topsoil and Seeding is included in Section 31_2900.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01_3000, copies of all permits required prior to clearing, grubbing, and stripping work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

A. Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground.

B. Preserve and protect trees and other vegetation designated on the Drawings or directed by the Engineer to remain as specified below.

C. Unless otherwise specified in these specifications or in the Plans, the CONTRACTOR shall replace all sod, shrubs, bushes, trees, and flowers disturbed or removed, that are located upon improved or landscaped public and private property. The CONTRACTOR shall replant vegetation and re-landscape or cause such to be performed throughout the work area as soon as possible after the pipelines and appurtenances have been installed. All vegetation damaged during or after removal shall be replaced with healthy vegetation of the same kind or type. All plants shall be replanted as close as possible to the original location or approved by the property UTILITY and or the utility. The CONTRACTOR shall maintain all such replanted vegetation by the application of water, fertilizers, and topsoil. The vegetation shall be cultivated to prohibit the growth of foreign vegetation until a well-developed root system has been established and transplanted vegetation has overcome the “shock” resulting from transplanting. The CONTRACTOR shall replace all vegetation that dies or becomes unhealthy. The contour of the ground shall be left as near the original contour as possible.

3.02 GRUBBING

A. Grub and remove all stumps, roots in excess of 1-1/2-in in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of (foundations) (and) (roadway subbase) whichever is deeper.

B. Refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density of 92% MPD.

3.03 STRIPPING

A. Strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.

B. Topsoil shall be free from brush, trash, large stones and other extraneous material. Avoid mixing topsoil with subsoil.

C. Stockpile and protect topsoil until it is used in landscaping, loaming and seeding operations. Dispose of surplus topsoil after all work is completed.

3.04 DISPOSAL

A. Cut tree trunks and limbs exceeding 4-in in diameter shall be cut into 4-ft lengths and stockpiled on site in the area designated by the UTILITY.

B. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area. No rubbish or debris of any kind shall be buried on the site.

C. On-site disposal of cleared and grubbed materials by open-air burning may be permitted only with the expressed written consent of the UTILITY. Burning operations and ash disposal shall be conducted in strict accordance with local and state requirements, subject to applicable permit requirements.

3.05 PROTECTION

B. Trees and other vegetation designated on the Drawings or directed by the Engineer to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. Conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed and so as to provide for the safety of employees and others.

B. Maintain protection until all work in the vicinity of the work being protected has been completed.

C. Do not operate heavy equipment or stockpile materials within the branch spread of existing trees.

D. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area.

E. When work is completed, remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches.

F. Restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the UTILITY. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations, shall be promptly restored to their original condition, to the full satisfaction of the property UTILITY.

END OF SECTION

SECTION 31 2000

EARTHWORK

PART 1 GENERAL

1.00 STATUTORY REQUIREMENTS

A. All excavation, trenching, sheeting, bracing, etc shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), and State and local requirements. Where conflict between OSHA, State and local regulations exists, the most stringent requirements shall apply.

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all excavation work and grading; place and compact backfill and fill; and dispose of unsuitable, waste and surplus materials as shown on the Drawings and as specified herein.

B. Provide the services of a licensed professional engineer registered in the State in which the work is located, to prepare temporary excavation support system designs and submittals.

C. Furnish and install temporary excavation support systems, including sheeting, shoring and bracing, to insure the safety of personnel and protect adjacent structures, piping, etc, in accordance with Federal, State and local laws, regulations and requirements.

1.02 RELATED WORK

A. Site Preparation is included in Section 31_1100.

B. Trenching, Backfilling and Compaction is included in Section 31_2300.

C. Fill and Backfill Materials are included in Section 31_2330.

D. Erosion and Sedimentation Control are included in Section 31_2500.

E. Topsoil and Seeding are included in Section 31_2900.

1.03 SUBMITTALS

A. Excavation support system designs shall be prepared by a licensed professional engineer, registered in the State in which the work is located, having a minimum of 5 years of professional experience in the design and construction of excavation support systems. Submit an original and three copies of the licensed professional engineer's certification, on the PE form specified in Section 01_3000, stating that the excavation support systems designs have been prepared by the professional engineer and that the professional engineer will be responsible for their execution. Do not submit excavation support system designs unless requested in writing.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. At all structures, prior to the placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with a soils testing laboratory to verify the suitability of the existing subgrade soil and to perform in-place soil density tests as required to verify that the bearing capacity of the subgrade is sufficient. Utilize Anderson Engineering Consultants, Inc. of Little Rock, AR. A min. of 1 nuclear density test per every 2,500 sf shall be performed.

B. Prior to and during the placement of backfill and fill for structures, coordinate with the soils testing laboratory to perform in-place soil density tests to verify that the backfill/fill material has been compacted in accordance with the compaction requirements specified elsewhere.

1.06 DEFINITIONS

A. Where the phrase "in-the-dry" is used in this Section, it shall be defined to mean a soil condition such that the in-place moisture content of the soil at that time is no more than two percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction.

B. Where used in this Section "structures" refers to all buildings, wet wells, manholes and below grade vaults. Stormwater structures and duct banks are not considered structures in this context.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials designated for use in this Section are specified in Section 31_2330.

PART 3 EXECUTION

3.01 PREPARATION

A. Test Pits

1. Perform exploratory excavation work (test pits) for the purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.

2. Test pits shall be backfilled as soon as the desired information has been obtained. Backfilled surfaces shall be stabilized in accordance with approved erosion and sedimentation control plans.

B. Dewatering and Drainage Systems

1. Temporary dewatering and drainage systems shall be in place and operational prior to beginning excavation work. Groundwater levels must be maintained a minimum of 2 ft. below the excavation bottom, to allow construction in the dry.

3.02 EXCAVATION SUPPORT

A. Furnish, install, monitor and maintain excavation support (e.g., shoring, sheeting, bracing, trench boxes, etc) as required by Federal, State or local laws, ordinances, regulations and safety requirements. Support the sides of excavation, to prevent any movement which could in any way reduce the width of the excavation below that necessary for proper construction and protect adjacent structures from undermining, settlement or other damage. Take care to prevent the formation of voids outside of sheeting. If voids occur behind sheeting, immediately backfill and compact the voids with common fill material. Voids in locations that cannot be properly compacted upon backfilling shall be filled with lean concrete.

B. Install excavation supports outside the neat lines of foundations. Supports shall be plumb and securely braced and tied in position. Excavation support shall be adequate to withstand all pressures to which the supports will be subjected. Any movement or bulging of supports shall be corrected to provide the necessary clearances, dimensions and structural integrity.

C. Excavation Supports Left in Place

1. Excavation supports that are required to remain in place, if applicable, are indicated on the Drawings.

2. The UTILITY or Engineer may direct that certain excavation supports remain in place, or be cut off at any specific elevation. Supports directed by the UTILITY or Engineer to be left in place and not so designated on the Drawings or otherwise specified herein to remain in place, will be paid for in accordance with the Unit Price Schedule. If the CONTRACTOR believes that such a directive increases CONTRACTOR's cost and would thereby entitle CONTRACTOR to a change in contract cost, CONTRACTOR shall notify the Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.

3. The right of the UTILITY or Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on the UTILITY or Engineer to give such direction, nor shall failure to give such direction relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.

D. Excavation supports shall be carefully removed in such manner so as not to endanger the Work or other adjacent structures, utilities, or property. All voids left or caused by withdrawal of supports shall be immediately filled with sand and compacted.

3.03 STRUCTURAL EXCAVATION PROCEDURES

A. Excavations for structures shall be suitably wide for construction of the structures, including excavation supports, dewatering and drainage systems and working clearances.

B. Excavation shall be performed in-the-dry and shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Drainage and dewatering systems shall be in place and operational prior to beginning excavation work. In no case shall the earth be plowed, scraped or excavated by any means so near to the finished subgrade that would disturb the finished subgrade. Hand excavation of the final 3 to 6-in may be required to obtain a satisfactory, undisturbed subgrade. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures as a result of inadequate excavation, dewatering, or other construction methods shall be removed and replaced with lean concrete, compacted structural fill or suitable crushed rock, subject to prior approval by the Engineer, at no additional cost to the UTILITY.

C. Subgrade Preparation

1. All structures unless otherwise shown on the Drawings or otherwise specified herein:

a. Compact the top 12-in of subgrade to a minimum of 95 percent modified proctor (ASTM D1557).

b. Where structures are supported by piles, compact the top 12-in of subgrade to a minimum of 90 percent modified proctor (ASTM D1557).

2. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working

mat. Prior to placing the lean concrete working mat, compact the top 12-in of existing subgrade to a minimum of 95 percent modified proctor (ASTM D1557).

D. When excavations have reached the required subgrade, including any allowances for working mats or base materials, prior to the placement of working mats or base materials, notify the soils testing laboratory to verify the suitability of the existing subgrade soils for the anticipated foundation and structural loadings. If the existing subgrade soils are determined to be unsuitable, direction will be provided by the Engineer regarding removal and replacement with suitable materials. If CONTRACTOR believes that such direction would increase CONTRACTOR's cost and would thereby entitle CONTRACTOR to a change in Contract cost, CONTRACTOR shall notify the Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.

E. Over-excavation beyond the limits and depths required by the Contract Documents shall be replaced at no additional cost to the UTILITY by low density cellular concrete or other approved material subject to the prior approval of the Engineer.

3.04 GENERAL FILLING AND BACKFILLING PROCEDURES

A. Fill and backfill materials shall be placed in lifts to suit the specified compaction requirements to the lines and grades required, making allowances for settlement and placement of cover materials (i.e. topsoil, sod, etc). Soft spots or uncompacted areas shall be corrected.

B. Fill and backfill materials shall not be placed on frozen surfaces, or surfaces covered by snow or ice. Fill and backfill material shall be free of snow, ice and frozen earth.

C. Compaction in open areas may be accomplished by any of the following methods: compaction equipment, fully loaded ten-wheel trucks, tractor dozers weighing at least 30,000 lbs and operated at full speed, or heavy vibratory rollers. Compaction in confined areas (including areas within a 45-degree angle extending upward and outward from the base of a wall) and in areas where the use of large equipment is impractical, shall be accomplished by hand operated vibratory equipment or mechanical tampers. Lift thickness shall not exceed 6-in (measured before compaction) when hand operated equipment is used.

D. Fill and backfill shall not be placed and compacted when the materials are too wet to properly compact (i.e. the in-place moisture content of the soil at that time is no more than three percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction).

3.05 FILL AND BACKFILL PROCEDURES

A. Fill required beneath foundations or slabs on grade (except sidewalks) shall be structural fill (AHTD Class 7 Base Course). Place and compact structural fill in even lifts having a maximum thickness (measured before compaction) of 8-in.

B. Fill and backfill material placed immediately adjacent to and within 5-ft of all structures shall be structural fill. All structure water-tightness tests and dampproofing/waterproofing shall be completed prior to placing fill or backfill around structures. Place and compact select fill in even lifts having a maximum thickness (measured before compaction) of 8-in uniformly around the structure.

C. Common fill may be used in areas beyond those designated for structural fill unless shown or specified otherwise. Common fill shall be placed in even lifts having a maximum thickness (measured before compaction) of 12-in.

3.06 EMBANKMENT FILL PROCEDURES

A. Prior to placing embankment fill materials, all organic materials (including peat and loam) and loose inorganic silt material (loess) shall be removed from areas beneath the embankments. If the subgrade slopes are excessive, the subgrade shall be stepped to produce a stable,

horizontal surface for the placement of embankment materials. The existing subgrade shall then be scarified to a depth of at least 6-in.

B. Embankment fill shall consist of common fill material and shall be placed and compacted in even lifts (measured before compaction) of 12-in.

C. Rock may be used in embankment fill only with prior, written approval of the Engineer.

3.07 COMPACTION REQUIREMENTS

A. Beneath foundations and slabs on grade (except sidewalks): Compact the top 12-in of existing subgrade and each layer of fill to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

B. 5-ft around structures: Compact the top 12-in of existing subgrade and each layer of fill or backfill to a minimum of 90 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

C. Fill beneath structures: Compact fill below structures to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

C. Embankments (except under roadways), lawn or unimproved areas: Compact the top 6-in of existing subgrade and each layer of fill or backfill to a minimum of 90 percent modified protctor (ASTM D1557) at or near its optimum moisture content (minus 1 to plus 4 percent).

D. Sidewalks: Compact the top 6-in of existing subgrade (and each 6-in layer of fill if applicable) to a minimum of 90 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

E. Roads, paved areas and roadway embankments: Compact the top 12-in of existing subgrade and each layer of fill or backfill to a minimum of 95 percent modified proctor (ASTM D1557) at or near its optimum moisture content (minus 2 to plus 3 percent).

3.08 DISPOSAL OF UNSUITABLE, WASTE AND/OR SURPLUS EXCAVATED MATERIAL

A. Unsuitable, waste and surplus excavated material shall be removed and disposed of on-site, in areas approved by the OWNER. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restrict access to the work site.

3.10 GRADING

A. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of. Subgrades shall be completely and continuously drained and dewatered throughout the grading process. Install temporary drains, drainage ditches, etc, to intercept or divert surface water which may affect the execution or condition of grading work.

B. If at the time of grading it is not possible to place any material in its proper section of the Work, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

C. Stones or rock fragments larger than 4-in in their greatest dimensions will not be permitted within the top 6-in of the finished grade of fills and embankments.

D. In cut areas, all loose or protruding rocks in slopes shall be removed to line or finished grade of the slope. All cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings unless otherwise directed by the Engineer.

END OF SECTION

SECTION 31 2300

TRENCHING, BACKFILL, AND COMPACTION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.

B. Excavation shall extend to the width and depth shown on the Drawings or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.

C. Furnish and place all sheeting, bracing and supports and shall remove from the excavation all materials which the Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry and in all respects, acceptable. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.

D. All excavation, trenching and related sheeting, bracing, etc, shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P) and all State and local requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

E. Wherever the requirement for percent compaction is referred to herein it shall mean "at least the specified percent of maximum density as determined by ASTM D698.

F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer for review.

1.02 RELATED WORK

A. Granular fill material is included in Section 31_2330.

B. Topsoil and seeding is included in Section 31_2900.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TRENCH EXCAVATION

A. Trench excavation shall include material of every description and of whatever substance encountered. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.

B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the CONTRACTOR's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.

D. Trenches shall be excavated to the depth indicated on the Drawings and in widths sufficient for laying the pipe, bracing and for pumping and drainage facilities. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be the practical minimum.

E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the CONTRACTOR's expense.

F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 1-ft of depth.

G. Where pipe is to be laid in screened gravel bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

H. Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing a flat-bottom true to grade upon undisturbed material. Bell holes shall be made as required.

3.02 DISPOSAL OF MATERIALS

A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as specified below.

B. Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench.

C. The CONTRACTOR shall dispose of excess material at an area off-site. Disposal costs shall be the responsibility of the CONTRACTOR.

3.03 SHEETING AND BRACING

A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the CONTRACTOR. Compliance with such order shall not relieve the CONTRACTOR from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.

1. When installing rigid pipe (R.C., V.C., A.C., etc), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the

next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.

2. When installing flexible pipe (PVC, D.I. etc), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be recompacted to provide uniform side support for the pipe.

D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.

E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.

F. No payment will be given for sheeting, bracing, etc, during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the CONTRACTOR.

G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1-ft above the top of the pipe.

3.04 TEST PITS

A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.

B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.05 EXCAVATION BELOW GRADE AND REFILL

A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.

B. If the CONTRACTOR excavates below grade through error or for the CONTRACTOR's own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the Engineer to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.

C. If the material at the level of trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel notwithstanding effective drainage, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-in layer of coarse sand, or a mixture graded from coarse sand to pea gravel, as approved by the Engineer, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the Engineer prior to placement. Screened gravel shall then be placed in 6-in layers thoroughly compacted up to the normal grade of the pipe. If directed by the Engineer, bank-run gravel shall be used for refill of excavation below grade.

D. Geotextile filter fabric may be substituted for filter layer if approved by the Engineer. Filter fabric shall be Mirafi 140N; Supac equivalent, or equal.

3.06 BACKFILLING

A. As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be prosecuted expeditiously. Bedding material, as specified for the type of pipe installed, shall be placed as specified in the pipe specification sections.

B. In areas where naturally occurring groundwater levels necessitates the dewatering of the trench, an impervious dam or bulkhead cutoff of clay or other impervious material shall be constructed in the trench as directed, to interrupt the unnatural flow of groundwater after construction is completed. The dam shall be effectively keyed into the trench bottom and sidewalls. Provide at least one clay or other impervious material dam in the pipe bedding where directed or every 300-ft, whichever is less.

C. Where the pipes are laid cross-country, the remainder of the trench shall be filled with common fill material in layers not to exceed 3-ft and mounded 6-in above the existing grade or as directed. Where a loam or gravel surface exists prior to cross-country excavations, it shall be removed, conserved and replaced to the full original depth as part of the work under the pipe items. In some areas it may be necessary to remove excess material during the clean-up process, so that the ground may be restored to its original level and condition.

D. Where the pipes are laid in existing paved roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to a depth of 3-in below the finished surface with crushed stone compacted to 95% modified proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in. The trench shall be capped with a minimum of 3-in. of compacted asphaltic concrete cold mix to serve as a temporary driving surface until permanent repairs are made.

E. Where the pipes are laid in proposed paved roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to the finished surface with crushed stone compacted to 98% standard proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in.

F. Where the pipes are laid in existing gravel roads, streets, alleys, driveways, and parking lots, the trench shall be backfilled from trench bottom up to the finished surface with crushed stone compacted to 98% standard proctor density. The crushed stone layers shall be placed in lifts not to exceed 6-in.

G. When trenches pass through existing sidewalks, the trench shall be backfilled from the bedding material up to 3-in. below the finished surface with select fill material. Backfill and compaction of the select fill material shall proceed as specified in Part 3.06 D above, except the temporary cap shall be 3-in. of compacted structural fill or asphaltic concrete cold mix.

H. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until bedding and selected material has been placed and compacted to a level 1-ft over the pipe.

I. Bedding and backfill shall be brought up evenly on all sides. Each layer of material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to a minimum of 90 percent standard proctor density, or greater, as specified elsewhere and in the pipe specification sections. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.

J. Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs; the material being spread and compacted in layers not over 6-in thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

K. Backfill around structures shall be selected common fill material, may be compacted by puddling where approved by the Engineer. All backfill shall be compacted, especially under and over pipes connected to the structures.

L. Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6-in may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2-ft of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.

M. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed. Frozen material shall not be used under any circumstances.

N. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.07 TRACER WIRE

A. A continuous 12 guage insulated (blue in color) solid copper tracing wire shall be installed with all non-metallic pipe. The wire shall be laid along the length of the pipe. The tracing wire shall be looped around valves, saddles, curb stops, and other appurtenances in such a manner that there is no interference with the operation of the appurtenances including water and sewer service lines. The tracing wire shall be looped up and left exposed above ground at all meter boxes, valve boxes, and pipe marker signs. Splices of the tracer wire shall be bare wire, twisted and crimped together with a Red 3M Scotchlok and inserted into a 3M DBR Direct Bury Splice Connector. A continuity test shall be performed after installation.

3.08 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and shall maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

B. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.

C. In sections where the pipeline passes through improved grassed areas (such as lawns), remove and replace the sod (as applicable), or loam and seed the surface in accordance with Section 31_2900.

3.09 SETTLEMENT

A. The Contractor shall be responsible for all settlement of backfills, fills, and embankments which may occur during the warranty period (one year) stipulated in the General Conditions.

B. The Contractor shall refill trenches as often as necessary to bring them back to original grade.

C. Where settlement occurs in streets, driveways, roads, parking areas, or other paved surfaces, the Contractor shall refill them frequently enough to maintain traffic without hazard at all times.

D. The Contractor shall make or cause to be made, all repairs or replacements made necessary by the settlement within 7 days after notice by the Engineer or Owner.

END OF SECTION

SECTION 31 2330

GRANULAR MATERIALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and obtain materials for filling and backfilling, grading and miscellaneous sitework, for the uses shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Site Preparation is included in Section 31_1100.

D. Earthwork is included in Section 31_2000.

E. Trenching, Backfilling and Compaction is included in Section 31_2300.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01_3000, complete product data for materials specified in this Section.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600kN-m/m)).

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Laboratory Testing

1. At least 7 days prior to the placement of any backfill or fill materials, deliver a representative sample of the proposed materials weighing at least 50 lbs to the soils testing laboratory.

2. Engage the soils testing laboratory to perform:

a. Grain size analyses of the samples to determine their suitability for use as backfill or fill material in conformance to the materials requirements specified herein.

b. The appropriate Proctor analyses to determine the maximum dry densities required for compaction testing as specified elsewhere in the Contract Documents.

3. Test results and determinations of suitability shall be delivered to the resident project representative no later than 3 days prior to the placement of backfill or fill materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Backfill and Fill materials shall be suitable excavated materials, natural or processed mineral soils obtained from off-site sources or graded crushed stone or gravel. Backfill and Fill materials shall be free of all organic material, trash, snow, ice, frozen soil, or other objectionable materials which may be compressible or which cannot be properly compacted. Soft, wet, plastic soils which may be expansive, clay soils having a natural, in-place water content in excess of 30 percent, soils containing more than 5 percent (by weight) fibrous organic materials, and soils having a plasticity index greater than 30 shall be considered unsuitable for use as backfill and fill. Backfill and fill materials shall have a maximum of 1 percent expansion when testing is performed on a sample remolded to 95 percent of maximum dry density (per ASTM D698) at 2 percent below optimum moisture content under a 100 lbs/sq ft surcharge.

B. Structural Fill shall be clean, crushed stone meeting the requirements of ARDOT Aggregate Base Course Class 7. This shall be used as fill under structures and extended horizontally to the limits of excavation.

C. Selected Common Fill shall conform to the requirements of common fill except that the material shall not contain any materials larger than 2-in in largest dimension.

D. Common Fill shall not contain granite blocks, broken concrete, masonry rubble, asphalt pavement, or any material larger than 6-in in any dimension. Common Fill shall have a plasticity index of less than 10 and shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
No. 40	75
No. 200	20

E. Crushed Stone shall be sound, durable stone, angular in shape, and free of any foreign material, structural defects and chemical decay. Crushed stone shall be locally available gravel screenings.

F. Pea Gravel shall be screened, uniformly rounded stone, free from sand, loam, clay, excess fines and other deleterious materials. Pea Gravel shall conform to the following gradation limits:

Sieve Size	Percent Finer By Weight
1/2-in	100
3/8-in	90
No. 4	30
No. 8	10
No. 16	5

H. Sand for concrete, grout, and masonry shall conform to ASTM C33 for fine aggregate. General purpose sand shall be Select Common Fill.

I. Flowable Fill shall be ready-mix, cast-in-place concrete conforming to the requirements of Division 3 Specifications and meeting the mix requirements in Part L below.

J. Geotextiles

1. Support fabric for road base shall be Mirafi HP270, or equal.

2. Filter fabric for clean stone shall be Mirafi, Type 140N, or equal.

K. Impermeable Fill shall conform to the requirements of the Unified Soil Classification System for soil types CL, CH, or OH per ASTM D2487 and shall have a coefficient of permeability of 1 x 10^{-7} cm/sec or less after compaction.

L. Flowable Fill used as backfill and fill shall be comprised of a mixture of Portland cement, coarse aggregate, fine aggregate and water. Materials, methods of preparation, and placement techniques shall comply with the requirements of Section 03_3300 as for concrete. Design mix shall result in a flowable material with a 28 day compressive strength of approximately 60 psi. Recommended mix shall be as follows:

Portland Cement	40	lbs/cu yd
Coarse Aggregate	1700	lbs/cu yd
Fine Aggregate	1900	lbs/cu yd
Water	325	lbs/cu yd, or as needed

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 31 2500

SWPPP AND EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Arkansas Department of Environmental Quality has promulgated the Construction General Permit (CGP) which authorizes stormwater discharges from large and small construction activities that result in a total land disturbance of equal to or greater than one acre, where those discharges enter surface waters of the State or a municipal separate storm sewer system (MS4) leading to surface waters of the State subject to the conditions set forth in the permit. This permit also authorizes stormwater discharges from any other construction activity designated by ADEQ where ADEQ makes that designation based on the potential for contribution to an excursion of a water quality standard or for significant contribution of pollutants to waters of the State.

B. The CONTRACTOR is responsible for obtaining coverage under the Construction General Permit or other individual permit, if applicable. Automatic coverage and waivers are available for small construction sites for which submittal of a NOI, SWPPP and fee are not required. The CONTRACTOR shall prepare and post the Notice of Coverage (NOC) and the Stormwater Pollution Prevention Plan (SWPP) as required by the Construction General Permit for sites less than 5 acres. The CONTRACTOR should make sure to read and understand the conditions of the permit. A copy of the General Stormwater Construction Permit is available on the ADEQ web site at
www.adeq.state.ar.us/water/branch_permits/general_permits/stormwater/.
You may also obtain a hard copy by contacting the ADEQ's General Permits Section at (501) 682-0623

C. If the site is larger than 5 acres, the CONTRACTOR SHALL OBTAIN COVERAGE IN THE UTILITY'S NAME and submit a Notice of Intent (NOI), a stormwater pollution prevention plan (SWPPP), and pertinent fees and other requirements set forth in the CGP.

1.02 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off site areas or into the stream system via surface runoff or underground drainage systems.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 31 2900

TOPSOIL AND SEEDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and place topsoil, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed and all existing lawn areas.

1.02 RELATED WORK

A. Site Preparation is included in Section 31_1100.

B. Earthwork is included in Section 31_2000.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete shop drawings, materials and equipment furnished under this Section including seed mixtures and product label information.

B. Samples of all materials shall be submitted for inspection and acceptance upon Engineer's request.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil shall be fertile, natural sandy loam soil, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the CONTRACTOR shall furnish additional loam at his/her own expense if required.

B. Fertilizer shall be a complete commercial fertilizer, 10-10-10 grade for grass areas. It shall be delivered to the site in the original unopened containers each showing the manufacturer's guaranteed analysis. Store fertilizer so that when used it shall be dry and free flowing.

C. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates.

D. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85 and shall have not more than 1 percent weed content. The mixture shall consist of that specified in Section 620, AHTD Standard Specifications for Highway Construction.

E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the certificates have been submitted.

F. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and

agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

PART 3 EXECUTION

3.01 APPLICATION

A. Unless otherwise shown on the Drawings, loam shall be placed to a minimum depth of 4-in. in all areas.

B. For all areas to be seeded:

1. Lime shall be applied at the rate of 25 lbs/1,000 sq ft.

2. Fertilizer (10-10-10) shall be applied at the rate of 30 lbs/1,000 sq ft.

3. Lawn grass seed shall be applied at the rate of 10 lbs/1,000 sq ft.

4. Fiber mulch shall be applied at the rate of 20 lbs/1,000 sq ft.

C. The application of fertilizer and lime may be performed hydraulically in one operation with hydroseeding and mulching. If lime is applied in this manner, clean all structures and paved areas of unwanted deposits.

3.02 INSTALLATION

A. The subgrade of all areas to be loamed and seeded shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam. Subgrade shall be inspected and approved by the Engineer before loam is placed.

B. Loam shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

C. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign material shall be removed from the loamed area and disposed of. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs/ft of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

D. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Engineer. Hydroseed only on a calm day.

E. Schedules for seeding and fertilizing must be submitted to the Engineer for approval prior to the work.

F. If lime and fertilizer are to be spread mechanically rather than in one operation with the hydroseeding, then:

1. After the loam is placed and before it is raked to true lines and rolled, limestone shall be spread evenly over loam surface and thoroughly incorporated with loam by heavy raking to

at least 1/2 the depth of loam.

2. Fertilizer shall be uniformly spread and immediately mixed with the upper 2-in of topsoil.

G. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Hydroseeder.

H. In order to prevent unnecessary erosion of newly graded slopes and unnecessary siltation of drainage ways, carry out seeding and mulching as soon as satisfactory completion of a unit or portion of the project. A unit of the work will be defined as not more than 20,000 sq ft.

I. When protection of newly graded areas is necessary at a time that is outside of the normal seeding season, protect those areas by whatever means necessary (such as straw applied with a tar tack) or by other measures as approved by the Engineer.

3.03 SEEDING IN WOODED AND UNGRADED AREAS

A. For preparation and seeding in wooded areas under this Contract and where no grading is required, all of the specified materials and procedures shall be utilized except that no disking shall be performed within the drip line of trees to be preserved. The seed bed shall be prepared by the addition of a thin layer of top soil roughly 1-in deep.

3.04 MAINTENANCE AND PROVISIONAL ACCEPTANCE

A. Keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain these areas in an approved condition including a minimum of two mowings of the lawn areas until provisional acceptance.

B. On slopes, provide against washouts by an approved method. Any washout that occurs shall be regraded and reseeded at the CONTRACTOR's expense until a good sod is established.

C. The Engineer will inspect all work for provisional acceptance at the end of the 8 week grass maintenance period, upon the written request, received at least 10 days before the anticipated date of inspection.

D. A satisfactory stand will be defined as a section of grass of 100 sq ft or larger that has:

1. No bare spots larger than 2 sq ft.

2. No more than 10 percent of total area with bare spots larger than 1 sq ft.

3. Not more than 15 percent of total area with bare spots larger than 6-in square.

E. Furnish full and complete written instructions for maintenance of the lawns to the UTILITY at the time of provisional acceptance.

F. The inspection by the Engineer will determine whether maintenance shall continue in any area of manner.

G. After all necessary corrective work and clean-up has been completed and maintenance instructions have been received by the UTILITY, the Engineer will certify in writing the

provisional acceptance of the lawn areas. Maintenance of lawns or parts of lawns shall cease on receipt of provisional acceptance.

3.05 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. All seeded areas shall be guaranteed for not less than 1 full year from the time of provisional acceptance.

B. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Lawn areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.

C. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawns.

END OF SECTION

SECTION 025110

GRAVEL SURFACING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Proposed gravel surfaces as indicated on the Drawings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. Arkansas Department of Transportation

1. Aggregate Base.

1.3 TESTS

A. Gradation of stone materials will be performed in accordance with ASTM C136.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Gravel: ARDOT Class 7 Aggregate Base

PART 3 - EXECUTION

3.1 PLACING GRAVEL

A. For compacted depths exceeding 8 inches, place material in multiple courses of equal depth which do not exceed 8 inches. Gravel surface shall be a minimum of 8-inches thick.

B. Compact each course with mechanical compaction equipment approved by the Engineer. Compaction with wheel of backhoe or track of trackhoe is not acceptable. Compact to 95 percent of maximum density at optimum moisture content as determined by ASTM D698 Standard Proctor Density.

C. Finish grade to provide smooth transition with surrounding gravel. Avoid leaving any humps or ruts.

E. Repair settling as required.

END OF SECTION

SECTION 33 0501

PIPELINE TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and test and clean all new pipelines installed under this Contract as specified herein, including chlorination of all potable water lines.

1.02 RELATED WORK

A. Buried pipelines are included in Division 33.

B. Above grade and exposed pipelines are included in Division 40.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Furnish all necessary equipment and labor for cleaning, testing and disinfecting the pipelines. The procedures and methods shall be approved by the Engineer.

B. Make any taps and furnish all necessary caps, plugs, etc, as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.02 CLEANING PIPELINES

A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.03 TESTING NON-PRESSURE GRAVITY PIPELINES

A. All gravity pipelines shall be tested for leakage by an infiltration or exfiltration test. Buried piping shall be tested by an infiltration test if the groundwater is more than 2-ft above the crown of the pipe for the full length of the section to be tested. Air testing may be used in lieu of an exfiltration test subject to approval of the Engineer.

B. Exfiltration Test

1. Leakage tests by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either a manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2-ft and the head over the downstream crown is not more than 6-ft. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of

at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.

2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant head in the pipe does not exceed 1.9 gallons per inch of diameter per day per 100-ft of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.

C. Infiltration Test

1. Pipe shall be tested for infiltration after the backfill has been placed and the ground water allowed to return to normal elevation. The length of line to be tested shall be not less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 1.9 gallons per inch of diameter per day per 100-ft of pipe in each section tested. There shall be no gushing or spurting leaks.

2. If an inspection of the completed pipeline or any part thereof shows pipes or joints which allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.

3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the Engineer.

D. When the pipeline to be tested is reinforced concrete pipe, the allowable leakage in the above tests shall be 4.7 gallons per inch of diameter per 100-ft of pipe.

E. Low Pressure Air Test

1. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. All air used shall pass through a single control panel.

2. Install plugs at manholes. Brace plugs securely as required for safety and allow no one in the manholes while pressurizing the line or during the test.

3. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig. The internal air pressure in the sealed line shall not be allowed to exceed 8 psig. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig shall not be less than that shown in Table 1 below.

Table 1 – Minimum Specified Time Required for a 1.0 psig Pressure drop for Size and Length of Pipe Indicated

Pipe Diameter (in)	Minimum Time, min:s	Length for Minimum Time, ft	Time for longer lengths, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
6	5:40	398	0.854L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31

Table 2 – Minimum Specified Time Required for a 0.5 psig Pressure drop for Size and Length of Pipe Indicated

Pipe Diameter (in)	Minimum Time, min:s	Length for Minimum Time, ft	Time for longer lengths, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
6	2:50	398	0.427	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16

4. If the pipe section does not pass the air test (time of air pressure drop is lower than the minimum time require in the table above), sectionalize the section tested to determine the location of the leak. Once the leak has been located, repair and retest.

3.04 TESTING PRESSURE PIPELINES

A. All pressure pipelines shall be pressure and leakage tested. Pipelines shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure and this pressure maintained for at least 10 minutes. The leakage test shall be conducted at the maximum operating pressure as determined by the Engineer, and this pressure shall be maintained for at least two hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure to within 5 psi of the test pressure setpoint. Where applicable, hydrant branch gate valves shall remain open during this test. The amount of leakage which will be permitted shall be in accordance with AWWA C600 as shown below:

$$L = SD\sqrt{P}/148{,}000$$

Where: L = makeup water in gallons per hour
S = length of pipe tested in feet
D = nominal pipe diameter in inches
P = average test pressure in psi

END OF SECTION

SECTION 33 05 61

CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
2. Bedding and cover materials.
3. Pile support systems.
4. Vertical adjustment of existing manholes and structures.

1.2 DEFINITIONS

A. Bedding: Specialized material placed under manhole prior to installation and subsequent backfill operations.

1.3 REFERENCE STANDARDS

A. American Association of State Highway Transportation Officials:
1. AASHTO M91 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
3. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

C. ASTM International:
1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
4. ASTM C55 - Standard Specification for Concrete Building Brick.
5. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
6. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
7. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
8. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

9. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
10. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
11. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
12. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
13. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
14. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.4 PREINSTALLATION MEETINGS

A. Section 01 31 19 – Project Meetings: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.

C. Shop Drawings:

1. Indicate structure locations and elevations.
2. Indicate sizes and elevations of piping, conduit, and penetrations.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
1. Manholes: certificate of construction compliance with ASTM C478.
2. Manhole Frame and Cover:
   a. Certificate of material compliance with ASTM A48, Class 35B tensile strength. Furnish certification that tensile test bars were from same pour as castings.
   b. Manufacturer certification AASHTO HS-20 highway loading requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
1. Manufacturer sworn certification that sanitary sewer manholes were constructed using Type II Portland cement.
2. Precast concrete unit manufacturer shall be listed in PennDOT Bulletin 15.
3. Precast concrete supplier plant shall be registered and certified under either the Prestressed Concrete Institute (PCI) or the National Precast Concrete Association (NPCA) plant certification program.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and

inspections.

H. Qualifications Statement:
1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.7 QUALITY ASSURANCE

A. Perform Work according to the Municipal Authority of the Township of Westfall's Rules and Regulations.

B. Structural Design Loading: Unless otherwise noted, utilities, structures and underground conveyance systems shall be constructed to withstand minimum loads in accordance with ASTM C857 with the following loading conditions, including impact load.
1. Heavy Traffic: ASTM C857; A-16, maximum 16,000 lb each wheel.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Handling: Comply with precast concrete manufacturer instructions and ASTM C913 for unloading and moving precast manholes and drainage structures.

C. Storage:
1. Store materials according to manufacturer instructions.
2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
3. Repair property damaged from materials storage.

D. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.10 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Cold Weather Requirements: Comply with ACI 530/530.1.

1.11 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 CONCRETE MANHOLES

A. Manhole Sections:
   1. Materials:
      a. Reinforced Precast Concrete: Comply with ASTM C478 with 4,500 psi Type II, concrete, with XYPEX admixture, or approved equivalent.
      b. Gaskets: Comply with ASTM C923.

   2. Joints:
      a. Comply with ASTM C913.
      b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

B. Shaft and Eccentric Cone Top Sections:
   1. Sections: Reinforced precast concrete.
   2. Joints:
      a. Lipped male/female.
      b. Dry.
   3. Hold Down Bolt Inserts:
      a. 4 inserts to accommodate 3/4-inch frame hold down bolts.
      b. Ultimate tension load capacity: 12,500 pounds.
      c. Locations coordinated with frame.

C. Shape: Cylindrical.

D. Clear Inside Dimensions:
   1. As indicated on Drawings.

E. Design Depth:
   1. As indicated on Drawings.

F. Clear Cover Opening:
   1. As indicated on Drawings.

G. Pipe Entry: Furnish openings as indicated on Drawings.

H. Structure Joint Gaskets:
   1. Comply with ASTM C361.
   2. Material: Rubber.

2.2 FRAMES AND COVERS

A. Description:
1. Material:
a. Cast iron.
b. Comply with ASTM A48/A48M, Class 35B.
2. Lid:
a. Bearing Surface: Machined flat.
b. Configuration: Removable with two concealed pick holes.
c. Security: None.
3. Cover Design: Closed.
4. Live-Load Rating: AASHTO Highway Loading Class H-20.
5. Furnish sealing gasket installed in grove machined into cover.
6. Cover: Molded with identifying name.
7. Frame Hold-down Bolts: ¾" diameter Type 316 stainless steel bolts and washers.
8. Nominal Lid Size: 24 inches.

2.3 RISER RINGS
1. Furnish materials acceptable to the UTILITY.

B. Riser Rings:
1. Thickness of 2 to 6 Inches:
a. Precast concrete.
b. Comply with ASTM C478.
2. Thickness Less Than 2 Inches:
a. Cast iron.
b. Comply with AASHTO M306.
3. Rubber Seal Wraps:
a. Wraps and Band Widths: Comply with ASTM C877, Type III.
b. Cone/Riser Ring Joint: Minimum 3-inch overlap.
c. Frame/Riser Ring Joint: 2-inch overlap.
d. Additional Bands: Overlap upper band by 2 inches.

2.4 ACCESSORIES

A. Steps:
1. Rungs: steel reinforced formed PP.
2. Width:
a. As indicated on Drawings.
3. Spacing:
a. As indicated on Drawings.

B. Pipe Openings:
1. Resilient Gasket Type Pipe Opening Seals:
a. Manufacturers:
1) A-LOK Products Corporation; A-LOK X-Cel Connectors.
2) Hamilton Kent; Tylox Dual Seal II Series.
3) Or equal.
b. Cast integrally with manhole component conforming to requirements specified in ASTM C923.
2. Expandable Sleeve Type: ASTM C923, consisting of a power sleeve, gasket and

two (2) take up clamps. Power sleeve is mechanically expanded to compress gasket against receptacle hole in manhole wall. Install at precast plant.

a. Power Sleeve: Type 304 stainless steel, 85,000 psi yield strength.
b. Gasket: Compound Polyisoprene suitable for use with raw sewage.
c. Take Up Clamps: Type 304 stainless steel with stainless steel screw.

C. Joint Sealant: Comply with ASTM C990 and Fed. Spec. SS-S-210A, Type 1

D. Fasteners: Stainless steel; ASTM F593.

E. Grout: As specified in Section 03 60 00 - Grouting.

F. Soil Backfill from Above Pipe to Finish Grade:
1. Soil Type as specified on Drawings.
2. Subsoil: No frozen earth, or foreign matter, or rocks more than 6 inches in diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that items provided by other Sections of Work are properly sized and located.

B. Verify that built-in items are in proper location and are ready for roughing into Work.

C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.

C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and

replace damaged units.

3.3 INSTALLATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.

B. Correct over-excavation with coarse aggregate.

C. Remove large stones or other hard matter impeding consistent backfilling or compaction.

D. Protect manhole from damage or displacement while backfilling operation is in progress.

E. Excavating:
   1. As specified in indicated locations and depths.
   2. Provide clearance around sidewalls of manhole or structure for construction operations and granular backfill.
   3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
   4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Architect/Engineer.

F. Attachments:
   1. Cut and fit for pipe and sleeves.
   2. Set cover frames and covers level to correct elevations without tipping.

G. Backfilling: As specified in Section 31 05 13 - Soils for Earthwork and 31 05 16 - Aggregates for Earthwork.

H. Precast Concrete Manholes:
   1. Lift precast components at lifting points designated by manufacturer.
   2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
   3. Assembly:
      a. Assemble multisection manholes and structures by lowering each section into excavation.
      b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
      c. Lower, set level, and firmly position base section before placing additional sections.
   4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
   5. Maintain alignment between sections by using guide devices affixed to lower section.
   6. Joint sealing materials may be installed on Site or at manufacturer's plant.
   7. Verify that installed manholes and structures meet required alignment and grade.

8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole and structures as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Testing:
1. Concrete Manhole Sections: Comply with ASTM C497.

C. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

3.5 ATTACHMENTS

A. Manholes: Precast concrete sections, copolymer polypropylene plastic steps, not less than dimension shown on plan, to depth indicated, with non-bolted lid.

END OF SECTION 33 05 61

SECTION 33 1101

DUCTILE IRON PRESSURE PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, install, and test ductile iron water pipe and fittings for piping as shown on the Drawings and as specified herein. This specification also governs the ductile iron pipe used for Wastewater and sludge forcemain applications.

B. Piping shall include all piping and fittings extending outward, upward and downward into the ground from the outside face of all buildings. Piping shall begin at the outside face of the buildings. The first joint shall be not more than 2-ft from the outside face of the building or structure unless otherwise shown on the Drawings. Piping shall include all piping in valve vaults, manholes, cleanouts and similar yard structures.

C. Piping shall be located substantially as shown on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the CONTRACTOR's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Trenching, Backfilling and Compaction is included in Section 31_2300.

B. Valves, Hydrants and Appurtenances are included in Section 33_1200.

1.03 SUBMITTALS

A. Submit shop drawings and product data, including piping layouts, design calculations, warranty information, test reports, in accordance with Section 01_3000 and the referenced standards.

B. Submit design calculations in accordance with Paragraph 2.02 below signed by a Professional Engineer, as noted in Section 01300.

C. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.

D. Prior to shipment of pipe, certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.

E. Submit copies of all shop tests, including hydrostatic tests.

F. Submit information on all warranties per Section 01_7836.

G. Submit shop drawings with a tabulated laying schedule which references stations and invert elevations as shown on the Drawings as well as all fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials, along with the manufacturer's drawings and specifications providing complete details of all items. The laying schedule shall

show pipe class, class coding, station limits and transition stations for various pipe classes. The above shall be submitted to the Engineer for approval before manufacture and shipment. The location of all pipes shall conform to the locations indicated on the Drawings. Full length pipe may be supplied from inventory provided that all specification requirements are met. Shop drawings shall include but not be limited to:

1. Complete and dimensional working drawings of all pipe layouts, including pipe stationing, invert elevation at changes in grade or horizontal alignment, all elements of curves and bends both in horizontal alignment and vertical position.

2. The grade of material; size, wall thickness, of the pipe and fittings and appurtenances, type and location of fittings, specials, and valves; and the type and limits of the lining, lining reinforcing and coating systems of the pipe and fittings. Methods and procedures recommended by the coating manufacturer will be documented.

3. Joint details; methods and locations of supports; and complete information concerning type, size and location of all welds. Shop welds (no field welding will be allowed) will be clearly differentiated and welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions. Locations and proposed joint details will also be clearly identified.

4. Method of manufacture of pipe; joint details; fittings; and any specials.

5. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings and related items.

H. Submit anticipated production and delivery schedule.

I. Prior to shipment of pipe, submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

J. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

2. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

3. ASTM A242 – Standard Specification for High-Strength Low-Allow Structural Steel

4. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tesile Strength.

5. ASTM A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.

6. ASTM C150 - Standard Specification for Portland Cement.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3-in through 48-in (75mm Through 1219mm) for Water.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water.

7. AWWA C115 – Flanged Ductile Iron Pipe With Ductile Iron or Grey Iron Threaded Flanges.

8. AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.

9. AWWA C153 - Ductile- Iron Compact Fittings, 3-in through 24-in and 54-in through 64-in, for Water.

10. AWWA C550 – Protective Interior Coatings for Valves and Hydrants

11. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

12. AWWA C606 - Grooved and Shouldered Joints.

13. AWWA C651 - Disinfecting Water Mains.

14. AWWA M41 – Ductile Iron Pipe and Fittings Manual of Water Supply Practices

C. National Sanitation Foundation (NSF)

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

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. It is a requirement of these Contract Documents to have all of the ductile iron pipe under thus section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. Similarly. It is a requirement of these Contract Documents to have all of the ductile iron fittings under thus section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. All connections between the pipe and fittings shall be compatible, as detailed in Section 1.06.

B. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any leak or rupture of the pipe wall. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

D. All ductile-iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the Engineer sworn certificates of such tests and their results at least 5 days prior to the shipment of the goods.

E. Inspection of the pipe and fittings will also be made by the Engineer or representative of the UTILITY after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements even though pipe may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery (including defects from manufacturing or delivery/transport) shall be marked for identification and shall immediately be removed from the job at the Contractors expense.

F. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the UTILITY at the UTILITY's expense.

G. A manufacturer's representative shall be made available to the UTILITY and UTILITY's representative during the manufacturing furnishing, transporting, and unloading of the pipe during installation and testing of the pipe to assist in insuring that the pipe is properly fabricated, transported, unloaded, stored in the field, joined and tested. Manufacturer's responsibilities relate only to the proper care and treatment of the pipe during these procedures and not the techniques or procedures used during installation and testing.

    1. The designated factory representative shall be made available at any time the UTILITY may request. The field or site representative shall be made available a minimum of [2] working days (time on site) during the project when requested by the UTILITY.

    2. The cost for the services of the factory representative, including expenses, shall be considered incidental to the project and will not be paid separately.

H. The manufacturer shall meet the following criteria and furnish the necessary project information , which demonstrates the required experience:

    1. Experience that includes successful fabrication (followed by installation, acceptance and service) to AWWA C151 standards of at least [50,000] lineal feet of the largest specified diameter or larger ductile iron pipe with similar linings/coatings within the past 5 years.

    2. Experience shall include the successful fabrication of at least 50- fittings in compliance with AWWA C110 or C153 of the largest specified diameter or larger with similar lining/coatings within the past 5 years.

    3. Experience that includes the successful fabrication (followed by installation, acceptance and service) of at least 10,000 lineal feet of the largest specified diameter or larger push-on style, boltless restrained joint for ductile iron pipe within the last 5 years.

I. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:

    1. Manufacturer, date.

    2. Size, type, class, or wall thickness.

    3. AWWA Standard(s) produced to.

4. Each pipe shall be identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation.

5. Special fittings, bends, and appurtenances requiring specific orientation will be appropriately marked with the words "TOP" in the correct position and in a consistent location.

1.06 DESCRIPTION OF SYSTEMS

A. Pipe shall be made in the United States. Fittings may be made outside the United States, but shall be supplied by one of the named pipe manufacturers or engineer approved equal. Pipe and fittings shall be as supplied by the American Cast Iron Pipe Co., U.S. Pipe and Foundry, Griffin Pipe Products, all pipe divisions of the McWane Company, or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA). All ductile iron pipe shall be supplied by a single manufacturer and all ductile iron fittings shall be supplied by a single manufacturer. The fittings supplier shall certify in writing that their fittings are compatible with the supplied brand of pipe.

B. Pipe is to be installed in those locations shown on the Drawings, and only where specifically indicated.

C. CONTRACTOR is responsible for compatibility between joints of all items they supply.

D. In the case of conflict between information on the pipe schedule, Drawings, and or this section especially concerning pressures, coatings, linings minimum thickness etc. the information given in the pipe schedule shall govern.

1.07 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, pipe linings and pipe coatings. See AWWA C600 and the referenced AWWA Standards for Shipping, handling and storage procedures. All pipe and fittings shall be examined as noted in Division 1. Any damage to linings or coatings discovered during the examination shall be repaired to the satisfaction of the Engineer at the cost of the CONTRACTOR, before proceeding with the work.

B. Pipe shall be transported to the job site on padded bunks or oak timbers and secured with steel banding or nylon tie down straps to adequately protect the pipe and coating. Slings, hooks, or pipe tongs or other devices acceptable to the Engineer shall be used in pipe handling. No uncushioned ropes, chairs, wedges, cables or levers shall be used in handling finished pipe, fittings or couplings. Under no circumstances shall the pipe or fittings be dropped or skidded against each other. Care shall be taken to preventing marring the pipe coating. Padded wooden pipe cradles, or chocks suitable for the protection of coatings shall be used between finished pipes and beneath them when pipes are placed upon rough surfaces. Pipe shall not be stored on bare ground unless soft sand berms are used to support the pipe and is approved by the Engineer.

C. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.

E. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

F. Lined and/or coated pipe shall be suitably protected from exposure and heating of the sun at all times following procedures recommended by the coating/lining system manufacturer. Exposure will not be allowed (except for short periods such as installation, assembly and repairs).

G. No metal tools or heavy objects shall be permitted to come in contact unnecessarily with the finished coating. Workers will be permitted to walk upon the coated pipe only when necessary, in which case they shall wear footwear with rubber or composition soles and heels that are sufficiently free of dirt and mud that coating remains undamaged.

H. It shall be the responsibility of the CONTRACTOR to prevent damage to the linings and coatings that might be caused by handling and/or onsite storage of the finished pipe at low temperatures (due to embrittlement), high temperatures or direct sunlight.

1.08 Warranties

A. Provide warranties as required in Section 017836

PART 2 PRODUCTS

2.01 MATERIALS

A. Ductile iron pipe shall conform to AWWA C151 or ASTM A746. Pipe shall be supplied in standard lengths as much as possible.

B. Thickness design shall be per AWWA C150. The pipe supplier shall perform thickness analysis as referenced in Paragraph 2.02. All ductile iron pipe supplied shall meet the minimum wall thickness and pressure class indicated on the drawings.

2.02 DUCTILE IRON PIPE DESIGN

A. Ductile iron pipe shall have a minimum tensile strength of 60,000 psi with minimum yield strength of 42,000 psi (per AWWA M-41). Design shall be done for external and internal pressures separately using the larger of the two for the net design thickness. Additional allowances shall be made for service allowance and casting tolerance per AWWA C150. The pipe classes determined for various sizes and conditions shall provide the total calculated thickness at a minimum or conform to minimum pipe class specified in Paragraph 2.01 B above, or as shown on the Drawings, whichever is greater.

B. Design for the net thickness for external loading shall be taken as the greater of the following conditions:

1. 2.5-ft of cover with AASHTO H-20 wheel loads, with an impact factor of 1.5.

2. Depth from existing ground level of future proposed grade (whichever is greater) to top of pipe as shown on the Drawings, with truck load.

3. Soil Density: 125 lbs/cu ft

4. Laying Conditions; AWWA C150, Type 2.

C. Design for the net thickness shall be based upon the following internal pressure conditions:

1. Design pressure: 350 psi

2. Surge allowance: 100 psi

3. Safety factor: 2

4. Total internal pressure design: 2 (350 + 100) = 900 psi

5. E': 300 psi

D. Copies of design calculations showing that the pipe meets all of the requirements specified herein shall be furnished to the Engineer for approval during shop drawing review in accordance with Section 01_3000. Yield strength of 42,000 psi shall be used during design calculations.

2.03 END TREATMENTS/JOINTS

A. Ductile iron pipe joints shall be push-on rubber gasket type or rubber-gasket mechanical joint per AWWA C111, except where flanged joints are required as shown on the drawings. All gasket materials shall comply with Table 5-1 of AWWA M-41. Rubber-gasket joints shall conform to AWWA C111. Gasket shall be of styrene butadiene rubber (SBR).

B. Unless otherwise noted, all buried ductile iron pipe fitting joints shall be rubber-gasket push-on-joint. Where shown on plans the push-on-joint shall utilize a locking restrained gasket for the number of pipe joints shown. *Contractor may substitute push-on-joint pipe with mechanical joint pipe and may substitute locking restrained gaskets, where required, with Megalug Series 1100 restrained glands.*

C. Unless otherwise noted, all exposed ductile iron pipe fitting joints shall be flanged joint per AWWA C110/C153.

D. Threaded ductile iron flanges for ductile iron pipe shall be fabricated per AWWA C115 and sealed during installation with a special high pressure, full face gasket per AWWA C111. At the pipe manufacturer's option, the use of 250 lb pattern flanges, which are faced and drilled in accordance with ANSI B16.1 may be substituted in order to match valves or other equipment and/or to meet the required working pressure requirements. All flanges shall be rated for the same pressure as the adjacent pipe in all cases. Compatibility of the flanges with the 250 lb class and higher special class AWWA valves will the responsibility of the CONTRACTOR.

1. Flanges shall be pre drilled and then faced after being screwed onto the pipe, with flanges true to 90 degrees of the pipe axis and shall be flush with the end of the pipe.

2. Gaskets shall be full face rubber, 1/8" thick SBR material, such as American Toruseal Gasket, or approved equal. Special material ring gaskets such as those by Garlock or equal may be required for pressures exceeding 250 for ANSI rated and custom flanges.

3. Flanged joints shall be supplied with bolts and nuts on one end, bolt studs with a nut at each end, or studs with nuts on one end where the flange is tapped. The number and size of bolts shall comply with the same standard as the flange. Bolts and nuts shall, except as otherwise specified or noted in the Specifications or on the Drawings, comply with ASTM A193, grade B7.

4. Blind flanges shall mate with regular flanges.

5. Filler flanges and beveled flange fillers shall be furnished faced and drilled complete with extra length bolts.

E. Couplings and Adapters

1. Sleeve type couplings shall be HyMax2 Mueller Water Products, or equal.
2. Flange adapters shall be Series 2100 Megaflange, EBAA Iron, or equal.

2.04 FITTINGS

A. Pipe fittings shall be ductile iron with pressure rating of 350 psi. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings shall have the same pressure rating and joining system, as a minimum, of the connecting pipe, unless shown otherwise.

B. Closures shall be made with mechanical joint ductile iron solid sleeves, restrained with follower glands on each end, unless alternate approved coupling systems as described in paragraph 2.03E are used and shall be located in straight runs of pipe at minimum cover outside the limits of restrained joint sections. Location of closures shall be subject to approval of the Engineer.

C. Unless otherwise noted, all buried ductile iron pipe fitting joints shall be rubber-gasket mechanical joint per AWWA C111 and shall be restrained with a Megalug Series 1100 retaining gland at each side.

D. Unless otherwise noted, all exposed ductile iron pipe fitting joints shall be flanged joint per AWWA C110/C153.

2.05 INTERIOR LINING

A. Ductile iron pipe and fittings shall have the same type of lining, as specified herein.

B. Ductile iron pipe and fittings for use in RAW WASTEWATER applications (defined as any flow prior to the clarified/decanted effluent from the activated sludge final clarifier/SBR process) shall have Protecto 401, Ceramapure, or TNEMEC Series 431 Permashield PL lining.

C. Ductile iron pipe and fittings for use in GRIT, SLUDGE, or SCUM applications shall have Protecto 401, Ceramapure, or TNEMEC Series 431 Permashield PL lining.

D. All other ductile iron pipe and fittings shall have cement mortar lining.

2.06 EXTERIOR COATING

A. Buried pipe and fittings shall be installed with a bituminous coating in accordance with AWWA C151 and C110 respectively.

B. Buried pipe and fittings shall be installed with polyethylene encasement. Polyethylene encasement shall have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition.

1. Polyethylene encasement shall meet minimum size requirements per TABLE 3 of section 2.15 of DIPRA's Installation Guide For Ductile Iron Pipe.

2. Test results from an independent testing agency certifying that the polyethylene encasement meets all criteria established by AWWA C105, current edition, shall be submitted to the Engineer prior to approval of the polyethylene encasement for use. In general, samples shall be submitted and include test results in accordance with the AWWA standard associated with tensile strength, elongation, dielectric strength, impact resistance, and propagation tear resistance.

3. A 2-inch wide plastic adhesive tape, such as Denso Utility Wrap, Calpico Vinyl, Polyken 900, or equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.

C. Exposed pipe and fittings shall be installed with an epoxy primer coating (shop primed) as specified for field top-coat in Section 099100, or equal, or supplied as uncoated pipe and field primed and painted in accordance with Section 099100.

PART 3 EXECUTION

3.01 GENERAL

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used fir pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe, lining or coatings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.

If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.

D. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Blocking will not be permitted. If any defective pipe or fitting is discovered after it has been laid, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner by the CONTRACTOR, at his/her own expense.

All pipe and fittings shall be kept clean until they are used in the work and shall be sound and thoroughly cleaned before laying. When laid, the pipe and fittings shall perform to the lines and grades required. When laying is not in progress, including lunch breaks, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed that recommended by the manufacturer.

All ductile iron pipe laid underground shall have a minimum of 3 of feet of cover unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid such that the invert elevations shown on the Drawings are not exceeded.

Fittings, in addition to those shown on the Drawings shall be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Engineer.

The pipe interior shall be maintained dry and broom clean throughout the construction period.

When field cutting the pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The end of the cut pipe shall be beveled to conform to the manufacture's recommendations for the spigot end. Any coating removed from the cut end shall be repaired according to manufacturer's recommendation and/or Section 2.06 whichever method is more stringent in the opinion of the Engineer. Lining shall be undamaged. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints. Where field cuts are permitted, the pipe to be cut shall be supplied by the factory as "gauged full length". Should full length gauged pipe be unavailable, the pipe to be cut shall be field gauged at the location of the new spigot using a measuring tape, or other means approved by the manufacturer, to verify that the diameter is within the tolerances permitted in Table 1 of AWWA C151.

B. Jointing Ductile-Iron Pipe

1. Push-on joints shall be made in strict accordance with manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is properly seated.

2. Mechanical joints shall be assembled in strict accordance with the manufacturer's instructions, AWWA C600 and Appendix A of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Pipe shall be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts shall be tightened to the specified torques. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage. After installation, apply a bitumastic coating to bolts and nuts and install polyethylene encasement as specified.

3. Bolts in mechanical or restrained joints shall be tightened alternately and evenly. Restraint for mechanical joint pipe shall use retainer glands for restraining joint. All restrained mechanical joints shall be suitable for the specified test pressure.

4. Restrained joints shall be installed according to pipe manufacturer's instructions.

5. Flanged joints shall be assembled in strict accordance with the manufacturer's instructions and Appendix C of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Extreme care shall be taken to ensure that there is no restraint on opposite ends of pipe or fitting, which would prevent uniform gasket compression, cause unnecessary stress, bending or torsional strains, or distortion of flanges or flanged fittings. Adjoining push on joints shall not be assembled until flanged joints have been tightened. Flange bolts shall be tightened uniformly to compress the gasket uniformly and obtain a seal. Flange bolts shall be left with approximately 1/2-inch projection beyond the face of the nut after tightening. After installation apply a bitumastic coating to the bolts and nuts as specified.

6. Sleeve couplings shall only be installed for closure or as shown on the Drawings. Couplings shall not be assembled until adjoining joints have been assembled. After installation. Apply a heavy bitumastic coating to the bolts and nuts and install protective wrap recommended by the manufacturer or as required herein. Care shall be exercised to insure that the insulating properties of insulating and dielectric couplings are maintained.

C. All blowoffs, outlets, valves, fittings and other appurtenances required shall be set and jointed as indicated on the Drawings in accordance with manufacturer's instructions.

D. Install polyethylene encasement around ductile iron pipe to limits shown on the Drawings and in accordance with pipe manufacturer's recommendations.

1. Polyethylene encasement shall be installed per ANSI/ AWWA C105/A21.5, Method 'A' in accordance with section 2.15 of DIPRA's Installation Guide For Ductile Iron Pipe.

2. A fabric type or padded sling shall be used when handling polyethylene encased pipe to prevent damage to the polyethylene encasement.

3. All seams in the polyethylene encasement shall be sealed completely with approved 2-inch wide plastic adhesive tape.

4. Extreme care shall be taken to ensure that all rips or tears in the polyethylene encasement are properly repaired with additional tape and film as described in ANSI/AWWA C105/A21.5

5. Extreme care shall be taken when backfilling to avoid damaging the polyethylene encasement

3.03 BEDDING AND BACKFILL

A. All buried ductile iron pipe shall be bedded in compacted crushed stone extending from 4" below the pipe up to a depth of $^1/_8$ of the pipe diameter. The bedding material shall be compacted to 90% standard proctor density (ASTM D 698).

B. For open ground areas, select common fill shall be used to backfill the pipe from the bedding up to the top of the pipe. The material shall be installed in lifts not to exceed 6" and compacted to 90% standard proctor density.

C. For paved areas, AHTD Class 7 Aggregate fill shall be used to backfill the pipe from the bedding up to the pavement subgrade. The material shall be installed in lifts not to exceed 6" and compacted to 90% standard proctor density.

D. All trenches shall be backfilled as soon as possible after installation of the pipelines and appurtenances. It may be necessary to backfill only a portion of the trench to allow adequate curing of concrete. The CONTRACTOR shall limit all open trenches to a minimum of 300 linear feet along public streets/highways/roads and shall completely backfill all trenches daily. Temporary road plating of open trenches in paved areas is allowed if approved by the street/road/highway department.

E. All backfilling shall meet the requirement of Section 31_2300.

3.04 CONNECTIONS TO STRUCTURES

A. Wherever a pipe 3-in in diameter or larger passes from concrete to earth horizontally, two flexible joints spaced from 2 to 5-ft apart depending on pipe size shall be installed, within 5-ft of the exterior face of the wall, whether or not shown on the Drawings.

B. Unless otherwise specified, all pipes passing through a wall will utilize a wall pipe designed to pass the thrust through the wall via restraint to the wall pipe (either restrained joint or Megalug restrained MJ follower gland).

C. Piping underneath structures shall be concrete encased.

3.05 FILLING AND TESTING

A. After installation, the pipe shall be tested for compliance as specified herein. Furnish all necessary equipment and labor for the hydrostatic pressure test on the pipelines.

B. Submit detailed test procedures and method for Engineer's review. In general, testing shall be conducted in accordance with AWWA C600. The method and procedures for performing the hydrostatic pressure test shall be approved by the Engineer. Submit the plan for testing to the Engineer at least 10 days before starting a test.

C. Pressure pipelines shall be pressure and leakage tested in accordance with Section 31_0501. The hydrostatic testing allowances shall not exceed those indicated in AWWA C600. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.

D. CONTRACTOR shall make any taps and furnish all necessary caps, plugs etc, as may be required in conjunction with performing the testing.

E. Gravity pipelines shall be subjected to hydrostatic pressure test as specified in AWWA C600.

F. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.

G. Hydrostatic pressure tests shall conform to Section 5.2 of AWWA C600. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure tests.

H. The UTILITY will provide a source of supply from the existing treated water distribution system for CONTRACTOR's use in filling the lines. An air break shall be maintained at all times between the UTILITY's distribution system and the CONTRACTOR's equipment to prevent cross-connection. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR. Provide accurate means for measuring the quantity of makeup water required to maintain this pressure.

I. The UTILITY shall supply, at no cost to the CONTRACTOR, a maximum quantity of water equal to 110 percent of the volume of the pipelines for testing. Additional water required by the CONTRACTOR will be provided at standard billing rates for the volume required. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR. Provide accurate means for measuring the quantity of makeup water required to maintain this pressure.

J. Duration of pressure test shall not be less than 2 hours. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves and accessories shall be removed and replaced.

3.06 CLEANING

A. At the conclusion of the work, thoroughly clean all of the pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

B. After the pipe has been cleaned and if the groundwater level is above the pipe or water in the pipe trench is above the pipe following a heavy rain, the Engineer will examine the pipe for leaks. If defective pipes, fittings or joints are discovered at this time, they shall be repaired or replaced by the CONTRACTOR.

END OF SECTION

SECTION 33 1200

VALVES, TAPPING SLEEVES, & HYDRANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all non-buried valves as shown on the Drawings and as specified herein.

B. The equipment shall include the following:

1. Valve Actuators - General

2. Gate Valves

3. Ball Valves

1.02 RELATED WORK

A. Piping is included in the respective Sections of Division 40.

B. Certain appurtenances for individual types of pipe or systems are specified with the specific type of pipe or system. However, additional items are specified in this Section.

C. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

D. Valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in Division 11. Valve operators shall, however, be mounted at the factory on the valves as specified herein, as part of the work of this Section.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01 3000, materials required to establish compliance with this Section. Submittals shall include at least the following:

1. Certified drawings showing all important details of construction and dimensions.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. The total weight of each item.

4. A complete bill of materials.

5. Additional submittal data, where noted with individual pieces of equipment.

6. Location of the valve and actuator manufacturing facility.

7. Electrical characteristics and wiring diagrams including but not limited to voltage, load in kW, Hp or FLA and phase.

B. Test Reports

1. Provide certified hydrostatic test data, per manufacturer’s standard procedure or MSS-SP-61 for all valves.

C. Certificates

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data

E. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01 8823. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

F. Manufacturer's Warranty

1.04 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B30 - Standard Specification for Copper Alloys in Ingot Form.

B. American Water Works Association (AWWA)

1. AWWA C504 - Rubber-Seated Butterfly Valves

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

3. AWWA C540 - Power-Actuating Devices for Valves and Slide Gates

4. AWWA C550 - Protective Interior Coatings for Valves and Hydrants

C. American National Standards Institute (ANSI)

1. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves

4. ANSI B16.104 - Butterfly Valves

D. American Iron and Steel Institute (AISI)

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS-SP-61 - Pressure Testing of Steel Valves.

2. MSS-SP-67 - Butterfly Valves.

3. MSS-SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends.

4. MSS-SP-71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.

5. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.

6. MSS-SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

7. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.

8. MSS-SP-82 - Valve Pressure Testing Methods

9. MSS-SP-98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum 10 years, reputable and qualified in the manufacture of the particular equipment to be furnished. Bonds in lieu of experience will not be acceptable.

2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Section as applicable.

3. All units of the same type shall be the product of one manufacturer.

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Inspection of the units may be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.06 SYSTEM DESCRIPTION

A. All of the equipment and materials specified herein is intended to be standard for use in controlling the flow of water and air as noted on the Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.

1.07 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01 6610 for additional information.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.

2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.

a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood, plywood, or plastic covers on each valve end.

b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.

c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.

d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced at no cost to the Owner.

C. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.08 MAINTENANCE

A. Special tools including packing maintenance hardware and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Sections 01 8823 and where noted, as specified herein.

B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

C. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after start-up and final acceptance.

1.09 WARRANTY

A. The Contractor shall obtain from each valve and actuator manufacturer its warranty that the equipment shall be warranted for a period of 1 year from the date of Substantial Completion, as defined in the General Conditions, Division 0 and specified in Section 01 7836, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), the part(s) shall be replaced in the equipment and the unit(s) restored to service at no expense to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves and appurtenances shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.

E. Unless otherwise noted, items shall have a minimum working pressure of 250 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

F. Joints, size and material - unless otherwise noted or required by the Engineer:

1. Except where noted, all buried joints referred to herein shall be mechanical joint.

2. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to unless otherwise specified.

3. All valves exposed to view, or in vaults.

a. 2-1/2-in and smaller - threaded or soldered ends as required.

b. 3-in - threaded or flanged as shown.

c. 4-in and larger flanged ends.

G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

H. Valves and actuators located outdoors but not within a building; within maximum 2-ft above liquid; in vaults; or where otherwise noted shall be designed for submerged service where water may completely submerge the valve and operator. All other units shall have NEMA 4X enclosures. Valves and actuators to be installed within valve vaults in yard and designed for submerged service shall have Type 316 stainless steel bolts and hardware.

2.02 VALVE ACTUATORS - GENERAL

A. See the Paragraph 2.01H above for submergence requirements.

B. The valve manufacturer shall supply, mount and test all actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.

C. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

D. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

E. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top by Clow or equal.

F. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt or equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.

G. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.

H. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.

I. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised castings. Decals or painted indications shall not be allowed.

J. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

2.03 GATE VALVES (& TAPPING VALVES)

A. Gate valves for water service shall be Mueller Resilient Wedge A-2361 gate valves, Clow (McWane) C515 gate valves, or equal.

B. Valve ends for buried service shall be MJxMJ, unless otherwise noted,, except tapping valves shall be equipped with one end as flanged to match tapping sleeve (MJxFL). Valves for exposed service shall be FLxFL, unless otherwise noted.

C. Tapping Sleeves

1. JCM 432 S.S. Tapping Sleeve for D.I. and C900 PVC Mains (JCM Industries, Nash, TX)
    a. All Hardware shall be Type 304 S.S.
2. Smith Blair 662 for SDR PVC Mains
3. All tapping sleeves shall be hydrostatic pressure tested at their max. rated working pressure for a min. of 1-hour prior to tap being made.

2.09 BALL VALVES

A. Ball valves shall be manually actuated unless otherwise shown on the Drawings. Valves shall be two piece, threaded, full port, 316 stainless steel construction. Valve seats shall be R-PTFE and easily accessible and replaceable. Valves shall be Dixon SSBV Series, or equal.

2.11 VALVE ACTUATORS

A. The valve manufacturer shall supply, mount and test actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.

B. Unless otherwise noted on the Drawings, valves shall be manually actuated. Buried and exposed valves with operating nuts shall have a non-rising stem with an AWWA 2-in nut; At least two tee handles shall be provided for each different size operating nut. Unless otherwise noted, operation for valves shall be counterclockwise open. Where shown on the drawings exposed valves shall be supplied with geared actuators and handwheels.

C. Actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

D. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

2.12 SURFACE PREPARATION AND SHOP COATINGS

A. Not withstanding any of the specified requirements, all coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.

B. If the manufacturer's requirement is not to require finished coating on any interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to the Engineer.

C. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer shall be applied in accordance with the instructions of the paint manufacturer. Primer shall be compatible with the finish coat provided.

D. Unless otherwise noted, interior ferrous surfaces of all valves shall be given a shop finish of an AWWA C550 approved epoxy with a minimum thickness of 4 mil.

E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

F. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.13 FACTORY INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to the Engineer.

C. In addition to all tests required by the referenced standards, the following shall also be factory tested:

1. Pressure regulating valves shall be factory tested at the specified pressures and flows.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the work.

C. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.

D. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.

E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.

B. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.

C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform with the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.

B. No testing shall be performed until the manufacturer's service engineer has provided written certification that the following installed equipment has been examined and found to be in complete accordance with the manufacturer's requirements:

1. All motorized valves.
2. All pressure regulating valves.
3. Combination sewage air valve.

C. Functional Test: Prior to startup, all items shall be inspected for proper alignment, quite operation, proper connection and satisfactory performance. All motorized units shall be operated through 20 complete cycles, without vibration, jamming, leakage, or overheating and perform the specified function. All manual actuators shall be operated through ten complete cycles.

D. The various pipelines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.

E. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

3.04 CLEANING

A. All items (including valve interiors) shall be cleaned prior to installation, testing and final acceptance.

END OF SECTION

SECTION 40 4100

PROCESS PIPING AND EQUIPMENT HEAT TRACING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section describes the requirement for supplying, installing, and testing of the electric heat tracing system of the plumbing piping.

1.2 RELATED WORK

A. Section 404200 , Piping Insulation

1.3 SUBMITTALS

A. Submit in accordance with Section 01300, shop drawings, product data, and samples.

B. The following product data shall be submitted:

1. Rated capacity
2. Length of cable
3. Cable spacing
4. Electrical power requirements

C. The shop drawings shall include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.

D. Operation and maintenance data shall be included.

1.4 QUALITY ASSURANCE

A. Manufacturer qualifications:

1. Ten years' experience in design, engineering, manufacture and support of specified system and components.

B. Product requirements:

1. Pipe or tank tracing cable assembly shall be factory assembled, immersed in water for a minimum of 12 hours, and then tested for insulation resistance, high potential breakdown and continuity before leaving the factory.
2. Factory Mutual approved self regulating cable.
3. UL listed, thermostat and contactor.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. International Code Council, (ICC):
   1. IPC-06, (R 2007) International Plumbing Code

C. The Institute Of Electrical And Electronic Engineers (IEEE):

   1. IEEE 515.1, (R 2007) Recommended Practice for the Testing, Design, Installation, And Maintenance of Electrical Resistance Heat Tracing For Commercial Applications

1.6 AS-BUILT DOCUMENTATION

A. Three sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

B. Three sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the as-built documentation.

PART 2 – PRODUCTS

2.1 SELF REGULATING PARALLEL RESISTANCE HEATING CABLES

A. The heating element shall be a pair of parallel No. 16 AWG stranded copper bus wires embedded in cross linked conductive polymer core, which varies heat output in response to temperature along its length. Cables shall be terminated with waterproof, factory assembled non heating leads with connects at one and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.

B. The electrical insulating jacket shall be flame retardant polyolefin.

C. The cable cover shall be tinned copper braid and TPR outer jacket.

D. The maximum power on operating temperature shall be 65°C (150°F).

E. The maximum power off exposure temperature shall be 85°C (185°F)

F. The capacities and characteristics shall be:

   1. Heat output 5.0 W/foot at 50°F, 1.0 W/foot at 150°F
   2. Pipe diameter: 1, 1-1/2, and 2" trade size
   3. Number of parallel cables: 1
   4. Volts: 120
   5. Phase: 1
   6. Hertz: 60
   7. Full load amps: Depending on length of cable
   8. Minimum circuit ampacity: 30
   9. Maximum over current protection: 30

2.2 CONTROLS

A. Pipe mounting thermostats for freeze protection shall have be a remote bulb unit with adjustable temperature range from minus 1 to 10°C (30 to 50°F). The thermostat shall be snap action, open-on-rise, single pole switch with minimum current rating adequate for the contactor to be controlled. The thermostat shall be remote bulb on capillary, resistance temperature device, or thermistor for direct sensing of pipe wall temperature.

B. The enclosure shall be corrosion resistant and waterproof suitable for outdoor mounting.

C. A minimum 120 volt, 30 amp contactor with disconnect switch in corrosion resistant, waterproof enclosure suitable for outdoor mounting, shall be provided for cable power on/off control and to indicate operational status.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Electric heating cable shall be installed for the following applications:

1. Freeze protection of plumbing piping.

B. Electric heating cable shall be installed across expansion, construction, and control joints according to the manufacturer's recommendations using cable protection conduit and slack cable to allow for movement without damage to cable.

C. Electric heating cable for pipe freeze protection shall be installed according to the following:

1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
2. Electric heat cables shall be installed according to IEEE 515.1
3. Insulation shall be installed or applied over piping with electric cables
4. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.

D. Field adjustable switches and circuit breaker trip ranges shall be set.

E. Heating cables including leads shall be protected from damage.

F. Equipment shall be grounded according to Division 16.

G. Wiring shall be connected according to Division 16.

3.2 TESTS

A. Tests shall be performed after cable installation but before the application of coverings such as insulation, wall or ceiling construction, or concrete. The cables shall be tested for electrical continuity and insulation integrity before energizing. The cables shall be tested to verify rating and power input. The cables shall be energized and voltage and current measured simultaneously. Test repeatedly after repairing heating cables with new products.

END OF SECTION

SECTION 404200

PROCESS PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Domestic and Process Water Systems, ambient up to 80°F (27°C).

1.2 REFERENCES

A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:

1. American Society for Testing of Materials (ASTM):

a. ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.
b. ASTM C585, Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
c. ASTM C1338, Standard Test method for Determining the Fungi Resistance of Insulation Materials and Facings.
d. ASTM C1393, Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.
e. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

2. Underwriters Laboratories (UL)

a. UL 723, Test for Surface Burning Characteristics of Building Materials.

3. National Fire Protection Association (NFPA):

a. NFPA 274, Standard Test Method to Evaluate Fire Performance Characteristics of Pipe Insulation

1.3 DEFINITIONS

A. The term "mineral fiber" as defined by the above specifications includes fibers manufactured of glass, rock, or slag processed from a molten state, with or without binder.

B. The term “jacketing” refers to 0.016” aluminum sheet used for outer protection of insulated pipe.

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of American Society of Heating, Refrigeration, and Air Conditioning Engineers ASHRAE 90.1 (2010), "Energy Efficient Design of New Buildings." Insulation installed on outdoor piping shall be 1” thick. Insulation installed indoors in either conditioned or unconditioned space shall be ½” thick.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section “Hangers and Supports of Plumbing Piping and Equipment.”

1. Coordinate clearance requirements with piping installer for piping insulation application.
2. Coordinate installation and testing of heat tracing.

B. Scheduling: Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing.

1.6 SUBMITTALS

A. Product Data: Submit product characteristics, performance criteria, and limitations, including installation instructions, for each type of product indicated.

1. For adhesives and sealants, submit documentation including printed statement of VOC content.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers.

C. Sustainable Design Submittals: Submit manufacturer’s sustainable design certifications as specified.

1.7 DELIVERY AND STORAGE OF MATERIALS

A. Delivery: Deliver materials in manufacturer’s original packaging.

B. Storage: Store and protect products in accordance with manufacturer’s instructions. Store in a dry indoors location. Protect insulation materials from moisture and soiling.

C. Do not install insulation that has been damaged or wet. Remove it from jobsite.

1. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.

2.2 INSULATION MATERIALS

A. General:

1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
2. Owens Corning pipe insulation is not known to contain penta-, octa, or deca-brominated diphenyl flame retardant substances, such as deca-Bromine (deca-BDE).
3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

B. Certifications:

1. Only Owens Corning ASJ, Evolution™ and VaporWick® pipe products are GREENGUARD Indoor Air Quality Certified® and GREENGUARD Children & Schools Certified℠.
2. Owens Corning pipe products are certified by Scientific Certification Systems (SCS) to contain a minimum of 57% recycled glass content (except FLEXWRAP® Insulation)
3. All Owens Corning pipe products are UL listed and labeled (except FLEXWRAP® Insulation and Pipe and Tank Insulation).

C. Molded Fibrous Glass Pipe Insulation: Comply with ASTM C 547, Type 1, Grade A, and ASTM C 585, for sizes required and of a type suitable for installation on piping systems as required. The following type shall be used:

1. For systems operating below ambient (32°F (0°C) to +65°F (18°C)) temperature:

a. Owens Corning™ VaporWick® Pipe Insulation.

2.3 ACCESSORY MATERIALS.

A. Provide accessories per insulating system manufacturer's recommendations, including the following:

1. Closure Materials: Butt strips, bands, wires, staples, mastics, adhesives, and pressure-sensitive tapes.

a. Mold resistant mastics are recommended for chilled water applications.

2. Field-Applied Jacketing Materials: Sheet metal, plastic, canvas, fiber glass cloth, insulating cement, PVC fitting covers.
3. Support Materials: Hanger straps, hanger rods, saddles, support rings, and high density inserts.

B. Adhesives For Indoor Applications: VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 JACKETING

A. Pipe Jacketing: Provide 0.016" thick aluminum sheet cut to fit over pipe insulation with 1" overlap.

B. Elbows: Provide pre-formed two-piece aluminum elbows, 0.024” aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that materials and accessories can be installed in accordance with Contract Documents and material manufacturers' recommendations.

B. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

3.2 PREPARATION

A. Ensure that surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include, but not be limited to, disposable dust respirators, gloves, hard hats, and eye protection.

3.4 INSTALLATION

A. General: Install insulation materials and accessories in accordance with Contract Documents and manufacturer's published instructions to ensure that it will serve its intended purpose.

1. Install insulation on piping subsequent to painting and acceptance tests.
2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over piping surfaces.
3. Maintain the integrity of factory-applied vapor retarder jacketing on pipe insulation, protecting it against puncture, tears or other damage. Seal circumferential joints with butt strips that are compatible with ASJ facing. Stapling is not required to complete the closure.

4. On cold systems, seal penetrations of the ASJ and exposed ends of insulation with vapor barrier mastic. Coat staples used on cold pipe insulation with suitable sealant to maintain vapor barrier integrity. Mastic pipe section ends at every fourth pipe section joint and at each fitting to provide isolation of water incursion. If humidities in excess of 90% are expected, the ASJ shall be protected with either a mastic coating or a suitable vapor retarding outer jacket.
5. When multiple layers are required, all inner layer(s) shall be No Wrap.
6. On insulated piping outdoors, install jacketing continuous, with overlaps between sections, and longitudinal overlaps arranged to shed rain water. Secure with self drilling sheet metal screws. Indoor piping insulation is not required to be jacketed.

B. Support piping so that the insulation is not compromised by the hanger or the effects of the hanger. Provide hanger spacing so that the circumferential joint may be made outside the hanger. Cover the evaporating holes with sealing tape for the length of the metal saddle.

1. Piping systems 3 in (75 mm) in diameter or less, insulated with fiberglass pipe insulation, may be supported by placing saddles of the proper length and spacing under the insulation.
2. For hot or cold piping systems larger than 3 in (75 mm) in diameter, operating at temperatures less than +200°F (93°C) and insulated with fiberglass, provide inserts such as foam or high-density fiberglass with sufficient compressive strength to support the weight of the piping system.
3. At vertical runs, provide insulation support rings, as indicated on Drawings.

C. Fittings:

1. Cover valves, fittings, and similar items in each piping system using one of the following:

    a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
    b. Insulation cement, equal in thickness to the adjoining insulation.
    c. PVC Fitting Covers insulated with material equal in thickness and composition to adjoining insulation.

2. Seal fitting joints with vapor retarder sealing tapes or mastics.
3. Use standard oversizing practices for valves and flanges.

D. Penetrations: Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise specified.

E. Joints: Butt pipe insulation against hanger inserts. For hot pipes, stagger joints when operating temperature is over 400°F (204°C) double layer. Seal jacketing according to type being used. Seal self-sealing laps by firmly rubbing down surface of tape and flap.

1. Taper and seal pipe insulation ends, regardless of service.

F. Vertical Piping: Protect vertical piping to a height of 8 ft -0 in (2.4 m) above the floor. Jacket insulated, exposed vertical piping within the building and insulated piping exposed to the outdoors with minimum 0.016 in thick (0.4 mm) aluminum.

G. Accessory Materials: Install in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

3.5 FIELD QUALITY ASSURANCE

A. Upon completion of insulation work, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.6 PROTECTION

A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

END OF SECTION

SECTION 40 91 16
Electromagnetic Flow Meter

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the requirements for an electromagnetic flow meter.

B. Under this item, the contractor shall furnish and install the flow measurement equipment and accessories as indicated on the plans and as herein specified.

1.2 QUALITY ASSURANCE

A. Referenced Standards and Guidelines - Complies with applicable portions of ANSI/AWWA Standards and NSF/ANSI Standard 61, Annex G. There are currently no AWWA standards that specifically address electromagnetic metering.

1. Flow measurement function complies with Industry Standards

a. ANSI B16.5 Class 150 RF

b. AWWA Class B

c. DIN EN 1092-1 (Flanges)

d. NEMA 4X/6P (IEC 60529 IP67)

e. CE

1.3 SUBMITTALS

A. The following information shall be included in the submittal for this section:

1. Data sheets and catalog literature for flow sensor

2. Installation and operations manual

3. List of spare parts

4. Complete technical product description including a complete list of options provided

5. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification

1.4 SYSTEM DESCRIPTION

A. When looking from the end of the meter into the inside bore, the two measuring electrodes are positioned at three o'clock and nine o'clock. As a conductive fluid flows through the magnetic field, a voltage is induced across the electrodes. This voltage is proportional to the average flow velocity of the fluid and is measured by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce an accurate analog or digital signal. The signal can then be used to indicate flow rate and totalization or to communicate to remote sensors and controllers.

B. Electromagnetic flow meter is intended for fluid metering in industries including water, wastewater, food and beverage, pharmaceutical and chemical. Measures fluid flow of water or fluids which are highly corrosive, very viscous, contain a moderate amount of solids, or require special handling. No moving parts are in the flow stream. Amplifier can be integrally mounted to the detector or can be remote-mounted. Unit is ideally suited for measuring dynamic, non-continuous flow. In applications where a minimum and/or maximum flow rate must be tracked and monitored, the unit provides pulse signals that can be fed to dedicated batch controllers, PLCs and other more specialized instrumentation.

1.5 DEFINITIONS

A. Amplifier – Device used for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with larger amplitude.

B. ANSI – (American National Standards Institute) A private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so that American products can be used worldwide.

C. AWWA – (American Water Works Association) An international non-profit professional organization founded to improve water quality and supply.

D. Detector Coils – The coils generate a magnetic field through which a conductive medium flows.

E. Detector Electrode – Two opposite measuring electrodes in the measuring tube conduct the induced voltage which is proportional to flow velocity to the amplifier.

F. Modbus RTU – a serial communications protocol published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). This is used in serial communication & makes use of a compact, binary representation of the data for protocol communication.

G. NEMA – (National Electrical Manufacturers Association) Is the 'Association of Electrical Equipment and Medical Imaging Manufacturers' in the United States. Its approximately 450 member companies manufacture products used in the generation, transmission, distribution, control, and end use of electricity. These products are used in utility, industrial, commercial, institutional, and residential applications.

H. NSF International – An independent, accredited organization that develops standards, and tests and certifies products and systems. They provide auditing, education and risk management solutions for public health and the environment.

I. PLCs – (Programmable Logic Controller) A digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines.

J. PTFE – (Polytetrafluoroethylene) A synthetic flouropolymer of tetrafluoroethylene that finds numerous applications. The best known brand name of PTFE is Teflon by DuPont Co.

K. Serial Communications – In telecommunication and computer science, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with specifications, provide flow measurement technology by one of the following:

1. Badger Meter

2. Or equal

2.2 OPERATING CONDITIONS

A. System Components

1. Metering Tube (Detector)

a. Consists of stainless steel tube lined with a non-conductive material. Energized detector coils around tube create a magnetic field across the diameter of the pipe. As a conductive fluid flows through the magnetic field, a voltage is induced across two electrodes; this voltage is proportional to the average flow velocity of the fluid.

2. Signal Amplifier

a. Consists of unit which receives, amplifies, and processes the detector's analog signal. Signal is converted to both analog and digital signals that are used to display rate of flow and totalization. Processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Integrated LCD display indicates rate of flow, forward and reverse totalizers and diagnostic messages. Display guides user through programmable routines.

B. Operational Requirements

1. Electromagnetic Flow Meter

a. Detector Housing Material

1) Carbon Steel

b. Amplifier Housing Material

1) Powder-coated aluminum die cast

c. Liner Material

1) Hard Rubber, PFA, PTFE, ETFE

d. Electrodes Material

1) Hastelloy C

e. Grounding Rings

1) Stainless Steel

f. Meter Size

1) 6 inch

g. Flow Range

1) 8.4…3361 GPM

h. Accuracy

1) ±0.3% of reading, ±2 mm/s

i. Repeatability

1) 0.1%

j. Fluid Temperature

1) 178° F (80° C)

k. Ambient Temperature Range

1) –4…140° F (–20…60° C)

l. Nominal Pressure

1) Up to 232 psi (16 bar)

m. Conductivity

    1) Minimum 5µS/cm (20 µS/cm for demineralized water)

n. Altitude

    1) 2500 m

o. Humidity

    1) 90% R.H. maximum

p. Analog Output

    1) 0/4…20 mA

    2) 0…10 mA

q. Pulse Output

    1) 2 open collectors

    2) Passive 32V DS

    3) 0…100 Hz 100 mA

    4) 100…10,000 Hz 20 mA

r. Frequency Output

    1) Maximum 10 kHz (open collector)

s. Communication

    1) RS232

    2) RS422

    3) RS485 Modbus RTU

t. Empty pipe Detection

    1) Field-tunable for optimum performance

u. Min-Max Flow Alarm

    1) Programmable outputs 1…100% of flow

v. Low Flow Cutoff

    1) Programmable 0…10% of maximum flow

w. Galvanic Separation

1) Functional 500 Volts

x. Pulse Width

1) Programmable 5…2000 ms

y. Coil Power

1) Pulsed DC

z. Power Supply

1) 240 VAC (50/60 Hz) <13 VA

aa. Process Connection

1) Flange

a. ANSI/AWWA

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow manufacturer's recommendation for installation and conform to the guidelines provided by the Installation and Operation Manual.

3.2 MANUFACTURER'S WARRANTY

A. Terms

1. The manufacturer of the above specified equipment shall guarantee for two (2) years from date of installation; or two (2) years and six (6) months after the date of shipment that the equipment shall be free from defects in design, workmanship or materials.

END OF SECTION

SECTION 40-9123

Ultrasonic Area Velocity Flow Meter

PART 1 - GENERAL

1.1 Flow meter to consist of a submersible ultrasonic sensor, connecting cable, and remote enclosure with indicating, logging, totalizing, transmitting and controlling electronics. System shall have no moving parts.

1.2 Level measurement accuracy shall be ±0.25% of reading or ±0.08”, whichever is greater. Repeatability & Linearity 0.1%. Velocity measurement accuracy shall be ±2% of reading or ±0.04 ft/sec, whichever is greater. Requires solids or bubbles minimum size of 100 microns, minimum concentration 75ppm. Repeatability & Linearity 0.5%.

PART 2 - MATERIALS

2.1 TRANSDUCER (SENSORS)

2.1.1 Ultrasonic sensor shall be rated for continuous submersion up to 15 feet (4.57 meters).

2.1.2 Using the Doppler principle, the sensor shall measure fluid velocities from 0.1 to 20 ft/sec (0.03 to 6.2 m/sec) and reverse flow to -5 ft/sec (-1.5 m/sec).

2.1.3 Using ultrasonic echo-ranging principle, the submerged sensor shall measure liquid level from 1" to 15 ft. (25.4 mm to 4.57 m).

2.1.4 Level sensing circuitry shall include a temperature sensor for automatic temperature compensation.

2.1.5 Sensor shall be constructed of 316 stainless steel and epoxy resin.

2.1.6 Sensor operating temperature shall be 5°F to 175°F (-15°C to 80°C).

2.1.7 Shall include manufacturer's recommended stainless steel sensor mounting bracket.

2 2 SENSOR CONNECTING CABLE

2.2.1 Provide minimum length 25 ft (7.6 m) tri-coaxial cable with potted bond to the Sensor head. Sensor cable shall be waterproof and electrically shielded. Exposed material shall only be polyurethane.

2.3 TRANSMITTER

2.3.1 The transmitter shall provide for field calibration to round pipes and open channels of any shape.

2.3.2 Configuration shall be via built-in 5-key calibration system with menu selection of parameters. Systems requiring calibration by Parameter codes, switches or external calibrators shall not be BCD accepted.

2.3.3 Configuration data shall be password protected and permanently stored through power interruptions for a minimum of 12 months.

2.3.4 Field configuration shall allow selection and automatic conversion of measurement units, measurement span, high/low flow alarm relay and flow proportional relay pulse rates.

2.3.5 Transmitter shall permit independent field programmable damping of both the level and velocity to smooth output in turbulent flow conditions

2.3.6 Transmitter operating temperature shall be from -5° to 140°F (-20° to 60°C). Transmitter shall contain a thermostat-controlled enclosure heater for condensation protection below 30°F (-1°C).

2.3.7 Transmitter shall have three isolated 4-20mA outputs rated for 1000 ohm maximum load with menu-selectable 0-5VDC alternative. Outputs shall be configured to transmit level, velocity and flow.

2.3.8 Provide two relay contacts rated 5 amp SPDT programmable for flow proportionate pulse to a remote totalizer or sampler, high or low flow alarm, velocity and/or level alarm, and echo loss alarm.

2.3.9 Provide a white, backlit matrix LCD display indicating flow rate, level, velocity, relay states, 14-digit totalizer in user-selected engineering units and multiplier, logger status, and sensor status.

2.3.10 Transmitter display indicating flow rate, units of calibration, totalizer, relay states, logger status, and sensor status shall be visible without opening cover.

2.3.11 Have a built-in 26 million point data logger with USB output to flash drives or mass storage devices. Data logger shall support time and date-stamped logging and generate formatted flow reports including total, average, minimum, maximum and times of occurrence. Include Windows software for data log graphing and export.

2.3.12 Meter shall store the minimum, maximum, and daily total flow for the last 365 days. This data can be downloaded directly to flash drives or mass storage devices for easy reporting.

2.3.13 Configuration parameters can be downloaded by invoking menu selection. Parameters download directly to flash drive or mass storage device.

2.3.14 Level and Doppler signals can be downloaded to flash drive or mass storage device, for diagnostic purposes, by invoking menu selection.

2.3.15 Transmitter shall be housed in a wall-mount, watertight NEMA4X (IP66) enclosure with hinged, clear cover. Mounting hardware shall be included.

2.3.16 Transmitter electronics shall be surge protected on AC power input, sensor, and 4-20mA outputs.

2.3.17 Transmitter power input shall be 100-240VAC 50-60Hz with power consumption of 10VA or less.

2.3.18 The transmitter shall permit plug-in field installation and autodetection of optional accessories including alternative sensor configurations, serial communications, and additional control relays.

2.4 Electronics

2.4.1 Have a thermostat controlled enclosure heater for Transmitter operation at temperatures below freezing.

2.4.2 Have manufacturer's recommended enclosure sunscreen to permit Electronics enclosure mounting in direct sunlight.

2.4.3 Transmitter power input shall be 9-32VDC with minimum power consumption of 10 Watts max.

2.5 MANUFACTURER

2.5.1 Area-Velocity Flow Meter shall be PULSAR Model AVFM 6.1, or equal, and warranted against defects in materials and workmanship for two years.

PART 3 – EXECUTION

3.1 Install instruments and ancillaries according to manufacturer’s instructions.

SECTION 44 4333

MECHANICALLY CLEANED BAR SCREEN

PART 1 – GENERAL

1.01 DESCRIPTION

Furnish, install, and test mechanically cleaned screening equipment.

1.02 SYSTEM

a. Screen shall remove solids from raw wastewater.
b. Screenings shall be mechanically raised on screen to the debris plate and automatically discharged as indicated on the plans or specified herein.

1.03 QUALITY ASSURANCE

a. All materials shall be new, of high grade, and with properties best suited to the working environment.
b. Manufacturer shall be successful in the experience of manufacture, operation, and servicing of equipment of type, size, quality, performance, and reliability equal to that specified.

1.04 SUBMITTAL

a. The manufacturer shall submit a general arrangement drawing that illustrates the layout of the equipment and principle dimensions, and other related data including descriptive literature, electrical control drawings, and catalog cut sheets for individual components and drive motor data.
b. The manufacturer shall submit the location of the nearest permanent service headquarters of the screen and motor manufacturer for the screen and motor submitted.
c. The manufacturer shall submit operating instructions with descriptive literature indicating materials of construction, weights, principle dimensions, and other important details.

1.05 DELIVERY, STORAGE, & HANDLING

a. Shipping
    i. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations, for protection of components, or for installation requirements.
    ii. Pack spare parts in containers bearing labels which clearly designate contents and pieces of equipment for which they are intended.
b. Receiving

    Store and safeguard equipment, material, and spare parts.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

a. Screen shall be of the following manufacture, or equal:
    i. Headworks® Bar Screen Type MS2 as manufactured by Headworks Inc.
    ii. Kusters Water, ProTechtor® Multirake Screen (Model MRS-C)
    iii. Parkson Corporation, Aqua Caiman Articulating Rake Screen
    iv. Duperon Corporation, FlexRake Full Penetration Screen.
    v. Or Equal

2.02 PROVISIONS

a. Screen shall be mechanically cleaned. Incline of bar screen shall be 15 degrees from vertical.
b. Rakes shall approach channel invert from upstream side of screen and rake upward at upstream face with tines between the bars.
c. The screen shall be designed to be pulled out of the channel. Rubber side seals shall seal the screen to the channel walls.
d. Framework of screen shall be constructed of Grade 304 stainless steel with cross section of minimum thickness 3/16". Various parts fastened by welding, riveting, or bolting shall be braced as necessary to ensure a rigid structure. The side frames shall be minimum 3/16" formed to a channel profile. The bottom thickness shall be a minimum of 3/16". The frame shall have support beams with U-profile thickness of 3/16" on the front above the maximum water line.
e. The screen frame shall be supplied in one piece, requiring no field assembly.
f. The drive mechanism for the rakes shall incorporate a solid shaft constructed of Grade 304 stainless steel.
g. Bolts and nuts shall be of Grade 304 stainless steel or other acceptable corrosion-resistant material. Anchor bolts shall be 3/4" or 5/8" Grade 304 stainless steel and furnished by the installing contractor.
h. Screen bars shall be constructed of Grade 304 stainless steel.
i. The bar rack shall consist of continuous bars of tapered dimension.
j. Round or rectangular bars shall not be used.
k. Bars shall be supported from framework and be readily removable. The screen bars shall be individually replaceable without any welding or cutting. Bars that are welded to the framework or welded into sub-assemblies shall not be allowed. Replacement screen bars shall be available from the screen manufacturer.
l. Bars shall be fastened to a debris plate that extends to the point of discharge. Bars shall extend a minimum of 8" (200mm) above the maximum water level.
m. The screenfield shall be accurately constructed to give a clear opening of 0.25 inches (6.35 mm) between the bars. There shall be no space wider than the opening between the bars which would permit passage of larger solids through the screen.
n. Debris plate of Grade 304 stainless steel plate (thickness is minimum 3/16") shall extend to the point of discharge. Debris plate shall be true and flat such that a close clearance between the raking tines and the plate can be maintained during the cleaning cycle. The debris plate shall be constructed to guarantee a maximum gap between rake bar and debris plate, leading to the discharge chute without interruption.
o. Screenings transported to the top of the screen shall be discharged positively by means of a scraper mechanism to the discharge chute. A scraper blade made of a combination of synthetic and other material shall be provided on the scraper.
p. The raking tines shall have the tooth profile precision cut from a single continuous bar of sufficient thickness and depth to ensure adequate stiffness and strength to cope with the specified duty cycle. The rakes shall run in guides on both sides to ensure engagement and clean the bars from the upstream side of the screen. The rakes shall be fabricated from Grade 304 stainless steel. The rake material, thickness of material, and capacity of rake is similar to the entire construction. The rake material thickness shall be as follows:

Thickness of rake bar	10mm (.375" min.)
Reinforcement profile	4mm (.1575" min.)
Side plates	10mm (.375" min.)

q. The rake capacity shall be as follows:
    Capacity/Rake Bar: 0.074 ft^3/ft Screen Field Width (SFW)
        Total Screen Capacity at approx. 10 second cleaning interval (ft^3/h)
        27.17 cfh = 0.074 ft^3 x SFW (ft) x 360
        Total Screen Capacity at approx. 5-second cleaning interval (ft^3/h)
        54.35 cfh = 0.074 ft^3 x SFW (ft) x 720
r. Rakes shall have a shovel shape to prevent screenings from falling back to the channel. Flat rakes without this feature are not permitted.
s. Rake tines shall penetrate into the screen bar spacing to ensure that screenings are completely cleared during each lifting operation. Rake tines are mechanically engaged into the screen bars. During each cleaning stroke, the raking tines shall engage into the bottom of the bar screen grids at the channel invert.
t. Drive chains, chain guides, chain sprockets, bearings, and shafts shall be fully replaceable without having to remove the screen from the channel.
u. The upper sprocket shall be made of Grade 304 stainless steel. The upper sprocket shall have a 125mm pitch and a tooth width of minimum 27mm. No split sprockets shall be used.
v. Upper bearings shall be UCF Type or equal; housed bearings are grease-lubricated and mounted to the take-up frame assembly. No bearings shall be submerged in the waste stream
w. The lower turn guide shall measure:

Pitch	4.92”
Disk Width	0.875”
Outer Diameter	10.695”
Inner Diameter	9.195”

x. Chains shall be heavy duty roller type with a minimum weight of 6 lbs/ft and made of Grade 304 stainless steel of high tensile strength and resistance to corrosion. Chain rollers must be stainless steel. The average ultimate strength of the chain shall be minimum 31,000 pound-force. Chain pins shall be a stainless steel and hardened.
y. Chain guides shall be securely fixed to the screen frame for the full height of travel and shall not protrude into the flow. The type of chain guide, thickness of material, and size is an L-profile, 2.5"/1.3125"/0.1875" (upper) and 2.687”/1.5”/0.1875” (lower), material Grade 304 stainless steel. Replaceable wear strips on chain guides located below the water level shall not be allowed.
z. The drive motor shall be maximum 0.5 HP. The motor shall be an inverter duty rated motor with a 1.0 service factor, rated for continuous duty. The motor shall be controlled by a VFD (variable frequency drive), rated for continuous operation. Enclosure shall be rated applicable for the specific installation environment. The drive unit, including the reduction gearbox, shall be directly shaft mounted and shall be positioned to facilitate maintenance work.
aa. A VFD and a PLC (programmable logic controller) shall be provided. VFD shall have solid state overload integral. On meeting a blockage, the device shall be able to automatically reverse the direction of travel of the raking mechanism for an adjustable distance and revert to the forward motion to try to clear the blockage. This reversing action can occur a maximum of three times for any one obstruction. The device shall reset automatically if the blockage causing the initial overload condition is cleared; should the blockage remain upon the completion of the fourth attempt, the screen shall be tripped and an alarm generated. The reverse function shall be effective only in the low speed mode.
bb. The raking mechanism shall be capable of two cleaning speeds. Normal speed shall have an approximate ten second cleaning interval and high speed shall have an approximate

five second cleaning interval. Screens which do not meet these performance criteria will not be considered.

cc. A discharge chute (thickness is minimum 3/16”) shall be provided for each screen to divert screenings discharged from the screen to a dumpster. The discharge chute shall be made of Grade 304 stainless steel. The discharge chute shall be mounted at an angle of 30 degrees. Panels are positioned on both sides to protect from splashing.

dd. Covers, which are easily removable, shall be provided for easy maintenance. Covers shall be constructed of clear, impact-resistant polycarbonate material (thickness is minimum 1/4") to allow for visual observation during screen operation. Polycarbonate covers shall have reinforced plastic pull handles. Polycarbonate covers shall be held in place with threaded plastic hand knobs. Stainless steel covers shall not be used.

2.03 SEQUENCE OF OPERATION – Dual Speed Operation

Main Panel *On/Off*	Local Panel *Hand/Off/Auto* *&* *Fwd/Off/Rev*	Result	Action when Blockage occurs	Comments
On	*Auto* *&* *Any Position*	Screen starts in LSP when the rising water differential reaches set level (Level 1).	Screen performs cleaning shuttle up to 4 times. If unsuccessful, screen stops and initiates alarm contact.	LSP - Low Speed Mode (approx. 10-second cleaning interval)
On	*Auto* *&* *Any Position*	Screen starts in HSP when the rising water differential reaches set level (Level 2.)	Screen performs cleaning shuttle up to 4 times. If unsuccessful, screen stops and initiates alarm contact.	HSP – High Speed Mode (approx. 5 second cleaning interval)
On	*Auto* *&* *Any Position*	Exercise Cycle	Screen performs cleaning shuttle up to 4 times. If no success, screen stops and initiates alarm signal.	X min in LSP, every Y min. (X & Y are Operator adjustable)
On	*Manual* *&* *Forward*	Screen operates forward in LSP.	Screen stops immediately. No cleaning shuttle.	
On	*Manual* *&* *Reverse*	Screen operates in reverse in LSP.	Screen stops immediately. No cleaning shuttle.	
On	*E-Stop Engaged*	Screen stops immediately.	N/A	
On	*Off* *&* *Any Position*	Screen will not operate.	N/A	

On	*Hand* *&* *Off*	Screen will not operate.	N/A	
Off	*Any Position* *&* *Any Position*	Screen will not operate.	N/A	

2.04 BAR SCREEN CONTROLS

a. A bar screen main control panel shall be furnished, completely pre-wired and tested, requiring only wall mounting and connection to interconnecting wiring in the field by an electrical contractor. The control panel shall include all equipment required to control one or more bar screen(s) as specified herein. The control panel shall bear a serialized UL 508, UL 698A, or CSA label when applicable and shall be manufactured by a CSIA certified panel shop. The panel shall be located in a non-classified area where no corrosive gases are present.

b. The control panel enclosure shall be sized as required to house equipment and shall be suitable for wall mounting or mounting to strut-type supports. The enclosure shall be rated NEMA 4X Grade 304 stainless steel.

c. Each bar screen motor shall be controlled by a ABB ACS 500 Series VFD with an internal swinging choke, sized as required for bar screen motor horsepower and suitable for use with variable torque loads. VFD shall include discrete and analog input and outputs as required by control panel manufacturer. No bypass starters will be required.

d. The VFD(s) shall be controlled by an Allen Bradley MicroLogix 1400 Series PLC with necessary extended I/O. The PLC shall be used to control the VFD to operate the screen at two (2) speeds and through the automatic reversing/cleaning shuttle sequence. The PLC shall include discrete and analog inputs and outputs as required.

e. Each screen shall be controlled in synchronization with ultrasonic level sensors, provide with the screen by the screen manufacturer. Upon reaching a predetermined differential set point the screen shall begin operation in low speed and shall shut down after a predetermined time if the differential level is less than the predetermined set point. Upon reaching a second, higher predetermined differential set point, the screen shall operate in high speed.

f. When an overcurrent is detected, the screen shall automatically stop and run in reverse for a predetermined time. The screen shall then stop and return to forward. If the cause of the overload is cleared, the screen shall automatically reset to normal operation. If an overload is again detected, the reversing cycle is repeated up to four (4) times prior to initiating an alarm contact. The use of clutches, friction disks, or similar devices for overload protection are not acceptable

g. The control panel shall have an OIT (Operator Interface Terminal) to allow adjustment of counter values, timers, and level set points without connecting to the PLC. The OIT shall be rated NEMA 4X and provide fault and troubleshooting information.

h. Door mounted NEMA 4X indicating lights shall be provided to indicate running and alarm status of the bar screen. Legend plates and a door mounted alarm reset push button shall also be provided.

i. Local control station(s) shall be provided at the bar screen(s) and shall be fitted a push button emergency stop switch, a Hand-Off-Auto switch, and a Forward-Off-Reverse switch. The local control station enclosure(s) shall be rated NEMA 7.

2.05 SPARE PARTS

a. The following minimum recommended spare parts shall be provided for mechanically cleaned screens:
   i. One (1) set of wiper arm wear pads
   ii. One (1) five-foot chain segment
   iii. Two (2) rake bars

2.06 DESIGN DATA

a.	Quantity of Bar Screens	1 each
b.	Channel Depth	54”
c.	Channel Width	30”
d.	Discharge Height above Floor Level	60”
e.	Maximum Water Depth	48”
f.	Bar Spacing	0.25”
g.	Screen Field Width	24”
h.	Maximum Design Flow per Bar Screen	3.0 MGD
i.	Screen Incline from Vertical	15 degrees

2.07 SURFACE FINISHES AND COATINGS

a. After all fabrication and welding has been completed, all stainless steel surfaces shall be glass bead blasted prior to equipment assembly. The bead blast shall remove all weld discoloration and surface contaminants and provide for spontaneous passivation as recognized in ASTM A380.
b. All purchased components such as motors, reducers, valves, switches, etc. shall be supplied with the manufacturer’s standard finish.

2.08 SCREWPACTOR WASHER/COMPACTOR

a. The bar screen shall be provided with a compatible washer/compactor that compacts screenings before directing through a discharge tube for disposal into a dumpster. Discharge height shall be a min. of 60” above grade to accommodate discharge into a 4 cubic yard dumpster. Wash water shall be controlled by a solenoid valve. The max. size of the compactor motor shall be 1.5 HP.

PART 3 – EXCECUTION

3.01 INSTALLATION

Equipment shall be installed in strict conformance with manufacturer's recommendations.

3.02 MANUFACTURER’S SERVICES

The equipment manufacturer shall furnish a qualified field technician on site for installation inspection, start-up, and operator training for up to two (2) consecutive days during one (1) trip to the jobsite. The number of days and trips specified shall be included in the contract price.

END OF SECTION