SEMINOLE TRIBE OF FLORIDA

IMMOKALEE RAW WATER WELL #4
WELLHEAD DESIGN

IMMOKALEE, FLORIDA

PROJECT NO: 383074

TECHNICAL SPECIFICATIONS
BID SET

APRIL 2024

Stantec

TECHNICAL SPECIFICATIONS

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Contractor to follow the STOF Engineering Design Guidelines for Water/Wastewater – Latest Version

SECTION 01 10 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section describes the project in general and provides an overview of the extent of the WORK to be performed under this Contract. Detailed requirements and extent of WORK is stated in the applicable Specification sections and shown on the Contract Drawings. The CONTRACTOR shall, except as otherwise specifically stated herein or in any applicable parts of the Contract Documents, provide and pay for all labor, materials, equipment, tools, construction equipment, and other facilities and services necessary for proper execution, testing, and completion of the WORK under this Contract.

B. The WORK to be performed under this Contract shall consist of furnishing materials, equipment, supplies, manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.

C. The WORK is located on the Immokalee Reservation of the Seminole Tribe of Florida (STOF). The well location is at 435 Eustis Ave E. Immokalee, FL 34142, which is located immediately east of the STOF’s Immokalee Water Treatment Plant (WTP).

1.2 DESCRIPTION OF WORK

A. The WORK of this CONTRACT comprises the construction of wellhead piping and appurtenances, and raw water piping to provide raw water to the STOF's Immokalee WTP. The WORK generally includes, but is not limited to, furnishing all materials, labor, equipment and testing necessary to:

1. Furnish and install a vertical well pump, column piping, and motor.

2. Furnish and install above grade well surface facilities, including wellhead, concrete slab on grade, and above grade well piping, valves, instruments, and appurtenances.

3. Furnish and install buried raw water main piping, fittings, valves and connect to existing raw water main.

4. Furnish and install instruments and controls for the well, including conduits and cables and connections to the existing PLC panel.

5. Furnishing and install electrical for the well, including panels, conduits, and cables local control station, disconnect switch, pullboxes, grounding, and NEMA starter to be installed in existing MCC.

6. Completing all site civil work including, re-grading site, remove portions of existing fence, install new security fencing, replace curb & gutter, roadway reconstruction, concrete sidewalk replacement, and gravel around well slab.

7. Completing general site civil work including, re-grading site, and sodding. Restoration of the site back to existing conditions or better.

8. All general condition and permitting activities, including site conditions surveys, site security, as-built drawings, and coordination with the OWNER.

B. Potable Water Contact: Potable water shall include raw water supply for potable water treatment and service. All materials immersed, exposed to, or in contact with potable water shall be made of materials or coated compliant with NSF Standard 61.

C. The Specifications included in these Contract Documents establish the minimum performance and quality requirements for materials and equipment together with the minimum standards for quality of workmanship and appearance. Generally, there has been no attempt to separate the Specification sections into groups for the WORK of separate subcontractors, or for WORK to be performed by the various trades. Should there be any question as to the interpretation of any particular Specification section or part of Specification section, such question should be directed to the ENGINEER prior to the submittal of a proposal for the WORK under this Contract.

Any part of the WORK which is not mentioned in the Specifications but is shown on the Contract Drawings, or any part not shown on the Contract Drawings but described in the Specifications, or any part not shown on the Contract Drawings nor described in the Specifications, but which is necessary or normally required as a part of such WORK, or is necessary or required to make each installation satisfactorily and legally operable, shall be performed by the CONTRACTOR as incidental WORK, without extra cost to the OWNER, as if fully described in the Specifications and shown on the Contract Drawings, and the expense thereof shall be included in the applicable unit prices or lump sum bid for the WORK.

1.3 OWNER USE OF THE SITE

A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

B. The CONTRACTOR shall restrict its operations and storage to the Staging Area identified on the Drawings, unless approved otherwise by the OWNER. Staging area shall be fenced with temporary construction fencing by the CONTRACTOR prior to construction activities.

C. Refer to Specification Section 01 55 00 Site Access and Storage for additional requirements.

D. Working hours shall be limited to 7:00 AM to 6:00 PM, Monday through Friday, outside the Water Treatment Plant. Work inside the Water Treatment Plant shall be limited to 8:00 AM to 6:00 PM, Monday through Friday.

1.4 WORK BY OWNER

A. The OWNER will perform the following services in connection with the Work:

1. Operate all existing valves and equipment that will affect the OWNER's operation, unless otherwise specified or indicated.

2. Provide a potable water source for the CONTRACTOR'S use. CONTRACTOR is responsible for securing and paying for the water meter.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 00 – CONSTRUCTION CONSTRAINTS

PART 1 -- GENERAL

1.1 SUMMARY

A. WORK shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the public and to the operation and maintenance of existing facilities.

B. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required under **Section 01 32 16 – CPM Construction Schedul**e.

C. The construction constraints in this Section do not include every item affecting the completion of the WORK, but are intended to describe the sequence of critical events necessary to minimize disruption to the raw water supply to the Immokalee WTP, and to ensure compliance with applicable Permit requirements. It shall be understood and agreed by the CONTRACTOR that the critical events described are not inclusive and that additional items of WORK not included may be required to minimize disruption and ensure compliance. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the CONTRACTOR will result in reducing disruption to the facility operation and maintaining treatment efficiency, and if deviation is approved in advance by the ENGINEER.

1.2 PERMITS

A. Refer to Section 01 77 40 Permits for permitting requirements and constraints. The CONTRACTOR shall incorporate all permitting requirements and durations into the project schedule as required to complete the Work within the Contract Time.

B. The CONTRACTOR shall abide by the conditions of permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the OWNER.

1.3 SCHEDULE CONSTRAINTS

A. General: It is the CONTRACTOR's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall WORK.

B. The listing of schedule constraints below does not mean that every constraint or special condition has been identified. The list does not substitute for the CONTRACTOR's coordination and planning for completion of the WORK within the Contract Times. The following constraints affect the construction schedule.

1. Working hours shall be limited to 7:00 AM to 6:00 PM, Monday through Friday, outside the Water Treatment Plant. Work inside the Water Treatment Plant shall be limited to 8:00 AM to 6:00 PM, Monday through Friday.

2. Work will not be permitted on Saturdays, Sundays, or Holidays and after 6 pm unless necessary to complete the work and approved by the OWNER. All requests to work on Saturdays, Sundays, or Holidays shall be submitted in writing to the OWNER a minimum of one (1) week in advance. All requests to work after 6 pm shall be submitted in writing to the OWNER a minimum of 48 hours in advance.

3. The CONTRACTOR shall be responsible for any fees or additional costs to the OWNER, ENGINEER, or regulatory agencies for their services needed during approved work on weekends, holidays, or after 6 pm on normal workdays.

1.4 CONSTRUCTION SEQUENCING

A. Construction activities shall be scheduled and sequenced to ensure continuous operation of the existing treatment facilities. The CONTRACTOR's scheduling shall develop construction sequencing so that the WORK will not adversely impact treatment. The CONTRACTOR shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the CONTRACTOR shall maintain the existing facilities in service until new facilities are constructed and are operational to supplement the existing capacity. When new facilities are operational, the existing facilities may be taken out of service. The following general guidelines shall be used by the CONTRACTOR in planning the sequence of construction.

1. Safe working conditions for personnel shall be maintained during rehabilitation, modification, and demolition WORK. The foregoing includes at least proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing, and protection of electrical equipment and power supply.

2. Temporary facilities shall be constructed in accordance with applicable codes and regulations to operate safely and properly.

3. Valves to be temporarily shut off during the WORK shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked.

4. Electrical and mechanical equipment shall be similarly shut down.

1.5 EXISTING WATER TREATMENT PLANT

A. The WORK will be executed while the existing Water Treatment Plant is in operation. The CONTRACTOR shall ensure the WORK does not interrupt or jeopardize the operation of the existing Plant.

1.6 WORK BY OTHERS

A. Where 2 or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the OWNER will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the OWNER may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount, and in manner and at time that the OWNER may determine. No OWNER determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for delay or damage except under provisions of the General Conditions for temporary suspensions of the work. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors and shall cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.

B. Interference With Work On Utilities**:** The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the

relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.7 OUTAGE PLAN AND REQUESTS

A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating pipeline, valve, channel, equipment, structure, road, or any other facility without permission from the ENGINEER.

B. Connection to existing raw water main should be scheduled during night-time when WTP operates at lower demands.

C. Where the WORK requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the CONTRACTOR shall submit a detailed outage plan and schedule for the ENGINEER's approval a minimum of 2 weeks in advance of the time that such outage is planned.

D. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.

E. The CONTRACTOR shall provide written confirmation of the shutdown date and time 2 working days prior to the actual shutdown.

1.8 TEMPORARY CONNECTIONS

A. Making connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. WORK shall be completed as quickly as possible and with as little delay as possible to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities and weekend, or holiday activity and overtime payments required during process interruptions shall be included in the WORK.

C. Temporary facilities shall be located to minimize interference with CONTRACTOR's construction facilities and OWNER's operation and maintenance of the Immokalee Water Treatment Plant.

D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the CONTRACTOR shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, CONTRACTOR shall furnish a submittal on the proposed components and installation for ENGINEER's review and approval.

E. A plan showing the size and location of the temporary facilities shall be submitted to the ENGINEER at the same time as the outage plan required under this Section. Costs for design, provision, operation, and removal of temporary facilities shall be part of the WORK.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00 - PROJECT MEETINGS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section describes the project meetings to be attended by the CONTRACTOR and the requirements for each meeting.

1.2 PROJECT KICKOFF MEETING – (OPTIONAL AT THE DISCRETION OF STOF)

A. A Project Kickoff Meeting will be scheduled and held following the issuance of a Notice to Proceed.

B. The Kickoff Meeting shall be attended by representatives from the following parties:

1. OWNER
2. Engineer
3. Program Manager (if applicable)
4. Contractor - Project Manager
5. Key Subcontractors
6. Others as requested by the Owner, Engineer or Contractor

C. The agenda for the Kickoff Meeting will consist of the following:

1. Introductions
2. Safety Moment
3. Roles and Responsibilities
4. Communication Protocols
5. Contractor submittal procedures and forms
6. Contractor RFIs procedures and forms
7. Field Orders and Change Order procedures and forms
8. Project Meetings
9. Contract Milestones and Preliminary Schedule

   a. Prior to the meeting, the CONTRACTOR shall submit the Schedule Plan of Operation and Project Overview Chart in accordance with **Specification Section 01 32 16.**

10. Submittal Schedule

    a. Prior to the meeting, submit a preliminary schedule of Submittals with any proposed substitutions in accordance with **Specification Section 01 33 00**.

11. Stakeholders and community relations

    a. Coordination with Rodeo Facility.

12. Subcontractors

13. Status of Insurance and Bonds

14. Permitting

    a. Prior to the meeting, submit a preliminary list of permits and licenses the CONTRACTOR shall obtain in accordance with **Specification Section 01 33 00** and the status of obtain each permit.

1.3 PRE-CONSTRUCTION CONFERENCE

A. A Pre-Construction Conference will be scheduled following the issuance of the Notice to Proceed.

B. The CONTRACTOR shall not initiate construction until after the Pre-Construction Conference.

C. The conference shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:

    1. OWNER

    2. ENGINEER and the Resident Project Representative.

    3. Others as requested by CONTRACTOR, OWNER, or ENGINEER.

D. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01 33 00 - Contractor Submittals.

E. The purpose of the conference is to designate responsible personnel and establish a working relationship during construction of the Work. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss the items listed below.

    1. Roles and Responsibilities - Designation of Responsible Personnel.

    2. Coordination with adjacent property.

    3. Procedures for when field conditions differ from design drawings and other unknown conditions

4. Use of Site and Work Area security

5. Maintenance of Traffic

6. Deliveries and storage

7. Safety procedures

8. Inspections

9. Sampling and testing procedures

10. Hurricane Preparedness

11. Schedule

    a. Status of Permits

        i. Prior to the meeting, submit an updated list of permits and licenses and the status of each in accordance with **Specification Section 01 33 00.**

    b. Submittals

        i. Prior to the meeting, submit an updated list of Submittals with any proposed substitutions in accordance with **Specification Section 01 33 00**.

    c. Critical work sequencing

12. Housekeeping

13. Processing applications for payment.

14. Maintaining record documents

15. Project Meetings

F. The ENGINEER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

G. The CONTRACTOR and its subcontractors should plan on the conference taking no less than 2 hours.

1.4 PROGRESS MEETINGS

A. The ENGINEER will schedule and hold regular on-Site progress meetings at least bi-weekly and at other times as requested by CONTRACTOR or as required by progress of the WORK.

B. The ENGINEER will preside at the progress meetings and will arrange for keeping and distributing the minutes.

C. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

D. The following entities shall attend the Progress Meetings:

1. CONTRACTOR - Project Manager and Superintendent
2. Construction Manager
3. ENGINEER
4. OWNER
5. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors.

E. The general agenda for the Project Meetings will consist of the following:

1. Safety Moment
2. Review and approve minutes of previous meetings
3. Review progress of Work since last meeting
4. Review Construction Schedule and current progress
5. Percent complete / Earned Value
6. Days ahead/behind schedule
7. Identify and discuss any problems which impede planned progress
8. Develop corrective measures and procedures to regain planned schedule
9. Revise construction schedule
10. Planned work for next period
11. Update of Planned Shutdowns for tie-ins
12. Status of Pay Applications
13. Status of Field Orders / Change Orders
14. Review of Allowance Authorizations
15. Community Relations Issues
16. Safety – Accident Reports

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: Stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Following award of the Contract, each party involved shall be notified in writing of the status of each alternate, in particular whether alternates have been accepted, rejected, or deferred for later consideration. Notification shall include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1.

1. **Base Bid:** Furnish and Install a 30HP pump and motor as described in Technical Specifications 43 24 05.
2. **Alternate:** Furnish and Install a 20HP pump and motor meeting the design requirements in Technical Specifications 43 24 05.

END OF SECTION

SECTION 01 29 00 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.1 SUMMARY

A. Payment for the various items of the Bid Schedule, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, and incidentals appurtenant to the items of work being described, as necessary to complete the various items of the WORK all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of permits and cost of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). No separate payment will be made for any item that is not specifically set forth in the Bid Schedule, and all costs shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.

B. The omission of reference to any item in this description shall not alter the intent of the Bid Form or relieve the CONTRACTOR of the necessity of furnishing such as a part of the Contract.

1.2 MEASUREMENTS

A. Units of measure shown on the Unit Price Sheet shall be as follows unless otherwise specified in the Contract Documents.

Unit	Measurement
AL	Allowance – Amount to be negotiated and agreed to by both parties.
ALT	Alternate – Refer to Spec 01 23 00
CF	Cubic Feet - Field measure by ENGINEER within limits specified or shown
CY	Cubic Yards - Field measure by ENGINEER within the limits specified or shown
EA	Each - Field Measure by ENGINEER
FT	Feet - Field Measure by ENGINEER
HR	Hours – Number of hours of work performed as documented by the ENGINEER
LF	Linear Feet – Field Measure by ENGINEER
LS	Lump Sum – Unit is one. No measurement will be made. Contractor is to provide a Schedule of Values to facilitate partial payments.
SF	Square Feet – Field measure by ENGINEER within the limits specified or shown
SY	Square Yards – Field measure by ENGINEER within the limits

1.3 ENGINEER'S ESTIMATE OF QUANTITIES

A. The unit quantities if any, set forth in the Unit Price Sheet are approximate and are given to establish a uniform basis for the comparison of Bids. The OWNER does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity, as the OWNER may deem necessary. The CONTRACTOR or the OWNER will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensation for any additions caused by changes or alterations in the WORK directed by the OWNER.

B. The unit prices as provided in the detailed Bid Schedule are used for periodic partial payments for Work performed, for determining the value of additions and/or deletions associated with approved Change Orders to the Contract, and wherever else reasonable.

C. For bidding purposes, the ENGINEER has estimated quantities of material; the CONTRACTOR shall be paid for only the actual amounts of materials required and services rendered under this Contract. There is no minimum amount of work guaranteed.

1.4 BID ITEMS

A. MOBILIZATION AND DEMOBILIZATION – **BID ITEM NO. 1**

1. No measurement will be made for this item.

2. Payment will be made at the lump sum price described on the schedule below. The cost of mobilization and demobilization shall not exceed 5.0% of the contract price. The lump sum amount shall be paid as noted below.

Construction % Complete	**Allowable % of Lump Sum for Mobilization / Demobilization**
5	25
10	50
25	75
100	100

3. No further payment shall be made for remobilization unless all of the work is suspended by the ENGINEER for a period in excess of three months and through no fault to the CONTRACTOR.

4. The Lump sum price shall include compensation for all labor, materials, equipment and all other incidentals required for project setup, all temporary facilities, temporary power, temporary water service, temporary access road and stabilization of the ground, videos, computer, insurance, construction trailers (complete), site cleanup, sanitary facilities, labor associated with permit acquisition, contractors staging area preparation and closure, project meetings, project signs, testing, stormwater pollution prevention facilities, demobilization, site and temporary access roadway restoration, laydown yard restoration, and any other pre- or post- construction expenses necessary for the start or cessation of the Work, not specifically identified in the costs of the work. The lump sum price shall exclude the storage of materials.

B. FURNISH AND INSTALL SLAB ON GRADE - **BID ITEM NO. 2**

1. Measurement for payment for furnishing and installing the well slab on grade will be based upon the number of reinforced concrete slabs installed, all in accordance the Contract Documents.

2. Payment for furnishing and installing the well slab on grade shall constitute full compensation for constructing the wellhead surface facilities and electrical control panel concrete slab on grade, including furnishing all required submittals, surveying to layout the slab location, clearing, grubbing, and stripping, excavation, grading, backfill, disposal of excess or unsuitable fill material; replacing disturbed or damaged utilities and areas to equal or better than original conditions; compaction; furnishing and installing formwork, furnishing and installing rebar and concrete, coordinating piping and conduit penetrations, scheduling permitting inspections, and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation.

C. FURNISH AND INSTALL WELL PUMP AND MOTOR ASSEMBLY - **BID ITEM NO. 3**

1. Measurement for payment for furnishing and installing well pump and motor assembly will be based upon the number of such well pump and motor assemblies constructed, all in accordance with the Contract Documents.

2. Payment for the furnishing and installing of the well pump and motor assembly shall constitute full payment for the furnishing and installing the well pump assembly, including furnishing submittals in accordance with the contract documents; furnishing and installing a new pump and motor to meet the operating specified conditions, including column piping, adapters, reinforced concrete pedestal, cables, ports, conduits, spare conduits, and all other ancillaries; furnishing all labor, tools, equipment, appurtenances, and supplies required to assemble and install the pump and motor; shipping and transportation costs; factory testing of the pump and motor; inspection, field adjustment, and startup of pump assembly; field testing and certification of installed assembly, coordination with the OWNER and ENGINEER; and all other appurtenant and miscellaneous required items for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

D. FURNISH AND INSTALL WELL DISCHARGE SURFACE PIPING, FITTINGS AND VALVES - **BID ITEM NO. 4**

1. No measurement will be made for this item.

2. Payment for furnishing and installing well discharge surface piping, valves, and fittings will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing surface piping (stainless steel), valves (check, ball, wafer, etc.) and fittings shall include full compensation for furnishing, installing, testing and disinfecting the surface piping installed on concrete slab on grade, including all piping, valves, fittings, air release/air vacuum valves, taps, appurtenances, nuts, bolts, and ancillary items; stainless steel piping, fittings; quick connect; sampling point and pressure monitoring assembly; Bacteriological and SDI sampling point assembly; Oxidation-Reduction Potential sensor tap & assembly; High Pressure Switch assembly; Electromagnetic Flow Meter assembly; valves, nuts,

bolts, and appurtenances; furnishing and installing stainless steel pipe supports, piping identification, and painting; furnishing all labor, tools, equipment, appurtenances, and supplies to complete the Work; pressure testing and disinfection of piping; and all other appurtenant and miscellaneous required items for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

E. FURNISH AND INSTALL BURIED WELL DISCHARGE PIPING, FITTINGS AND VALVES - **BID ITEM NO. 5**

1. No measurement will be made for this item.

2. Payment for furnishing and installing well discharge buried raw water piping, valves, and fittings will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing well discharge surface piping, valves, and fittings shall include full compensation for furnishing, installing, testing and disinfecting buried piping from slab on grade to existing raw water main, including all piping, valves, fittings, restraints, saddle taps and corp stops for hose bibb, appurtenances, nuts, bolts, and ancillary items; valves, and supports; furnishing and installing valve boxes, riser pipes, stems, concrete pads, and identification discs; excavation, dewatering, placing and compacting backfill, and disposing of excess or unsuitable fill material; supporting and relocating existing conflicting utilities and replacing disturbed or damaged utilities and areas to equal or better than original conditions; pressure testing and disinfection; surveying final installed piping and fittings and existing utility crossings; and all other appurtenant and miscellaneous items and work for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

F. CONNECT TO EXISTING 6-INCH RAW WATER MAIN - **BID ITEM NO. 6**

1. Measurement for payment for connecting to the existing raw water main will be based upon the number of actual connection, Each, all in accordance with the Contract Documents.

2. Payment for connecting to the existing 6-inch raw water main shall constitute full compensation for furnishing and installing tee, valves, fittings; coordinate shut-down and cut-in into existing raw water main; night-time work should be assumed for this work; and connecting the new buried piping, including potholing to confirm the location of the existing raw water main and existing utilities, furnishing and installing valve boxes, riser pipes, stems, concrete pads, and identification discs; excavation, dewatering, placing and compacting backfill, and disposing of excess or unsuitable fill material; supporting and relocating existing conflicting utilities and replacing disturbed or damaged utilities and areas to equal or better than original conditions; pressure testing and disinfection; surveying final installed piping and fittings and existing utility crossings; and all other appurtenant and miscellaneous items and work for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

G. FURNISH AND INSTALL WELLHEAD ELECTRICAL - **BID ITEM NO. 7**

1. No measurement will be made for this item.

2. Payment for furnishing and installing wellhead electrical will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing wellhead electrical shall constitute full compensation for furnishing and installing all wellhead electrical components, including all electrical panels, safety disconnect switch, junction boxes, receptacles, conduits, fittings, couplings, supports, cables, grounding, and appurtenances; equipment rack supports, unistruts, nuts, and bolts for mounting panels; furnishing and installing Well Pump Motor Control Pane, PLC Control Panel and installing new circuit breaker in existing Switchboard MSB-1; field inspection and coordination with the OWNER for routing of electrical conduits in existing Control Building, including core drilling existing Control Building wall and installing conduits, pull boxes, supports, cables and connecting to electrical and control ductbank; furnishing and installing terminal strips, warning labels, identification tags; STOF staff training; all other electrical components associated with the wellhead that are not included in other bid items; coordination with ENGINEER and the OWNER; connection and testing of equipment; and all other appurtenant and miscellaneous required items for a complete, satisfactory, and functional wellhead electrical installation, all in accordance with the requirements of the Contract Documents.

H. FURNISH AND INSTALL WELLHEAD INSTRUMENTATION - **BID ITEM NO. 8**

1. No measurement will be made for this item.

2. Payment for furnishing and installing wellhead instrumentation will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing wellhead instrumentation shall constitute full compensation for furnishing and installing all wellhead instruments and controls, including all instruments, surge arrestors, instrument panels, control cables, and appurtenances; including all supports, mounting stanchions, sunshields, unistruts, nuts, and bolts; field inspection and coordination with the OWNER for routing of instrumentation conduits to existing Main Control Panel in the Control Building, furnishing and installing identification tags and labels; all other instrumentation components associated with the wellhead that are not included in other bid items; coordination with ENGINEER and the OWNER; connection and testing of equipment; and all other appurtenant and miscellaneous required items for a complete, satisfactory, and functional wellhead instrumentation installation, all in accordance with the requirements of the Contract Documents.

I. FURNISH AND INSTALL ELECTRICAL AND CONTROL DUCTBANK - **BID ITEM NO. 9**

1. No measurement will be made for this item.

2. Payment for furnishing and installing electrical and control duct bank will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing electrical and control duct bank shall constitute full compensation for furnishing and installing a complete electrical and control ductbank installation, including furnishing and installing all conduits, and spare conduit, cables, fittings, couplings, pullboxes, concrete encasement, duct spacers,

pull strings, grounding rods, wells, and conductors, and appurtenances; furnishing and installing concrete formwork, rebar, spacers, and concrete; excavation, dewatering, placing and compacting backfill, and disposing of excess or unsuitable fill material; supporting and relocating existing conflicting utilities and replacing disturbed or damaged utilities and areas to equal or better than original conditions; surveying installed ductbanks and existing utility crossings; and all other appurtenant and miscellaneous items and work including final cleanup for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

J. FURNISH AND INSTALL WELL SITE CIVIL - **BID ITEM NO. 10**

1. No measurement will be made for this item.

2. Payment for furnishing and installing well site civil will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing well site civil shall constitute full compensation for furnishing and installing all site civil work, including, but not limited to clearing, grubbing, stripping, and site grading; excavation and compaction; disposal of excess or unsuitable fill material; restore concrete curb and gutter; remove and replace concrete sidewalk; and appurtenances; replacing disturbed or damaged utilities and areas to equal or better than original conditions; and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

K. FURNISH AND INSTALL SOD - **BID ITEM NO. 11**

1. Measurement for payment for furnishing and installing sod will be based upon the number of square yards of sod installed, as determined by field measurements, all in accordance with the Contract Documents.

2. Payment for furnishing and installing sod shall constitute full compensation for furnishing and installing all labor, material, and equipment required to install sod, including preparation of subgrade for installation; furnishing and installing all materials (soil, sod, mulch, sand, fertilizer, etc.), equipment, and labor to install the sod; including repair of damage to existing utilities; temporary and final restoration of all areas incidental to the sod installation; 21-days of watering and maintenance of the sod as specified; and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional sod installation, all in accordance with the requirements of the Contract Documents.

L. SEDIMENT AND EROSION CONTROL - **BID ITEM NO. 12**

1. No measurement will be made for this item.

2. Payment for furnishing and installing site-wide sediment and erosion control measures will be made as a percentage of the lump sum in the approved Schedule of Values.

3. Payment for furnishing and installing site sediment and erosion controls shall constitute full compensation for furnishing, installing, and maintaining all necessary erosion and sediment control measures, including, but not limited to, filter fabric fences, gravel filters, floating turbidity barriers, and sediment basins; furnishing all labor, equipment, tools, materials, and services need to install and maintain the

erosion and sediment control measures; removal of measures and restoration at the completion of the Work; and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation, in compliance with the requirements of applicable federal, state, and local rules and regulations and with the Contract Documents.

M. AS-BUILT DRAWINGS - **BID ITEM NO. 13**

1. No measurement will be made for this item.

2. Payment for As-Built Drawings will be made based on the lump sum in the approved Schedule of Values. Payment under this pay item will be 50% after submittal and approval to outside permitting agencies, and the remaining 50% will be paid once final approval from STOF is received.

3. Payment for As-Built drawings shall constitute full compensation for the complete and accurate development of As-Built drawings of all the Work installed, including the services of a Florida Registered Land Surveyor to survey the Work, CAD work to develop As-Built Drawings, addressing OWNER and ENGINEER review comments, submitting drawings to the STOF for review, addressing all review comments and submitting Final As-Builts, all labor, materials, and equipment necessary to complete As-Built Drawings, and all reproduction costs associated with submittals to the ENGINEER and STOF.

N. FURNISH AND INSTALL GRAVEL AT WELL PAD - **BID ITEM NO. 14**

1. Measurement for payment for furnishing and installing the gravel at Well Pad will be made as a percentage of the lump sum in the approved Schedule of Values.

2. Payment for furnishing and installing the gravel on grade shall constitute full compensation for constructing the well surface facilities on grade, including furnishing all required submittals, clearing, grubbing, excavation, grading, backfill, disposal of excess or unsuitable fill material; replacing disturbed or damaged utilities and areas to equal or better than original conditions; compaction; furnishing and installing gravel, scheduling permitting inspections, and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation.

O. FURNISH AND INSTALL GUARD POST - **BID ITEM NO. 15**

1. Measurement for payment for furnishing and installing Guard Posts will be made upon the number of Each guard post installed in accordance with the contract documents.

2. Payment for furnishing and installing the 6” Steel Pipe guard post shall constitute full compensation for furnishing and installation, including providing all required submittals, clearing, grubbing, excavation, grading, concrete encasement, backfill, lightning protection, grounding rod per NEC2016, grounding wire, disposal of excess or unsuitable fill material; replacing disturbed or damaged areas to equal or better than original conditions; compaction; furnishing and installing guard posts, painting, and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation.

P. CONDUCT SITE CONDITION SURVEYS - **BID ITEM NO. 16**

1. Measurement for payment for conducting pre- and post- site condition surveys will be made as a percentage of the lump sum in the approved Schedule of Values.

2. Payment for conducting pre- and post- site condition surveys shall constitute full compensation for preparing and submitting the requirements under Section 02 22 00 SITE CONDITION SURVEYS. Work includes conducting thorough pre-construction and post-construction Site Condition Survey of the entire project area, including anticipated access route.

Q. FURNISH AND INSTALL ASPHALT - **BID ITEM NO. 17**

1. Measurement for payment for furnishing and installing asphalt will be based upon the number of square yards of asphalt installed, as determined by field measurements, all in accordance with the Contract Documents.

2. Payment for furnishing and installing asphalt shall constitute full compensation for furnishing and installing all labor, material, and equipment required to provide a 2" thick (after compaction) (2-lifts) asphaltic concrete layer at all work areas and as shown in the plans. Also included are complete thermoplastic pavement markings, disposal of debris, replacement of car stops, tack and prime coats, compaction, asphaltic concrete, paving of asphalt areas damaged by construction activities; protection of newly laid asphalt, and any other related activities required for providing a new asphalt pavement surface for all affected areas in this contract, all in accordance with the requirements of the Contract Documents.

R. REMOVE EXISTING CHAIN LINK FENCE - **BID ITEM NO. 18**

1. Measurement for payment for removing existing chain link fence will be based upon the number of linear feet of fence removed, as determined by field measurements, all in accordance with the Contract Documents.

2. Payment for remove existing chain link fence shall constitute full compensation for removing existing chain link fence and gate(s), including, but not limited to clearing, grubbing; proper disposal; excavation and compaction; disposal of excess or unsuitable fill material; removal and disposal of existing 3-strand barbed-wire and barbed-tape concertina; and appurtenances, including excavation and complete removal of existing posts; replacing disturbed or damaged utilities and areas to equal or better than original conditions; and all other appurtenant and miscellaneous items and for a complete, removal, all in accordance with the requirements of the Contract Documents.

S. FURNISH AND INSTALL NEW CHAIN LINK FENCE - **BID ITEM NO. 19**

1. Measurement for payment for furnishing and installing chain link fence will be based upon the number of linear feet of fence installed, as determined by field measurements, all in accordance with the Contract Documents.

2. Payment for furnishing and installing chain link fence shall constitute full compensation for furnishing and installing new chain link fence and swing gate, including, but not limited to clearing, grubbing, stripping, survey staking, and site grading; excavation and compaction; disposal of excess or unsuitable fill material; swing gates; 3-strand barbed-wire; lightning protection, grounding rod per NEC2016, grounding wire; and appurtenances, including excavation and concrete encasement

for posts; replacing disturbed or damaged utilities and areas to equal or better than original conditions; and all other appurtenant and miscellaneous items and for a complete, satisfactory, and functional installation, all in accordance with the requirements of the Contract Documents.

T. WELL DEVELOPMENT - **BID ITEM NO. 20**

1. Measurement for payment for well development will be based upon the number of actual hours of development performed as determined by field observation, all in accordance with the Contract Documents.

2. Payment for well development shall constitute full compensation for the developing the wells, including providing all necessary labor and equipment for well development, including furnishing and installing all temporary pumps, piping, connections, supports, appurtenances, and settling tanks for disposal of development waters, including all necessary earthwork and surface restoration, sampling and analysis required by permitting agencies, reporting to permitting agencies, coordination with property owner, and all other work not included in other bid items, all in accordance with Section 33 21 00 - Water Supply Well and the Contract Documents.

U. CONDUCT VIDEO SURVEY LOG - **BID ITEM NO. 21**

1. Measurement for conducting the video survey log on the well will be based upon the number of video logs successfully completed, all in accordance with Section 33 21 00 - Water Supply Well and the Contract Documents.

2. Payment for conducting the video survey log shall constitute full compensation for video logging completed wells including preparing the well for logging, providing all necessary equipment, preparing and furnishing reports to the ENGINEER for review, and providing all necessary labor and equipment to complete logging activities, and all other appurtenant and miscellaneous items not included in other bid items for a complete, satisfactory, and functional installation, all in accordance with Section 33 21 00 - Water Supply Well and the Contract Documents.

V. DISINFECT AND SAMPLE WELL - **BID ITEM NO. 22**

1. Measurement for payment for disinfecting and sampling the well will be based upon the number of wells successfully disinfected and sampled, all in accordance with Section 33 21 00 - Water Supply Well and the Contract Documents.

2. Payment for disinfecting and sampling the well shall constitute full compensation for successfully disinfecting and sampling the well, including furnishing all necessary chemicals for disinfection, including furnishing and installing all temporary piping, valves, and connections required for disinfection and sampling, including conducting all necessary sampling, obtaining the services of a certified laboratory to conduct the specified analyses of samples taken from the well, and providing all necessary labor and equipment to complete disinfection and sampling of the well, all in accordance with Section 33 21 00 - Water Supply Well and the Contract Documents.

W. OWNER'S ALLOWANCE - **BID ITEM NO. A-1**

1. Included in this allowance are works associated with undefined conditions, additional work, or conflicts developing from undefined conditions. All work authorized for payment will be authorized in writing by the STOF in advance of commencement for this work. Amount to be paid per undefined conditions, additional work, or conflict

shall be negotiated or agreed to by both parties. The STOF reserves the right to award any, all, or none of the money associated with this allowance.

X. OWNER'S ALLOWANCE - **BID ITEM NO. A-2**

1. Camera installation and any fiber optic equipment needed not specified in the contract drawings.

Y. ALTERNATE - **BID ITEM NO. ALT-1**

1. ALT 1 - Base Bid included Furnish and Install a 30HP pump as described in the design documents. ALT-1 is for Furnish and Install a 20HP pump instead of 30HP. Refer to Technical Specification 01 23 00.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16 - CPM CONSTRUCTION SCHEDULE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall schedule the WORK in accordance with this Section.

B. Development of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling.

C. The CPM schedule and related reports should be prepared with Primavera Project Planner P6 software or Microsoft Project.

1.2 DEFINITIONS

A. CPM Scheduling: The term shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this Section and the AGC document, this Section shall govern.

B. Float: Unless otherwise indicated herein, float and total float are synonymous. Total float is the period of time measured by the number of Days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the WORK. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.

1.3 SCHEDULING QUALIFICATION SUBMITTALS

A. CONTRACTOR shall submit a statement of computerized CPM capability within 15 Days after Notice to Proceed to verify that either: (1) the CONTRACTOR has in-house capability qualified to use CPM techniques or (2) that the CONTRACTOR will arrange for the services of a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling and shall describe the construction projects required below. The statement shall also identify the contact persons for the referenced projects with current telephone and address information.

B. Criteria: The individual performing scheduling shall have successfully applied computerized CPM technique to at least 2 projects of similar nature, scope, and value not less than one half the Total Bid Price of this project.

1.4 INITIAL SCHEDULE SUBMITTALS

A. CONTRACTOR shall submit schedule at the preconstruction meeting.

1.5 CPM SCHEDULE SUBMITTALS

A. Original CPM Schedule Submittal: Within the days specified in the General Conditions of the Agreement, the CONTRACTOR shall submit for review by the ENGINEER and OWNER the CPM schedule and the computerized schedule report tabulations. The CONTRACTOR shall also submit a USB (flash) drive that contain the schedule submittal information. The data shall be compatible with Primavera P6 to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR's Project Manager, superintendent, and estimator prior to submission. The CPM schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships and shall show the critical path. The CONTRACTOR's attention is directed to the requirement that the schedule shall contain sufficient detail and information to the CPM schedule in accordance with the approved schedule of values under Section 01 29 73 – Schedule of Values. Each installation and sitework activity shall be cost loaded as indicated.

B. The computerized schedule report tabulations shall include the following:

1. Report of activities sorted by activity number: Activity numbers, where practical, shall correlate to the area numbers designated on the Contract Drawings as further defined in Section 01 10 00 – Summary of Work.

2. Report of activities sorted by early start date.

3. Report of activities sorted by total float.

4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, ENGINEER, OWNER, Subcontractors, Suppliers, etc. These codes shall be identified in the Network Diagram.

5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.

C. Analysis

1. Float Ownership: Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. Liability for delay to the project completion date rests with the party causing the delay. For example, if Party A is responsible for consuming a portion of the float time and Party B later consumes the remainder of the float time plus additional time beyond the float time, Party B is responsible for the time that is a delay past the completion date. Party A would not be responsible for any delay since it did not consume all the float time, additional float time remained after its delay, and the completion date was unaffected by its tardiness.

The ENGINEER's review will be limited to conformance with the Contract Documents. However, the review may also include:

2. Clarifications of the design intent.

3. Directions to include activities and information missing from the submittal.

4. Requests to the CONTRACTOR to clarify and revise the schedule.

D. Revisions to the Original CPM Schedule: The CONTRACTOR shall revise the original CPM schedule submittal to address review comments from the original CPM schedule review meeting and resubmit the network diagrams and reports for the ENGINEER's review. The ENGINEER, within 14 Days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the requirements or are unsatisfactory for the ENGINEER to monitor the progress and status of WORK or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule conditional upon the first monthly CPM schedule update correcting deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The ENGINEER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

E. Acceptance

1. Acceptance of the CONTRACTOR's schedule by the ENGINEER and OWNER will be based solely upon compliance with the requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform WORK in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

2. Submission of the CONTRACTOR's progress schedule to the ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

F. Monthly Updates and Periodic CPM Schedule Submittals

1. Following acceptance of the CONTRACTOR's original CPM schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submittal shall be complete including information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show WORK activities including those already completed. Completed activities shall accurately depict "as built" information by indicating when the WORK was actually started and completed.

2. Neither the submission nor the updating of the CONTRACTOR's original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted by the CONTRACTOR, nor the ENGINEER's review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying in any way the Contract Times or milestone dates or of modifying or limiting in any way the CONTRACTOR's obligations under the Contract. Only a signed, fully executed Change Order can modify contractual obligations.

3. The monthly schedule update submittal will be reviewed with the CONTRACTOR during the **Progress Meetings**. If required, follow up meetings with be scheduled following the **Progress Meetings** to address and resolved comments and revisions. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to

initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last schedule update. The status of the WORK will be determined by the percent complete of each activity in the updated CPM schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend, including the CONTRACTOR's Project Manager and superintendent. Within 7 Days after the meeting, the CONTRACTOR shall submit the revised CPM schedule, the revised CPM computerized tabulations, the revised successor/predecessor report, the project status reports as defined below and the CONTRACTOR's Application for Payment. Within 5 Days of receipt of the revised submittals, the ENGINEER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete in the monthly update shall be the basis for the monthly invoice to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the monthly invoice for the update period will be processed.

G. Schedule Revisions: The CONTRACTOR shall highlight or otherwise identify changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because activities are behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

A. Upon approval of a Change Order or upon receipt by the CONTRACTOR of authorization to proceed with additional WORK, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed WORK and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made. Whenever the CONTRACTOR believes that a Change Order will extend the Contract Times, the sub-network analysis herein shall be submitted with the price proposal for the change. If the CONTRACTOR does not submit the sub-network demonstrating that the change affects the Contract Times, then no subsequent claim for additional time due to the change will be accepted.

1.7 CPM STANDARDS

A. Construction Schedules: Construction schedules shall include a graphic network diagram and computerized schedule reports as required below for status reporting.

B. Networks: The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets.

C. Construction and procurement activities shall be presented in a time-scaled format with a calendar timeline along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar timeline. Every activity shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. Activity items shall be identified by their activity number, responsibility code, and duration. Non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.

D. Duration Estimates: The duration estimate for each activity shall be computed in Days and shall represent the single best estimate considering the scope of the WORK and

resources planned for the activity. Except for certain non-labor activities such as curing of concrete or delivery of materials, activity duration shall not exceed 10 Days nor be less than one Day, unless otherwise accepted by the ENGINEER.

1.8 SCHEDULE REPORT FORMAT

A. Schedule Reports: Schedule reports shall be prepared based on the CPM schedule. Reports should be provided in electronic PDF format and shall be submitted via e-mail or USB (flash) drive. The report shall include the following minimum data for each activity:

1. Activity numbers and responsibility codes.
2. Work Order No.
3. Estimated activity duration.
4. Activity description.
5. Activity percent completion.
6. Early start date (calendar dated).
7. Early finish date (calendar dated).
8. Late start date (calendar dated).
9. Late finish date (calendar dated).
10. Status (whether critical).
11. Total float for each activity.
12. Free float for each activity.

B. Project Information: Each Schedule Report shall be prefaced with the following summary data:

1. Project name.
2. CONTRACTOR name.
3. Type of tabulation.
4. Project duration.
5. Contract Times (as revised by Change Orders).
6. The commencement date stated in the Notice to Proceed.
7. The data date and plot date of the CPM Schedule.
8. If an update, cite the new schedule completion date.

1.9 PROJECT STATUS REPORTING

A. The CONTRACTOR shall furnish monthly project status reports (overview bar chart and a written narrative report) in conjunction with the revised CPM schedules as indicated above. Status reporting shall be in the form below.

B. The CONTRACTOR shall prepare and submit monthly an overview bar chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM schedule (original and as updated and adjusted throughout the entire construction period). The major project components shall be represented as time bars which shall be subdivided into various types of WORK including demolition, excavation, drilling and earthwork, dewatering, best management practices for excavated soil and extracted groundwater (as needed), yard piping, concrete construction, and mechanical, electrical and instrumentation installations. Major components shall include each new structure by area designation, sitework, modifications to existing structures, tie-ins to existing facilities, and startups.

C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM schedule is submitted to the ENGINEER. The CONTRACTOR shall amend the overview schedule to include any additional detail required by the ENGINEER. The CONTRACTOR shall include any additional information requested by the ENGINEER at any time during the construction of the WORK.

D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the ENGINEER. Status reports shall include:

1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.

2. The progress made on critical activities indicated on the CPM schedule.

3. Explanations for any lack of WORK on critical path activities planned for the last month.

4. Explanations for any schedule changes, including changes to the logic and to activity durations.

5. A list of the critical activities scheduled to be performed in the next 2 months.

6. The status of major material and equipment procurement.

7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.

8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the WORK.

E. The CONTRACTOR may include any other information pertinent to the status of the WORK. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.10 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

A. The CONTRACTOR's schedule shall include Calendar Days of delay due to inclement severe weather as required by the Contract General Conditions.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This section defines the requirements and procedures for CONTRACTOR submittals.

B. At the Pre-Construction Conference of **Section 01 20 00 – Project Meetings**, submit the following items to the ENGINEER for review:

1. An updated schedule of Submittals and proposed substitutions

2. An updated list of permits and licenses and the status of each

1.2 SHOP DRAWINGS

A. Wherever called for in the Contract Documents or where required by the ENGINEER, furnish one electronic PDF. Always keep a hard copy at site.

B. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.

C. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the Project is located, unless otherwise indicated.

D. Transmittal Form

1. Shop Drawing submittals shall be accompanied by the ENGINEER's standard submittal transmittal form, an electronic and hard copy of which is available from the ENGINEER.

2. A submittal without the form, or where applicable items on the form have not been completed, will be returned for resubmittal.

3. All submittals need to be managed using ProjectWise construction platform. Training will be provided at the beginning of the project.

E. Organization

1. Use a single submittal transmittal form for each technical specification Section or item or class of material or equipment for which a submittal is required.

2. A single submittal covering multiple Sections will not be accepted, unless the primary specification references other Sections for components: For example, if a pump Section references other Sections for the motor, shop-applied protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted, whereas a single submittal covering vertical turbine pumps and horizontal split-case pumps would not be accepted.

3. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components.

4. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.

5. Unless otherwise indicated, match terminology and equipment names and numbers used in the submittals with those used in the Contract Documents.

F. Format

1. Minimum sheet size shall be 8-1/2 inches by 11 inches, and maximum sheet size shall be 24 inches by 36 inches.

2. Number every page in a submittal in sequence.

3. Collate and staple or bind, as appropriate, each copy of a submittal; the ENGINEER will not collate sheets or copies.

4. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports.

5. Present a sufficient level of detail for assessment of compliance with the Contract Documents.

6. Numbering

a. Assign to each submittal a unique number. Use specification section to assign the number, following with a sequence #'s.

b. Number the submittals sequentially, with the submittal numbers clearly noted on the transmittal.

G. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

H. ENGINEER's Review- will be done through ProjectWise platform.

1. Except as otherwise indicated, the ENGINEER answer each submittal to the CONTRACTOR with comments noted thereon, within 14 Days following receipt by the ENGINEER.

2. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the first resubmittal on an item.

3. The OWNER reserves the right to withhold payments due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the first resubmittal.

4. The ENGINEER'S maximum review period for each submittal or resubmittal will be 14 Days; thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 42 Days.

I. If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required, unless is requested in the submittal approval.

J. If a submittal is returned marked "MAKE CORRECTIONS NOTED," the CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required.

K. Resubmittals

1. If a submittal is returned marked "REVISE-RESUBMIT," the CONTRACTOR shall revise the submittal and resubmit the required number of copies.

2. Resubmittal of portions of multi-page or multi-drawing submittals will not be accepted: For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE-RESUBMIT," the submittal as a whole is deemed "REVISE-RESUBMIT," and 10 drawings are required to be resubmitted.

3. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

L. Rejected Submittals

1. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with Section 01 60 00 – Products, Materials, Equipment, and Substitutions.

2. In the first 2 cases, the CONTRACTOR shall prepare a new submittal and shall submit the required number of copies.

3. In the latter case, the CONTRACTOR shall submit the substitution request according to the requirements of Contract Document General Conditions.

4. The resubmittal of rejected portions of a previous submittal will not be accepted.

M. The fabrication of an item may commence only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

N. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

O. Review by CONTRACTOR

1. Submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER.

2. Each submittal shall be dated and signed by the CONTRACTOR as being correct and in strict conformance with the Contract Documents.

3. In the case of Shop Drawings, each sheet shall be so dated and signed.

4. Any deviations from the Contract Documents shall be noted on the transmittal sheet.

5. The ENGINEER will only review submittals that have been so verified by the CONTRACTOR.

6. Non-verified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.

P. Conformance

1. Corrections or comments made on the CONTRACTOR's Shop Drawings during review shall not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications.

2. A lack of comments made on the CONTRACTOR’s Shop Drawings during review shall not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications.

3. Review is for conformance to the design concept and general compliance with the Contract Documents only.

4. The CONTRACTOR shall be responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating WORK with the trades, and satisfactory and safe performance of the WORK.

1.3 SAMPLES

A. Quantity

1. The CONTRACTOR shall submit the (hardcopies) number of samples indicated by the Specifications.

2. If the number is not indicated, submit not less than 3 samples.

3. Where the quantity of each sample is not indicated, submit such quantity as necessary for proper examination and testing by the methods indicated.

B. Identification and Distribution

1. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and the manufacturer's name.

2. Upon acceptance by the ENGINEER, one set of the samples will be returned to the CONTRACTOR, and the remaining samples will be retained by the ENGINEER.

C. Selection

1. Unless otherwise indicated, the ENGINEER will select colors and textures from the manufacturer's standard colors and standard materials, products, or equipment lines.

2. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the CONTRACTOR shall clearly state so on the transmittal page of the submittal.

1.4 OPERATIONS AND MAINTENANCE MANUALS

A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized Operations and Maintenance Manual.

B. The manual shall be written such that it can be used and understood by the OWNER's operation and maintenance staff.

C. Categories

1. The Technical Manual shall be subdivided first by Specification Section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

a. Category 1 - Equipment Summary

1) Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.

2) Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.

b. Category 2 - Operational Procedures

1) Procedures: Manufacturer-recommended procedures on the following shall be included:

- Installation
- Adjustment
- Startup
- Location of controls, special tools, equipment required, or related instrumentation needed for operation
- Operation procedures
- Load changes
- Calibration
- Shutdown
- Troubleshooting
- Disassembly
- Reassembly
- Realignment
- Testing to determine performance efficiency

- Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices
- List of all electrical relay settings including alarm and contact settings

c. Category 3 - Preventive Maintenance Procedures

1) Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

2) Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

d. Category 4 - Parts and Spare Parts List

1) Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

2) Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

3) Spare Parts List: The spare parts list shall include those spare parts that each manufacturer recommends to be maintained by the OWNER in inventory.

a) The spare parts list shall include a current list price of each spare part.

b) Each manufacturer or supplier of spare parts shall indicate the name, address, and telephone number of its nearest outlet of spare parts, to assist the OWNER in ordering.

e. Category 5 - Wiring Diagrams

1) Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

f. Category 6 - Shop Drawings

1) Drawings: This category includes approved shop or fabrication drawings with ENGINEER comments and corrections incorporated, complete with dimensions.

g. Category 7 - Safety

1) Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Category 8 - Documentation:

1) Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

D. Format

1. Bind each Operations and Maintenance Manual in standard size 3-ring hardcover binders, labeled on the spine and cover with Project name, OWNER's project number, Specification Section number, equipment name, and equipment identification number

2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.

3. Documents in binders shall be 3-hole punched, with no text punched out, and pages larger than 8-1/2 by 11 shall be folded to 8-1/2 by 11 size.

4. Provide a USB (flash) drive and/or CD with electronic files with each final Operations and Maintenance Manual, as follows:

a. One PDF Binder of the complete manual

b. Native files (Microsoft Office 365) for documents and spreadsheets;

c. PDFs of manufacturer and vendor information;

d. AutoCad, version 2019 for all drawings, figures, and schematics

E. Review Process

1. Furnish 1 PDF copy of Draft Operations and Maintenance Manual for each Specification Section that requires a manual.

2. The ENGINEER will review and return review comments to the CONTRACTOR.

3. Incorporate and address all comments. Submit 1 PDF copy of the revised Operations and Maintenance Manual for review and approval. If additional comments are provided, address and resubmit until accepted.

4. Following acceptance by the ENGINEER, submit 5 identical hardcopies of the Final Operations and Maintenance Manual for acceptance.

F. Schedule: Schedule submittal of Draft Operations and Maintenance Manuals as required to ensure that Final Operations and Maintenance Manual are accepted prior to start-up and commissioning.

G. Manuals that are incomplete or unacceptable at the schedule criterion above will constitute sufficient justification for the OWNER to retain the amount in Paragraph "Technical Manual Submittals" of Section 01 77 00 – Project Closeout, from any payments due the CONTRACTOR.

H. If the parts list would be the same as the spare parts list on the Project, Paragraph 1.6A could be incorporated into Category 4 of the Technical Manual, above.

1.5 AS-BUILT DRAWINGS

A. During the life of the Contract, the CONTRACTOR shall retain the services of a Florida Registered Land Surveyor who shall maintain records of the installation, including all deviations from Plans and Specifications.

B. Refer to **Section 02 22 00 Site Conditions Surveys** for Asbuilt requirements.

C. On-Site Drawings Set

1. Maintain one set of Drawings at the Site for the preparation of As-built drawings.

2. On this set, mark every project condition, location, configuration, and any other change or deviation which may differ from the Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction.

3. Give special attention to recording the horizontal and vertical location of buried utilities that differ from the locations indicated, or that were not indicated on the Contract Drawings.

4. Supplement the As-built drawings by any detailed sketches as necessary or as directed, in order to fully indicate the WORK as actually constructed.

5. The As-built drawings are the CONTRACTOR's representation of As-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the WORK.

6. Use red ink for alterations and notes.

7. Notes shall identify relevant Change Orders by number and date.

D. In the case of those drawings that depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, update the As-built drawings by indicating those portions which are superseded by Change Order drawings or final Shop Drawings, and by including appropriate reference information describing the Change Orders by number and the Shop Drawings by manufacturer, drawing, and revision numbers.

E. Submittal

1. A copy of the Asbuilts shall be accessible to the ENGINEER's review at all during the construction period.

2. Submit 2 full size (24" x 36") hard copies and 1 PDF copy of Draft Asbuilt Drawings after Substantial Completion. The ENGINEER will review the Draft Asbuilt Drawings and provide comments to the CONTRACTOR.

3. Unacceptable Drawings: Disorganized or incomplete As-built drawings will not be accepted.

4. The CONTRACTOR shall address review comments on the Draft Asbuilt Drawings and submit 1 PDF of the Final Asbuilt Drawings. Following acceptance by the ENGINEER, the CONTRACTOR shall submit the following for the Final Asbuilt Drawings:

    a. 3 full size (24" x 36") hard copies

    b. Provide a USB (flash) drive with: 1 PDF Binder of all drawings and Autocad, 2019 files for all drawings

    c. One PDF copy of the complete manual

    d. Project-specific files created in Microsoft Office 365 ;

    e. AutoCad, version 2019 for all drawings

F. Final Payment: Final payment will not be acted upon until the As-built drawings have been completed and delivered to the ENGINEER.

G. Information submitted by the CONTRACTOR will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information.

1.6 QUALITY CONTROL (QC) SUBMITTALS

A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the ENGINEER that the CONTRACTOR has satisfied certain requirements of the Contract Documents.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:

    a. Manufacturers' installation instructions

    b. Manufacturers' and Installers' experience qualifications

    c. Ready mix concrete delivery tickets

    d. Design calculations

    e. Affidavits and manufacturers' certification of compliance with indicated product requirements

    f. Laboratory analysis results

    g. Factory test reports

2. Within 30 Days of the event documented for the following types of submittals:

    a. Manufacturers' field representative certification of proper installation

    b. Field measurement

    c. Field test reports

    d. Receipt of permit

e. Receipt of regulatory approval

C. The ENGINEER will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

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SECTION 01 35 53 – SITE SECURITY

PART 1 -- GENERAL

1.1 SECURITY

A. The CONTRACTOR shall secure and protect WORK from theft, vandalism, and unauthorized entry.

B. The CONTRACTOR shall:

1. Restrict entry of persons and vehicles into Site.
2. Allow entry only to authorized persons with proper identification.
3. Maintain log of workmen and visitors and make log available to OWNER on request.
4. Coordinate access of ENGINEER's and OWNER'S personnel to Site.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

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SECTION 01 42 13 - ABBREVIATIONS OF INSTITUTIONS

PART 1 -- GENERAL

1.1 GENERAL

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of the Specifications, the following acronyms or abbreviations which may appear shall have the meanings indicated herein.

1.2 ABBREVIATIONS

Abbreviation	Definition
AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABMA	American Bearing Manufacturer's Association – ABMA
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AF&PA	American Forest and Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AIIM	Association for Information and Image Management
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMA	Acoustical Material Association
AMCA	Air Movement and Control Association International, Inc
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.

APA	The Engineered Wood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQ	American Society for Quality
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMAA	A division/section of the Material Handling Industry of America
CPG	Compressed Gas Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drilling Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association

EI	Energy Institute
EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FBC	Florida Building Code, 7th Edition (2020)
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute, Hydraulic Institute
HSWA	Federal Hazardous and Solid Waste Amendments
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICC-ES	International Code Council Evaluation Service
ICCEC	Electrical Code
ICEA	Insulated Cable Engineers Association
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFC	International Fire Code
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code, Association Connecting Electronic Industries
IRC	International Residential Code
ISA	Instrument Society of Automation
ISDI	Insulated Steel Door Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers

ITU-T	Telecommunications Standardization Sector of the International Telecommunications Union
LPI	Lightning Protection Institute
LRQA	Lloyd’s Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturer's
NAIMA	North American Insulation Manufacturers’ Association
NACE	National Association of Corrosion Engineers
DASMA	Door and Access Systems Manufacturers Association International
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NCCLS	National Committee for Clinical Laboratory Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association
NISO	National Information Standards Organization
NIST	National Institute of Standards and Technology
NLGI	National Lubricating Grease Institute
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing Drainage Institute
PPI	Plastic Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service, a division of the California Redwood Association, CRA

RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SDI	Steel Door Institute, Steel Deck Institute
SFWMD	South Florida Water Management District
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricator’s Association
SPIB	Southern Pine Inspection Bureau
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
STLE	Society of Tribologists and Lubricating Engineers
TAPPI	Technical Association of the Worldwide Pulp, Paper, and Converting Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USEPA	United States of America Environmental Protection Agency
WCLIB	West Coast Lumber Inspection Bureau
WDMA	National Window and Door Manufacturers Association
WEF	Water Environment Federation
WI	Woodwork Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

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SECTION 01 42 19 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 THE SUMMARY

A. Titles of Sections and Paragraphs: Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only and do not form a part of the Specifications.

B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is indicated, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for Bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of or omission from said standards or requirements.

C. Specialists, Assignments: In certain instances, specification text requires (or implies) that specific WORK is to be assigned to specialists or expert entities who must be engaged to perform that WORK. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also, they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of WORK is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The CONTRACTOR shall construct the WORK in accordance with the Contract Documents and the referenced portions of those referenced codes, standards, and specifications.

B. References to "Building Code" shall mean the Florida Building Code, 7th Edition (2020).

C. References to International Building Code" shall mean International Building Code of the International Code Council (ICC) as amended by the local jurisdiction. Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Association of Plumbing and Mechanical Officials (IAPMO) as amended by the local jurisdiction.

D. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for Bids shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.

E. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and direction prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.

F. Applicable Safety Standards: References to "OSHA" shall mean United States Department of Labor, Occupational Safety and Health Administration, as amended to date, and all changes and amendments thereto.

G. References to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. References to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The CONTRACTOR shall be responsible that all WORK included in the Contract Documents, regardless if indicated or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other federal, state, and local regulations governing the storage and conveyance of hazardous materials.

B. Where no specific regulations exist and the OWNER has not waived the requirement in writing, chemical, hazardous, and petroleum product piping and storage in underground locations shall be double containment piping and tanks or be installed in separate concrete trenches and vaults with an approved lining that cannot be penetrated by the chemicals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 -- GENERAL

1.1 DEFINITION

A. Specific quality control requirements for the WORK are indicated throughout the Contract Documents. The requirements of this Section are primarily related to performance of the WORK beyond furnishing of manufactured products. The term "Quality Control" includes inspection, sampling and testing, and associated requirements.

1.2 INSPECTION AT PLACE OF MANUFACTURE

A. Unless otherwise indicated, all products, materials, and equipment shall be subject to inspection by the ENGINEER at the place of manufacture.

B. The presence of the ENGINEER at the place of manufacturer, however, shall not relieve the CONTRACTOR of the responsibility for providing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the CONTRACTOR, and said duty shall not be avoided by any act or omission on the part of the ENGINEER.

1.3 SAMPLING AND TESTING

A. Unless otherwise indicated, all sampling and testing will be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the OWNER reserves the right to use any generally accepted system of sampling and testing which, in the opinion of the ENGINEER will assure the OWNER that the quality of the workmanship is in full accord with the Contract Documents.

B. Any waiver by the OWNER of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the testing or other quality assurance requirements originally indicated, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial WORK, shall not be construed as a waiver of any requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, the ENGINEER reserves the right to make independent investigations and tests, and failure of any portion of the WORK to meet any of the requirements of the Contract Documents, shall be reasonable cause for the ENGINEER to require the removal or correction and reconstruction of any such WORK in accordance with the General Conditions.

D. The CONTRACTOR shall employ and pay for the services of an independent testing laboratory for specified testing as indicated in the Contract Document or specified by the ENGINEER, OWNER or Engineering Inspector or Building Department Inspector for the purposes of determining conformance with the Contract Documents. The CONTRACTOR shall furnish, all materials required for testing, and is responsible for providing testing equipment, water, electric power, or fuel for the various evaluations and tests ordered. The CONTRACTOR will bear the cost of all tests, evaluations or investigations for the purpose of determining conformance with the Contract Documents

E. The actions of the testing laboratory shall in no way relieve the CONTRACTOR of his obligations under the Contract. The laboratory testing work will include such evaluations and testing required by the Contract Documents, existing laws, codes, ordinances, etc. The testing laboratory will have no authority to change the requirements of the Contract Documents, nor perform, accept or approve any of the CONTRACTOR's Work.

F. The CONTRACTOR shall include the time required for testing of materials and equipment in his published schedule and the cost for testing of materials and equipment in its bid. The ENGINEER and OWNER will rely on this schedule to plan visits to manufacturing facilities and fabrication facilities for the purpose of inspecting workmanship and witness performance testing. Cost to the ENGINEER and OWNER for unscheduled or repeat inspections will be borne by the CONTRACTOR.

G. The OWNER may request additional testing by an independent firm to supplement or verify testing performed by the CONTRACTOR. The CONTRACTOR shall cooperate with the OWNER or independent firm and furnish samples of materials, design mix, equipment, tools, storage, and assistance as requested. Cost for retesting required because of non-conformance shall be paid by the CONTRACTOR.

H. Reports of testing, regardless of whether the testing was the OWNER'S or the CONTRACTOR'S responsibility, will be submitted to the ENGINEER in electronic PDF format with 2 hard copies. Testing results should indicate the results of tests and indicate compliance or non-compliance with Contract Documents.

1.4 CERTIFICATES OF PROPER INSTALLATION

A. The CONTRACTOR shall provide the services of representatives of the manufacturers of certain equipment, as specified in other sections of these Contract Documents.

B. The CONTRACTOR shall, after the equipment has been inspected and adjusted by the manufacturer's representative and prior to start-up and testing, provide a certification signed by the manufacturer representative and the CONTRACTOR that the equipment has been installed to manufacturer requirements and is ready for functional operation.

1.5 SITE INVESTIGATION AND CONTROL

A. The Contractor shall verify and control all dimensions for the WORK. The Contractor shall be solely responsible for any inaccuracies built in the Work due to its failure to comply with this requirement.

1.6 EVALUATION OF THE WORK

A. The Work shall be conducted under the general observation of the ENGINEER and shall be subject to evaluation by representatives of the ENGINEER acting on behalf of the OWNER to ensure strict compliance with the requirements of the Contract Documents. Such evaluation may include mill, plant, and shop or field evaluation, as required. The ENGINEER and OWNER shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.

B. The presence of the ENGINEER or any evaluator; however, shall not relieve the CONTRACTOR of the responsibility for the proper execution of the Work in accordance with the Contract Documents. Compliance is a duty of the CONTRACTOR, and is not be relieved by any act or omission on the part of the ENGINEER.

C. Materials and articles furnished by the CONTRACTOR shall be subject to evaluation, and acceptance by the ENGINEER prior to use for the Work.

D. No Work shall be backfilled, buried, cast in concrete, hidden or otherwise covered until the ENGINEER, has completed his inspection or evaluation. Any Work so covered in the absence of evaluation shall be subject to uncovering. Where unevaluated Work cannot be uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper evaluation, and no additional payment will be allowed, therefore.

E. If any portion of asphalt work is not accepted by the ENGINEER, OWNER or Engineering Inspector, the CONTRACTOR shall remove and reconstruct across the width of the lane and for the length of the lane. In the asphalt pavement area, no splicing, cut-in sections or patchwork will be accepted.

1.7 RIGHT OF REJECTION

A. The ENGINEER and OWNER shall have the right, to reject any articles or materials that fail to meet the requirements of the Contract Documents or standards in accordance with the Contract for Construction. Any failure or omission on the part of any inspector, the ENGINEER or any agent of the OWNER, to condemn any defective work or material shall not release the Contractor from its obligations to install the Work free from faults and defects and to promptly remove and repair any defective or deficient work.

B. The CONTRACTOR shall immediately proceed to correct Work rejected by the ENGINEER as defective or failing to conform to the Contract Document requirements. The CONTRACTOR shall pay all costs and expenses associated with correcting such rejected Work, including any additional testing and inspections, and reimbursement to the OWNER for the ENGINEER services and expenses made necessary thereby.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Inspection: The CONTRACTOR shall inspect materials or equipment upon the arrival on the job site and immediately prior to installation, and reject damaged and defective items.

B. Measurements: The CONTRACTOR shall verify measurements and dimensions of the WORK, as an integral step of starting each installation.

C. Manufacturer's Instructions: Where installations include manufactured products, the CONTRACTOR shall comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicated in Contract Documents.

END OF SECTION

SECTION 01 50 00 - MOBILIZATION

PART 1 - GENERAL

1.1 THE SUMMARY

A. CONTRACTOR shall mobilize as required for the proper performance and completion of the WORK and in accordance with the Contract Documents.

B. Mobilization shall include at least the following items:

1. Providing final Certificates of Insurance and Payment and Performance Bonds
2. Applying for and submitting all required information for necessary permits
3. Completing preconstruction videos and photographs in accordance with **Section 02 22 00 - Site Conditions Survey**
4. Preparing and securing CONTRACTOR's Staging Area, including installation of temporary construction fencing.
5. Installation of stormwater pollution prevention plan (SWPP).
6. Installing temporary construction power, wiring, and lighting facilities, if applicable.
7. Stabilizing the temporary access to the site, laydown area, and restoring the area to a condition equal to or better than original.
8. Providing on-Site sanitary facilities and potable water facilities.
9. Developing construction water supply.
10. Constructing and implementing security features and requirements complying with **Section 01 35 53 – Site Security.**
11. Moving onto the Site of CONTRACTOR's equipment and materials necessary for the first month of operations.
12. Having OSHA required notices and establishing safety programs.
13. Having the CONTRACTOR's superintendent at the Site full time.
14. Submitting initial submittals.

1.2 PAYMENT FOR MOBILIZATION/ DEMOBILIZATION

A. Payment for mobilization and demobilization shall not exceed 5% of the contract price

B. Payment for mobilization and demobilization will be made at the lump sum bid price named in the Bid Summary Form

C. Partial payments for mobilization and demobilization will be made as follows:

Construction Complete %	Allowable % of Lump Sum for Mobilization
5	25
10	50
25	75
100	100

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 10 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.1 GENERAL

A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 NOTIFICATION BY THE CONTRACTOR

A. The CONTRACTOR shall contact the Underground Utilities Center of Florida, Sunshine State One Call (811), a minimum of 48 hours in advance of any excavation. The CONTRACTOR shall provide the ENGINEER and OWNER with a copy of the ticket from Sunshine.

B. THE CONTRACTOR SHALL NOTIFY SEMINOLE TRIBE OF FLORIDA (STOF) PUBLIC WORKS DEPARTMENT AT (954) 894-1060 AND DIGPUBLICWORKS@SEMTRIBE.COM BEFORE DIGGING OR TRENCHING OPERATIONS BEGIN.

C. The CONTRACTOR shall provide written notification to Owner's of utilities that are not members of Sunshine State One-Call or when utilities are located on private property a minimum of 72 hours prior to excavation.

D. The CONTRACTOR shall restore and immediately repair irrigation systems damaged by the CONTRACTOR equipment.

1.3 EXISTING UTILITIES AND IMPROVEMENTS

A. General: Existing utilities have been shown on the Drawings based on information from available Survey supplied by the Owner. However, it is the CONTRACTOR's responsibility to preserve all existing utilities whether shown on the Drawings or not. The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Except where the Drawings indicate Utilities have been field located during design or certain Utility locations shall be exposed as part of the WORK, the CONTRACTOR shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's progress. When such exploratory excavations show the Utility location as shown on the Drawings to be in error, the CONTRACTOR shall so notify the ENGINEER. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.

C. Damages to any utilities shall promptly be repaired at the CONTRACTOR'S expense and at no additional cost to the OWNER. At the sole discretion of the OWNER, such repairs shall be repaired by the CONTRACTOR or another contractor retained by the CONTRACTOR. All repairs to existing utilities shall be in accordance with the utility owner's current standards and the repairs shall be inspected and approved by the utility owner prior to acceptance by the OWNER. Any delays ensuing from repairing damage utilities will be considered inexcusable and the OWNER will have the right to hire a contractor to repair the damage and charge the CONTRACTOR for the costs associated.

D. Utilities to be Moved: In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the OWNER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

E. Utilities to be Removed: Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the ENGINEER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

F. OWNER's Right of Access: The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

G. Underground Utilities Indicated: Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the CONTRACTOR shall reimburse said owner for the costs of repair.

H. Underground Utilities Not Indicated: In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the ENGINEER and a written report thereof shall be made promptly thereafter. The ENGINEER will immediately notify the owner of the damaged Utility. If the ENGINEER is not immediately available, the CONTRACTOR shall notify the Utility owner of the damage. If directed by the ENGINEER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work contained in the Contract Documents.

I. Costs of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such Utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the WORK which was interrupted or idled

by removal or relocation of such Utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the Contract Documents.

J. Approval of Repairs: All repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.

K. Maintaining in Service: Unless indicated otherwise, all existing utilities in the area of WORK shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the owner of said existing utility. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.4 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General: Except where trees or shrubs are indicated to be removed or relocated, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency and OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs and the details in the Drawings.

B. Trimming: Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement: The CONTRACTOR shall immediately notify the jurisdictional agency and/or the OWNER if any tree or shrub is damaged by the CONTRACTOR's operations. If, in the opinion of said agency or the OWNER, the damage is such that replacement is necessary, the CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, the CONTRACTOR shall pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with Landscape Drawings. Unless otherwise indicated, the CONTRACTOR shall water and maintain the replacement trees and shrubs for 5 months after planting.

1.5 LAWN AREAS

A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the property owner.

1.6 PROTECTION OF STREET OR ROADWAY MARKERS

A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent

marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.7 RESTORATION OF PAVEMENT

A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.

B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 51 00 - TEMPORARY UTILITIES

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide for temporary utilities and services for its own operations. The CONTRACTOR shall provide submittals, obtain approvals and permits, and furnish and install all temporary utilities, as required, during construction of the Work. The CONTRACTOR shall remove all temporary utilities following the establishment of permanent utilities or when the temporary utilities are no longer required to before the Work.

B. It shall be the CONTRACTOR's responsibility to provide services, equipment, and appurtenances for temporary utilities that are adequate for performance of the Work. All services, equipment, and appurtenances installed shall be safe and meet all laws and regulations of the local regulatory agencies having jurisdiction. The installations shall be subject to the review by the ENGINEER, OWNER, or regulatory inspectors at any time within the duration of the Contract.

C. The CONTRACTOR shall not use facilities on the Immokalee WTP without the OWNER's written permission.

D. The types of utility services required for general temporary use at the Site include the following:

1. Water service

2. Sanitary sewer

3. Electric power service

4. Construction fencing

PART 2 -- PRODUCTS

2.1 MATERIALS

A. The CONTRACTOR shall provide either new or used materials and equipment, that are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of temporary utility is provided by utility company, the CONTRACTOR shall provide the remaining portion with matching and compatible materials and equipment and shall comply with recommendations of the utility company.

PART 3 -- EXECUTION

3.1 WATER SUPPLY

A. General: Except as noted otherwise, the CONTRACTOR shall make arrangements for and pay for all costs for water used during construction of the Work. The CONTRACTOR shall provide and maintain all facilities necessary to convey the water from the source to

the points of use, including all piping, fittings, adapters, valves, and appurtenances, in accordance with the requirements of the Contract Documents.

B. Water Connections: The CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission from the OWNER and obtain all required permits and meters for monitoring water usage. The CONTRACTOR shall pay permit and water charges.

C. Drinking Water: All drinking water on the site during construction shall be furnished by the CONTRACTOR and shall be bottled water or water furnished in suitable dispensers.

D. The CONTRACTOR shall remove all temporary water connections when no longer needed for completion of the Work and prior to final acceptance of the Work. All affected areas shall be restored to their original condition or better, to the satisfaction of the ENGINEER.

3.2 INSTALLATION OF SANITARY FACILITIES

A. Toilet Facilities: A suitable number of portable chemical toilets shall be provided wherever needed for the use of CONTRACTOR's employees. Toilets at construction sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.

B. Toilet facilities shall be made available when the first employees arrive on Site and shall be properly secluded from public observation.

C. The CONTRACTOR shall maintain toilet facilities in a satisfactory and sanitary condition at all times and shall rigorously enforce their use by all employees and visitors to the site.

D. Sanitary and Other Organic Wastes: The CONTRACTOR shall establish a regular daily collection of sanitary and organic wastes. Wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in accordance with laws and regulations pertaining thereto.

3.3 INSTALLATION OF TEMPORARY UTILITY SERVICES

A. General: Wherever feasible, the CONTRACTOR shall engage the utility company to install temporary service to the Site, or as a minimum, to make connection to existing utility service; locate services where they will not interfere with WORK, including installation of permanent utility services; and maintain temporary services as installed for required period of use; and relocate, modify or extend as necessary from time to time during that period as required to accommodate WORK in progress.

B. Approval of Electrical Connections: Temporary connections for electricity shall be subject to approval of the power company representative, and shall be removed in like manner at the CONTRACTOR's expense prior to final acceptance of the WORK.

C. Separation of Circuits: Circuits used for power purposes shall be separate from lighting circuits.

D. Construction Wiring: Wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. Electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

3.4 INSTALLATION OF POWER DISTRIBUTION SYSTEM

A. Power: The CONTRACTOR shall provide temporary power required for its operations under the Contract and shall provide and maintain temporary power lines required to perform the WORK in a safe and satisfactory manner. All temporary power distribution shall be subject to review by the ENGINEER, the local Building Department, and Power Company (if applicable).

B. Temporary Power Distribution: The CONTRACTOR shall provide a weatherproof, grounded, temporary power distribution system sufficient for performance of the entire WORK, including operation of test equipment and systems which cannot be delayed until permanent power connections are operable, temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps and other equipment), and power for temporary operation of existing facilities (if any) at the Site during change-over to permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring where it will be least exposed to possible damage from construction operations and will result in minimal interference with performance of the WORK; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade or other exposures to damage or abuse.

C. Temporary Construction Lighting: WORK conducted at night or under conditions of deficient daylight shall be suitably lighted to ensure proper performance and to afford adequate facilities for inspection and safe working conditions. The CONTRACTOR shall furnish and install all temporary lighting and power for lighting as required for completion of the Work.

3.5 INSPECTION, PROTECTION, AND TERMINATIONS

A. Inspections: Prior to placing temporary utility services into use, the CONTRACTOR shall inspect and test each service and arrange for governing authorities' required inspection and tests, and obtain required certifications and permits for use thereof.

B. Protection: The CONTRACTOR shall maintain distinct markers for underground lines, and protect from damage during excavating operations.

C. Termination and Removal: When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the CONTRACTOR shall promptly remove installation, unless requested by ENGINEER to retain it for a longer period. Affected improvements shall be restored to original condition or better, to the satisfaction of the ENGINEER and to the agency owning the affected utility.

3.6 CONSTRUCTION FENCING

A. General: Except as noted otherwise, the CONTRACTOR shall make arrangements for and pay for all costs for all temporary fencing to include temporary fence posts, gates and locks used to secure the Staging Area. The CONTRACTOR shall provide, set up, maintain, relocate and remove all temporary fencing and fence posts required.

B. All temporary fencing shall be six (6) foot high, galvanized chain link fabric, knuckled at the top edge and knuckled at the bottom edge with temporary portable posts set at a maximum of ten (10) feet on-center.

C. The CONTRACTOR shall obtain all necessary permits and approvals for all temporary fencing.

D. The CONTRACTOR shall provide all necessary temporary fencing and appurtenances at his own expense.

E. The CONTRACTOR shall coordinate ensure the construction fencing secures the area from the public. The CONTRACTOR shall coordinate with the OWNER in the location of the construction fencing and make any adjustments requested in a prompt manner.

END OF SECTION

SECTION 01 55 00 - SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section specifies the CONTRACTOR'S access to and use of the project Site.

B. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

C. The CONTRACTOR shall not use the private property of the surrounding parcels unless written permission is obtained from the property owner of any of its construction operations.

1.2 SITE ACCESS AND ROAD ACCESS LIMITATIONS

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review the Drawings and maps of the Site to confirm the OWNER's property and right-of-way lines. Site access shall be directed by the OWNER and ENGINEER. Access shall be from the south side of the Immokalee WTP to the Work area.

B. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK.

C. It shall be the CONTRACTOR's responsibility to determine the maximum loads, heights, and size of trucks that can be used on the existing roads to access the Site for delivery of equipment and materials. Temporary access

D. CONTRACTOR will be responsible to restore to a condition equal to or better than original conditions. This work should be captured under the mobilization pay item.

E. It shall be the CONTRACTOR's responsibility to construct and maintain any temporary access roads required for its construction operations.

1.3 TEMPORARY CROSSINGS

A. General: Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial and industrial establishments, housing developments, parking lots, and other existing public and private establishments. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300-feet shall be provided. The CONTRACTOR shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential entry ways, parking areas and driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.

B. Temporary Bridges: Wherever necessary, to maintain vehicular crossings, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to

excavation. Such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the CONTRACTOR shall adopt designs furnished by said authority for such bridges or steel plates, or shall submit designs to said authority for approval, as may be required.

C. Street Use: Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall conduct its operations to not interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the ENGINEER and proper governmental authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise indicated. Toe boards shall be provided to retain excavated material if required by the ENGINEER or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the WORK shall be kept accessible to fire-fighting equipment. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks and the proper functioning of gutters, storm drain inlets, and other drainage facilities.

D. Traffic Control: The CONTRACTOR shall take necessary precautions for the protection of the WORK and the safety of the public. Barricades and obstructions shall be illuminated at night, and lights shall be kept burning from sunset until sunrise. Traffic Control shall be provided by the CONTRACTOR. If the temporary closure of any street is required during construction, the CONTRACTOR shall outline the requirements in a MOT plan and obtain approval from the STOF.

E. Temporary Driveway Closure: The CONTRACTOR shall notify the owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than 2-hours at least 3 working days prior to the closure. The CONTRACTOR shall minimize the inconvenience and minimize the time period that the driveways will be closed. The CONTRACTOR shall fully explain to the owner/occupant how long the closure will take and when closure will start.

1.4 CONTRACTOR'S WORK AND STORAGE AREA

A. The CONTRACTOR's Staging area is indicated on the Drawings for its exclusive use during the term of the Contract as a work and storage area for its construction operations on the WORK. At completion of WORK, the CONTRACTOR shall return this area to its original condition, including grading and landscaping.

B. Staging area shall be fenced by the CONTRACTOR prior to construction activities. Refer to Section 01 57 19 Temporary Environmental Controls for temporary construction fencing requirements. No grading outside of grading shown in the Drawings at the wellhead shall occur in these areas without prior approval from the OWNER.

C. All construction activities shall be contained within the Temporary Work Zone indicated on the Drawings.

D. The CONTRACTOR may use the OWNER's Immokalee WTP site for storage, as approved by the OWNER. The designated storage area will be identified by the OWNER once the project has been awarded. The designated storage area shall only be used for materials and equipment related to the Work for this project. All storage shall

be confined to the limits of the designated storage area. The CONTRACTOR shall be responsible for securing all stored products and equipment at the WTP.

E. The CONTRACTOR shall move any equipment or stored products which interfere with the OWNER's operations and maintenance activities.

F. The CONTRACTOR'S staging areas shall be kept in a clean and orderly fashion at all times. The areas shall be sloped to drain off all storm runoff.

G. Sediment and erosion control shall be installed to ensure catch basins and drains adjacent to the Staging area are protected from runoff containing silt.

H. The CONTRACTOR shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the WORK.

I. The CONTRACTOR shall construct and use a separate storage area for hazardous materials used in constructing the WORK.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, 2-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.

2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.

3. The CONTRACTOR shall develop and submit to the ENGINEER a plan for storing and disposing of the materials above.

4. The CONTRACTOR shall obtain and submit to the ENGINEER a single EPA number for wastes generated at the Site.

5. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.

6. Hazardous materials that are delivered in containers shall be stored in the original containers until use. Hazardous materials delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.5 PARKING

A. The CONTRACTOR shall park all vehicles in the Temporary Work Zone. No vehicles shall be parked throughout the John Jimmie Memorial Arena, within the existing roadway right of way, or within any parking areas.

B. If necessary and requested, the CONTRACTOR may park vehicles in the OWNER's Immokalee WTP site as locations directed by the OWNER. The OWNER shall not be responsible for the security of vehicles.

C. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The CONTRACTOR

shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 57 19 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 RUBBISH CONTROL

A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas for which it is responsible in a neat and clean condition and free from any accumulation of rubbish. The CONTRACTOR shall dispose of rubbish and waste materials of any nature and shall establish regular intervals of collection and disposal of such materials and waste.

B. The CONTRACTOR shall keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with applicable safety laws and the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

C. The CONTRACTOR shall pay for disposal of waste to include garbage and construction and demolition debris in accordance with applicable local codes and its exclusive solid waste franchise agreements.

D. Provide on-site waste containers for collection of waste materials, debris and rubbish.

1.2 DUST ABATEMENT

A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity of the Site. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. Dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.

B. Storage Piles: Enclose, cover, water (as needed), or apply non-toxic soil binders according to manufacturer's specifications on material piles (i.e. gravel, sand, dirt) with a silt content of 5 percent or greater.

C. Active Areas of Site: Water active construction areas and unpaved roads as needed and as requested by ENGINEER.

D. Inactive Areas of Site: Water as needed to maintain adequate dust control.

E. Vehicle Loads: Cover or maintain at least 2-feet of freeboard vertical distance between the top of the load and the top of the trailer sides on trucks hauling dirt, sand, soil, or other loose materials off of the Site.

F. Roads: When there is visible track-out onto a paved public road, install wheel washers where the vehicles exit and enter onto the paved roads and wash the undercarriage of trucks and any equipment leaving the Site on each trip. Sweep the paved street at the end of each shift with a Mobil Athey or similar water spray pick-up broom-type street sweeper as necessary or as directed.

G. Vehicle Speeds: If watering of unpaved roads is not sufficient to control dust, reduce vehicle speeds to 15 mph or less on such roads.

1.3 SEDIMENTATION ABATEMENT

A. The CONTRACTOR shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials in compliance with applicable federal, state, and local rules and regulations and the Contract Documents.

B. Install and maintain erosion and sediment control measures, such as swales, grade stabilization structures, berms, dikes, waterways, filter fabric fences, and sediment basins.

C. Filter fabric barrier systems, if used, shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

D. Remove and dispose of sediment deposits at the designated spoil area. If a spoil area is not indicated, dispose of sediment off-Site at a location not in or adjacent to a stream or floodplain. Sediment to be placed at the spoil area should be spread evenly, compacted, and stabilized. Sediment shall not be allowed to flush into a stream or drainage way.

E. Maintain erosion and sediment control measures until final acceptance or until requested by the ENGINEER to remove it.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00 - PRODUCTS, MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. The word "Products," as used in the Contract Documents, is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment including those furnished by OWNER, by methods to prevent soiling and damage.

C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.

B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.

C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.

D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.

E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.

F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

A. The CONTRACTOR'S bid price shall include materials or equipment meeting the specifications. Proposed substitutions will only be considered following award of the Contract as described herein.

B. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.

3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.

4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.

5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.

6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.

C. The procedure for review by the ENGINEER will include the following:

1. Prior to proposing any substitute item, CONTRACTOR shall satisfy itself that the item proposed is: equal or better to that specified; that such item will fit into the space allocated; that such item affords comparable ease of operation, maintenance and service; that the appearance, longevity and suitability for the climate are comparable; that by reason of costs savings, reduced construction time or similar demonstrable benefit, the substitution of such item will be in OWNER’s interest and will in no way detrimentally impact the project schedule. The burden of proof that such an item offered is equal in all respects to that specified shall be CONTRACTOR’S

2. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form." A copy of this form is attached to the end of this Specification. Following award of contract, an electronic copy of the Substitution Request Form will be provided to the CONTRACTOR.

3. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35-day period after award of the Contract.

4. Wherever a proposed substitution item has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment

has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.

5. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.

6. The ENGINEER will evaluate each proposed substitution within a reasonable period of time, not to exceed 30 days.

7. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."

8. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.

D. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:

1. Complete data substantiating compliance of proposed substitution with the requirements of the Contract Documents, including:

   a. Product identification, including manufacturer’s name and address and model number of product

   b. Manufacturer’s literature, identifying

      1) Product description

      2) Reference Standards

      3) Performance, testing, and relevant engineering data

   c. Samples, if applicable

   d. List two similar projects where substitution was utilized. Provide the following information for each project:

      1) Contact person name and phone number. Contact should be able to provide information on the use of the product.

      2) Location of installation

      3) Date of installation

      4) Quantity installed

      5) Scope and description of project

2. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.

3. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.

4. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.

5. Whether all variations of the proposed substitution from the items originally specified are identified.

6. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

7. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

8. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.

E. In making the formal request for substitution, the CONTRACTOR represents that:

1. The substitution has been investigated and it has been determined that is equal to or superior in all respects to the specified product.

2. The CONTRACTOR will provide the same warranties and bonds for the substitution as the product specified

3. The substitution will be coordinated into the installation of the WORK and any required changes to complete the WORK in all respects as a result of the substitution will be made by the CONTRACTOR at no additional cost to the OWNER.

4. The CONTRACTOR waives claims for additional cost caused by the substitution, which may subsequently become apparent.

5. All cost data provided is complete and accurate

F. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment, products and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part

of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the ENGINEER.

2.2 SHIPPING AND TRANSPORT

A. All equipment shall be protected against damage from moisture, dust, handling, or other causes during transport from manufacturer's premises to site. Each item or package shall be adequately marked to identify the package contents.

B. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units where possible.

C. Bearing housings, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt.

D. Damage shall be corrected to conform to the requirements of the contract before the assembly is incorporated into the work. The CONTRACTOR shall bear the costs arising out of dismantling, inspection, repair and reassembly.

2.3 FACTORY APPLIED COATINGS:

A. Unless otherwise specified, each item of equipment shall be shipped to the site of the work with the manufacturer's shop applied coating as specified in Section 099600. The prime coating shall be applied over clean dry surfaces in accordance with the coating manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats.

2.4 STORAGE:

A. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.

B. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.

2.5 PROTECTION OF EQUIPMENT AFTER INSTALLATION:

A. After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing piping and equipment.

B. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint.

C. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted and the ventilation systems installed.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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Substitution Request Form

To: Owner: Seminole Tribe of Florida

Project: Immokalee Raw Water Well 4

Specified Item:

Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

Proposed Substitution: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. Applicable portions of the data are clearly identified.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings and will not require a change in any of the Contract Documents.
2. The undersigned will pay for changes to the design, including engineering design, detailing, and construction costs caused by the request substitution which is estimated to be $_____.
3. The proposed substitution will have no adverse effect on other contractors, the construction schedule (specifically the date of substantial completion), or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The incorporation or use of the substitute in connection with the work is not subject to payment of any license fee or royalty.

The undersigned further states that the function, appearance, and quality of the Proposed Substitution are equivalent or superior to the Specified item.

Submitted by **Contractor:**	Reviewed by **Engineer:**	
	☐ Accepted	☐ Accepted as Noted
Signature _____	☐ Not Accepted	☐ Received too Late
Firm _____	By: _____	
_____	Title: _____	
Date: _____	Date: _____	
Telephone: _____	Remarks: _____	
Attachments: _____	_____	

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SECTION 01 75 00 – EQUIPMENT TESTING AND PLANT STARTUP

PART 1 - GENERAL

1.1 THE SUMMARY

A. Plant startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times.

B. Conduct all test, check out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the ENGINEER prior to requesting Substantial Completion from the ENGINEER. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup

C. Startup requires the combined expertise of the CONTRACTOR, Subcontractors, the ENGINEER, and the OWNER. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the OWNER will be available for operational advice prior to and during startup but the ultimate responsibility for successful startup shall remain that of the CONTRACTOR.

D. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.

E. Temporary facilities may be necessary. If so, CONTRACTOR shall design, provide, operate, and later decommission them.

1.2 DEFINITIONS

A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.

B. Pre-commissioning is the systematic demonstration through testing that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the ENGINEER. Pre-commissioning of all portions of the WORK shall be successfully completed prior to starting Commissioning.

C. Commissioning is the verification that the complete WORK functions in full conformance with the Contract requirements over a 7-day period, minimum.

1.3 SUBMITTALS

A. Schedule: The schedule for startup shall be submitted under Section 013216 – CPM Construction Schedule.

B. Startup Plan: Not less than 45 Days prior to startup, submit for review a detailed Startup Plan. The CONTRACTOR shall revise the Plan as necessary based on review comments. The Plan shall include:

1. Schedule for receipt of manufacturers' equipment certifications of proper installation

2. Schedule for submittal of final Technical Manuals

3. Schedule for training the OWNER's personnel

4. Description of temporary facilities and schedule for installation and decommissioning them

5. List of OWNER- and CONTRACTOR-furnished supplies

6. Detailed schedule of operations to achieve successful pre-commissioning and commissioning

7. Checklists and data forms for each item of equipment

8. Address coordination requirements with the OWNER's staff

9. Designate a representative of the CONTRACTOR who has the authority to act in matters relating to startup and has startup experience with facilities similar to this facility. The Plan shall also designate the roles and responsibilities of any Subcontractors that may be involved in startup activities.

10. Safety, startup, and testing procedures, and proposed inspection and certification forms and records.

11. Interconnection of new to existing facilities

    a. Date and time frame of proposed shutdown or interconnection, including sequence of events and activities to be conducted.

    b. A detailed description of sequences and activities for the planned shutdown and interconnection.

    c. Staff, equipment, and materials that will be at the Site before commencing the shutdown.

    d. Other provisions so that interconnection, testing, and startup will be completed within the planned time.

C. System Outage Requests: Request for shutdown of existing systems as necessary to test or start up new facilities.

D. Records and Documentation

1. Where required by the specifications, submit equipment installation certifications under those Sections.

2. Records of startup as indicated below.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MALFUNCTIONS

A. During the 7-day operational demonstration, all components, subsystems, systems, and equipment shall be placed in service 24 hours per day throughout the test period. Unless indicated otherwise, any significant malfunctions occurring during this test shall be remedied and the test restarted with no credit given for the operating time before the malfunction. Malfunctions satisfying all 3 of the following conditions shall not be considered significant, and will allow the demonstration period to resume at the elapsed time when the malfunction started:

1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.

2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.

3. Malfunction was corrected within two hours of the time the malfunction was detected (the one hour period includes the time required to locate the cause of the malfunction, beginning upon CONTRACTOR's awareness or notification that a malfunction has occurred, and ending when the malfunction is remedied and the system is successfully placed back into operation).

B. The CONTRACTOR shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.2 PREREQUISITES

A. Pre-commissioning and commissioning activities shall be scheduled according to Section 013216 – CPM Construction Schedule. The 7 Day demonstration shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the OWNER's calendar.

B. The following shall be completed before pre-commissioning begins.

1. All Technical Manual information required by the Contract Documents have been submitted.

2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The ENGINEER has approved the Startup Plan.

6. Temporary facilities are functional, adjusted, and ready for use.

7. Pressure switch, flow switch, timing relay, level switch, vibration switch, temperature switch, RTD monitor, pressure regulating valve, and other control device settings determined by the ENGINEER or the equipment manufacturer have been adjusted for accuracy.

3.3 GENERAL

A. Supplies

1. The CONTRACTOR shall furnish all materials and test equipment, not listed for the OWNER to furnish, required to complete the facility startup

2. The OWNER will furnish:

a. Water

b. Power

B. Startup Records: The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER:

1. Lubrication and service records for each mechanical and electrical equipment item

2. Hours of daily operation for each mechanical and electrical equipment item

3. Logs of electrical measurements and tests

4. Instrumentation calibration and testing logs

5. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms

6. Factory and field equipment settings

7. Log of problems encountered and remedial action taken

8. Other records, logs, and checklists as required by the Contract Documents

3.4 PRE-COMMISSIONING

A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.

B. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.

C. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.

D. Furnish the ENGINEER at least 10 Days written notice confirming the start of pre-commissioning. The OWNER's staff will observe pre-commissioning.

3.5 COMMISSIONING

A. Commissioning shall not begin until pre-commissioning has been completed and accepted by the ENGINEER. The CONTRACTOR shall operate the facility without malfunction for a 7 Day, 24 hour/day period, subject to the malfunction criteria specified hereinabove.

B. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgement of the ENGINEER, be cause for extending the demonstration an equal amount of time.

C. The OWNER will furnish certified treatment plant operators during the startup period. Certified operators will be under the direct supervision of and be responsible to the CONTRACTOR.

D. During commissioning, the CONTRACTOR shall:

1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.

2. Clean or replace strainers, screens, and filter elements.

END OF SECTION

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 GENERAL

A. The CONTRACTOR shall comply with all requirements for project closeout specified in the Contract Documents, including all technical and administrative requirements.

B. The CONTRACTOR shall not submit a Final Application for Payment until all project closeout activities have been completed and accepted by the ENGINEER and OWNER.

1.2 SUBSTANTIAL COMPLETION

A. Approximately 2 weeks before CONTRACTOR considers the Work will be Substantially Complete, the CONTRACTOR shall submit to the ENGINEER:

1. A written notice that the Work, or designated portion thereof, is substantially complete.

2. A list of items to be completed or corrected.

B. Within a reasonable time after receipt of such notice, the ENGINEER will make an inspection to determine the status of completion.

C. Should the ENGINEER determine that the Work is not Substantially Complete, the ENGINEER will promptly notify the CONTRACTOR in writing, giving the reasons therefor. The CONTRACTOR shall remedy the deficiencies in the Work, and send a second written notice of substantial completion to the ENGINEER. The ENGINEER will re-inspect the Work.

D. When the ENGINEER finds that the Work is Substantially Complete, the ENGINEER will complete the following:

1. Prepare and deliver to OWNER a tentative Certificate of Substantial Completion using Owner's template with a tentative list of items to be completed or corrected before final payment.

2. After consideration of any objections made by the OWNER as provided in Conditions of the Contract, and when the ENGINEER considers the Work substantially complete, the ENGINEER will execute and deliver to the OWNER and the CONTRACTOR a definite Certificate of Substantial Completion with a revised tentative list of items to be completed or corrected.

3. Request that the CONTRACTOR initiate closeout submittals.

1.3 FINAL SUBMITTALS

A. The CONTRACTOR shall review the Contract Documents and ensure that all final documentation and certifications are submitted to the ENGINEER and OWNER.

B. Submit all Final Operations and Maintenance Manuals in electronic and hardcopy format in accordance with **Section 01 33 00 - Contractor Submittals.**

C. Submit all Final Asbuilt Drawings in electronic and hardcopy format in accordance with **Section 01 33 00 - Contractor Submittals.**

D. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER:

1. Final inspection certificates and permit closeout documentation

2. A completed punchlist, signed by CONTRACTOR, ENGINEER, and OWNER.

3. Warranties, where required

4. Written guarantees, where required.

5. Maintenance stock items; spare parts; special tools.

6. Final Releases from all sub-contractor and vendors in contract with the CONTRACTOR.

7. Any other document requested in the contract documents.

1.4 FINAL CLEANUP

A. At the completion of work and immediately prior to final inspection, cleaning of the entire project shall be accomplished according to the requirements specified below.

B. The CONTRACTOR shall thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. The cleaning shall leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.

C. All subcontractors shall similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their Contracts.

D. The CONTRACTOR shall remove all temporary structures and all debris, including all dirt, sand, gravel, rubbish and waste material.

E. Should the CONTRACTOR not remove rubbish or debris or not clean the structures and site as specified, the ENGINEER reserves the right to have the cleaning done at the expense of the CONTRACTOR.

F. Only experienced workers, or professional cleaners, shall be employed for final cleaning.

G. Grease, dust, dirt, stains, labels, and other foreign materials shall be removed from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

H. Marred surfaces shall be repaired, patched, and touched up to specified finish, to match adjacent surfaces.

I. All temporary utility drops, fencing, and water supply outlets shall be removed.

J. All identification signs, barricades, tools, rubbish collection receptacles and other such items shall be removed by the CONTRACTOR.

K. All remaining earthen stockpiles of excess excavated material shall be graded to provide gentle slopes to prevent erosion as directed by the ENGINEER.

L. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

1.5 FINAL INSPECTION

A. When CONTRACTOR considers the Work is complete, the CONTRACTOR shall submit written certification that:

1. Contract Documents have been reviewed.

2. Work has been inspected for compliance with Contract Documents.

3. Work has been completed in accordance with Contract Documents.

4. All equipment and systems have been tested in the presence of the OWNER'S representative and are operational.

5. Work is completed and ready for final inspection.

B. The ENGINEER will make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.

C. Should the ENGINEER consider that the Work is incomplete or defective:

1. The ENGINEER will promptly notify the CONTRACTOR in writing, listing the incomplete or defective work.

2. CONTRACTOR shall take immediate steps to remedy the stated deficiencies, and send a second written certification to the ENGINEER that the Work is complete.

3. The ENGINEER will re-inspect the Work.

D. When the ENGINEER finds that the Work is acceptable under the Contract Documents, the ENGINEER shall request the CONTRACTOR to complete any remaining closeout submittals.

1.6 RE-INSPECTION FEES

A. Should the ENGINEER perform re-inspections due to failure of the Work to comply with the claims of status of completion made by the CONTRACTOR:

1. OWNER will compensate the ENGINEER for such additional services.

2. OWNER will deduct the amount of such compensation from the final payment to the CONTRACTOR.

1.7 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in the Contract Documents.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.

C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the OWNER for the cost thereof.

1.8 FINAL APPLICATION FOR PAYMENT

A. The CONTRACTOR shall submit the Final Application for Payment only after all of the project closeout activities and documentation have been completed and submitted.

B. Final Application for Payment shall be in accordance with procedures and requirements of the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 10 - CLEANING

PART 1 -- GENERAL

1.1 SUMMARY

A. This Section specifies the maintenance of the WORK site in a clean, orderly, hazard-free condition.

B. Refer to **Section 01 57 19 Temporary Environmental Controls** for additional requirements

1.2 QUALITY ASSURANCE

A. Conduct cleaning and disposal operations in accordance with local ordinances and anti-pollution laws.

B. Rubbish, volatile wastes, and other construction wastes shall be neither burned nor buried on the work site, and shall not be disposed of into storm drains, sanitary drains, streams, or other waterways.

PART 2 -- PRODUCTS

2.1 ON-SITE WASTE CONTAINERS

A. Provide on-site waste containers for collection of waste materials, debris, and rubbish in accordance with **Section 01 57 19 Temporary Environmental Controls.**

2.2 CLEANING MATERIALS

A. Cleaning materials shall be as recommended by the manufacturer of the surface to be cleaned.

PART 3 -- EXECUTION

3.1 SAFETY REQUIREMENTS

A. Maintain work site in accordance with local ordinances and anti-pollution laws applicable to work site cleanliness and in a neat, orderly, and hazard-free condition until final acceptance of the WORK. Catwalks, accessible underground structures, work site sidewalks and walkways adjacent to the work site shall be kept free from hazards caused by construction activities.

B. Store volatile wastes including rags in covered metal containers, and remove from work site daily.

C. Prevent accumulations of wastes which create hazardous conditions.

3.2 INTERIM CLEANING

A. The CONTRACTOR shall at all times during the execution of this Contract keep the work site free and clear of all rubbish and debris.

B. Perform cleaning every workday for duration of the WORK. Structures, grounds, and areas of the work site and public and private properties shall be maintained free from accumulations of waste materials and rubbish caused by construction operations on the work site. Place waste materials and rubbish in on-site containers.

C. Remove or secure loose material on open decks and on other exposed surfaces at end of each day's work or more often to maintain work site in hazard-free condition. Prevent dislodgement of materials due to wind and other forces.

D. Complete dust abatement in accordance with **Section 01 57 19 Temporary Environmental Controls**.

E. Empty on-site waste containers whenever necessary so that trash overflow does not occur. Legally dispose of contents at either public or private dumping areas.

F. Control the handling of materials, debris, and rubbish; do not drop or throw from heights.

G. Immediately remove spillages of fuels or oil or of construction-related materials from hauling routes or the site.

H. Perform cleaning operations so dust and other contaminants resulting from cleaning processes will not fall on wet, newly painted surfaces.

3.3 FINAL CLEANING

A. In addition to the cleaning performed above, in preparation for final inspection, remove grease, dust, dirt, rust stain from surfaces. Remove labels, fingerprints, and other foreign materials from exposed exterior finished surfaces. Flush down all pullbox, manhole and other covers and frames, valve boxes, and areas leaving such surfaces clean of all sand, laitance on concrete pads and walls, etc.

B. As soon as the WORK is completed, the accumulated rubbish or surplus materials shall be promptly removed. The CONTRACTOR shall also restore in an acceptable manner all property, both public and private, which has been displaced or damaged during the prosecution of the WORK, and shall leave the site and vicinity unobstructed and in a neat and presentable condition.

C. In the event of delay exceeding two days after written notice is given to the CONTRACTOR by the ENGINEER to remove such rubbish or materials or to restore displaced or damaged property, the ENGINEER may employ such labor and equipment as he may deem necessary for the purpose, and the cost of such work, together with the cost of supervision, shall be charged to the CONTRACTOR and shall be deducted from any monies due him.

D. The project shall not be considered as having been completed until all rubbish and surplus materials have been removed and disposed of properly.

END OF SECTION

SECTION 01 77 40 - PERMITS

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall identify and make sure all the necessary permits and licenses are in place prior to the commencement of the WORK. The CONTRACTOR shall keep copies of all permits on the project site at all times. Record copies of all permits shall be furnished to the ENGINEER and the STOF.

B. Upon issuance of the “Notice of Award” letter, the CONTRACTOR shall spare no expense in personnel and time in order to secure all necessary permits within sixty (60) days. If the CONTRACTOR, through no fault of their own, is unable to secure permits within this time period, the Contractor shall notify the STOF in writing detailing the reason for the delay and request a non-compensable time extension to secure permits. It is at the discretion of the STOF to either award or deny the Contractor’s request for a time extension. If the request is approved, the STOF shall issue a letter specifying the additional number of days the Contractor has to complete acquisition of the permits.

C. The “Notice to Proceed Date” shall be determined once the Contractor has obtained any and all permits necessary to commence construction <u>or</u> if the request for a time extension is denied, the STOF shall issue a “Notice to Proceed” letter” in which the “Notice to Proceed Date” is established as set forth in Contract for Construction.

D. No site construction work will be permitted prior to the ENGINEER receiving copies of all approved permits from the CONTRACTOR.

E. Permits obtained by the OWNER and anticipated CONTRACTOR permits are outlined in this Section. Listed CONTRACTOR permits are for reference only. It is the CONTRACTOR's responsibility to identify and obtain all required permits.

F. The CONTRACTOR shall abide by the conditions of all permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the OWNER. The CONTRACTOR shall assume throughout the life of the Contract all obligations and responsibilities imposed on the OWNER by permits.

1.2 PERMITS BY THE OWNER

A. None.

1.3 PERMITS BY CONTRACTOR

A. The CONTRACTOR shall identify, apply for, and obtain all required permits. The CONTRACTOR shall make sure all the necessary permits and licenses are in place prior to the commencement of the WORK.

B. The following table presents a list of state and local organizations and some of the permits that they administer. This list is for reference only and it shall be the CONTRACTOR’S responsibility to identify and obtain all required permits.

C.

Agency	Permit
South Florida Water Management District (SFWMD) 3301 Gun Club Road, Building B-1 West Palm Beach, FL 33406	• Dewatering • NPDES
Seminole Tribe of Florida Environmental Resource Management Department (ERMD), Public Works Department, and Building Department.	• Dewatering Plan • Dig Permit • Temp Facilities • Fence
Florida Department of Environmental Protection (FDEP) / South Florida Water Management District	State of Florida Permit Application to Construct, Repair, Modify , or Abandon Well - Form 62-532.900(1)

D. In the event any of the conditions of the permits are in conflict with the requirements of these Specifications, the more stringent conditions shall take precedence.

E. The CONTRACTOR is to conform to all regulations of the governmental agencies having jurisdiction over this WORK, whether or not included in the permit.

F. Any deviations from the Plans, Specifications or permits appended thereto, must first be approved by the ENGINEER even if approval for the change has been given by the permitting agency.

1.4 PERMIT FEES AND EXPENSES

A. The CONTRACTOR shall be responsible for all required permit and inspection fees.

B. The CONTRACTOR shall be responsible for all costs associated with supplying all necessary information (submittal information, shop drawings, applications, division of drawings to facilitate permit applications, etc.) to obtain permits. The OWNER and ENGINEER will assist in providing information related to the design and existing system.

C. Permit re-inspection fees shall be paid by the CONTRACTOR at no additional cost to the OWNER.

D. All expenses necessary for compliance with the regulations and requirements of each permitting agency and its permit shall be borne by the CONTRACTOR and shall be included in the overall bid price.

1.5 PERMIT SUBMITTALS

A. The CONTRACTOR shall meet as necessary and coordinate with all permitting jurisdictions and the ENGINEER with respect to submittals, modifications, and resubmittals.

B. The CONTRACTOR shall respond to permitting agencies questions and requests for additional information and respond to comments within seven (7) days of receipt from permitting agencies.

C. Within 7 days of receipt of permits, the CONTRACTOR shall submit one (1) copy to the ENGINEER and one (1) copy to the OWNER.

1.6 PERMITTING MEETINGS

A. The CONTRACTOR shall schedule, coordinate and attend all meetings as required or applying for and obtaining all required permits.

B. The CONTRACTOR shall schedule, coordinate, and attend Pre-construction Meetings as required by the following permitting agencies:

1. Seminole Tribe of Florida Public Works Department

1.7 PERMIT REQUIREMENTS

A. The CONTRACTOR shall abide by the conditions of all permits.

B. The CONTRACTOR shall obtain proof of satisfaction of conditions of permit from each agency prior to acceptance of the WORK by the OWNER. The CONTRACTOR shall furnish one (1) copy of the proof the ENGINEER and one (1) copy to the OWNER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 02 22 00 - SITE CONDITION SURVEYS

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall conduct thorough pre-construction and post-construction Site Condition Survey of the entire Project. Site Condition Survey shall consist of photographs, digital recordings, and topographic mapping.

B. All equipment, accessories, materials, and labor to perform the Site Condition Survey Work shall be furnished by the CONTRACTOR.

1.2 CONTRACTOR SUBMITTALS

A. Digital surveys, photographs, and other data of the preconstruction conditions shall be submitted to the ENGINEER for record purposes prior to, but not more than two weeks before, commencement of any construction activities.

B. Post-construction topographic mapping shall be completed and incorporated into Asbuilt Drawings.

C. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the OWNER and ENGINEER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PHOTOGRAPHS AND VIDEO RECORDINGS

A. CONTRACTOR, as a minimum, shall document pre- and post-construction conditions by preparing digital videotaping surveys of the following:

1. Roadways used to access the Site or haul materials and equipment to the Site.

2. Work areas, including complete stage area, access corridors, all areas immediately surrounding the Work and staging areas, and any areas that may be impacted by the Work .

3. Any work completed by other contractors at the Site that will be connected to or otherwise affected by the WORK.

4. Driveways, sidewalks, and buildings which might be affected by the WORK.

5. Supplement video surveys with photographs as required to thoroughly document the original condition and location of existing features and facilities.

6. All video recordings and photographs shall only be conducted during periods of good visibility.

B. No construction shall begin prior to review and acceptance of the pre-construction videotape surveys and photographs covering the construction area by the ENGINEER. The ENGINEER shall have the authority to reject all or any portion of the video not conforming to the specification and order that it be redone at no additional cost to the OWNER. The CONTRACTOR shall reschedule unacceptable coverage within five (5) days after being notified. The ENGINEER shall designate those area, if any, to be omitted from or added to the audio-video coverage.

C. All videos, photographs, and written records shall become the property of the OWNER.

3.2 TOPOGRAPHIC MAPPING

A. General

1. The ENGINEER shall provide a digital AutoCAD file of the original survey used for design and the design drawings to the CONTRACTOR.

2. Topographic mapping shall be developed using the Project coordinates, shall be referenced to the Project benchmarks, and shall be adequate to ascertain pre-construction and post-construction elevations of all public and private property within and adjacent to the construction limits

3. All pre- and post-construction topographic mapping and other data, including spot elevations, shall be prepared and sealed by a Florida Registered Land Surveyor. During the life of the Contract, the CONTRACTOR shall retain the services of a Florida Registered Land Surveyor who shall maintain records of the installation, including all deviations from Plans and Specifications.

4. All pre- and post-construction survey data shall be furnished as follows:

a. Site mapping shall be submitted as a separate electronic drawing in AutoCAD 2019, or later.

b. Each AutoCAD site map shall also be submitted in hard copy plot format in full size 24" x 36" (five hard copies).

c. ENGINEER will review hardcopy plots for accuracy relative to the indicated requirements. CONTRACTOR shall amend mapping files as required, based on ENGINEER's comments.

B. Pre-Construction Topography

1. Topographic mapping shall be conducted as required to supplement the survey and design information provided by the ENGINEER to adequately document existing conditions prior to initiating the Work.

C. Post-Construction Topography

1. Topographic mapping shall be conducted to document the post-construction topography of the Site, including the well location and all surface facilities, new piping, fittings and valves and appurtenances, new electrical and control ductbanks, existing utilities encountered during installation of new piping and ductbanks, and all new chain-link fence.

a. Topographic mapping for all utilities encountered during construction shall be recorded. Topographic mapping shall also be conducted to document the coordinates of each corner of structures, corner posts of all fencing and gates, and limits of geoblock material.

b. Spot elevation surveys used to document the final grade elevations and connections to existing grade and all areas influenced by the WORK.

c. The electronic mapping files shall be produced using field survey techniques with sufficient accuracy for reproduction and use as base maps at a scale of 1"=20' horizontal and 1-foot contour intervals as specified for National Map Accuracy Standards.

END OF SECTION

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE, REINFORCEMENT AND FORMWORK

Part 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Provide all labor, materials, equipment, fabrication, incidentals, transportation, placing and supervision necessary to complete all cast-in-place concrete work, its finishing, and all related work called for by the Contract Drawings and/or Specifications, or reasonably inferable from either or both, as needed for a complete and proper installation.

B. Related work: Work affecting this Section includes, but is not limited to:

1. Shop Drawings-Per General Conditions and as specified herein.
2. Materials and storage thereof
3. Reinforcing-Bar and fabric
4. Accessories of every nature, including form tie system.
5. Formwork and removal thereof, including shoring and reshoring
6. Concrete proportions and mixes
7. Placing of concrete
8. Admixtures
9. Joints, metal joint screeds and joint fillers
10. Finishes of all types
11. Protection and curing
12. Patching
13. Laboratory Testing

C. Shop Drawings:

1. Shop bending diagrams, placing lists, and drawings of reinforcing steel prior to fabrication.
2. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Details of reinforcing steel for fabrication and erection shall conform to ACI 315V and the requirements herein. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. Include bar placement diagrams which clearly indicate the dimensions of each bar splice.
3. Where mechanical couplers are required or permitted to be used to splice reinforcing steel, submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler

used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

4. Placement drawings showing the location and type of joints for each structure.
5. If reinforcement steel is spliced by welding at any location, submit mill test reports that contain the information necessary for the determination of the carbon equivalent per AWS D1.4 Structural Welding Code – Reinforcing Steel. The CONTRACTOR shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable. The CONTRACTOR shall submit certifications of procedure qualifications for each welding procedure used and welder qualifications, for each welding procedure, and for each welder performing the WORK. Such qualifications shall be as specified in AWS D1.4.

D. Mix Designs: Prior to beginning the WORK, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete. The mix designs shall be checked by an independent testing laboratory acceptable to the ENGINEER. Costs related to such checking shall be the CONTRACTOR's responsibility. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete both with and without the admixture.

E. Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall furnish certified delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each certificate shall state the mix number, total yield in cubic yards, and the time of day to the nearest minute, corresponding to the time when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

1.02 QUALITY ASSURANCE

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the requirements of ACI 301-96 "Specifications for Structural Concrete for Buildings", except as modified by supplemental requirements hereinafter.

B. Testing of Reinforcing Steel:

1. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcing steel in a quantity adequate for testing. Costs of initial

tests will be paid by the OWNER. Costs of additional tests, if material fails initial tests, shall be the CONTRACTOR's responsibility.

2. If requested by the ENGINEER, the CONTRACTOR shall furnish samples of each type of welded splice used in the WORK in a quantity and of dimensions adequate for testing. At the discretion of the ENGINEER, radiographic testing of direct butt welded splices will be performed. The CONTRACTOR shall provide assistance necessary to facilitate testing. The CONTRACTOR shall repair any weld that fails to meet the requirements of AWS D1.4. The costs of testing will be paid by the OWNER; but the costs of tests that fail to meet requirements shall be the CONTRACTOR's responsibility.

C. Testing of Materials:

1. Tests on component materials and for compressive strength of concrete will be performed as indicated herein. Tests for determining slump will be in accordance with the requirements of ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness in accordance with ASTM C 33 - Concrete Aggregates.
3. The cost of laboratory tests on cement, aggregates, and concrete, will be paid by the OWNER. However, the CONTRACTOR shall pay the cost of any additional tests and investigations on WORK that does not meet the Specifications. The laboratory will meet or exceed the requirements of ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
4. Concrete for testing shall be furnished by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

D. Inspections: Continuous inspection by a special inspector approved by the local building department having jurisdiction and by the ENGINEER will be required where necessary to conform, to code requirements. Costs of the special inspector shall be paid for by the CONTRACTOR. Inspection reports shall be submitted to the ENGINEER. The special inspector shall observe the following WORK for conformance with the Drawings and Specifications:

1. During the preparation and taking of required test specimens.
2. Placing of concrete except sitework concrete fully supported on earth.

E. Field Compression Tests:

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete herein and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with these Specifications. Each set of test specimens will be a minimum of 4 cylinders.
2. Compression test specimens for concrete will be made in accordance with Section 9.2 of ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field. Specimens will be 6-inches diameter by 12-inches high cylinders.
3. Compression tests will be performed in accordance with ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test cylinder will be tested at 7 Days and 2 at 28 Days. The remaining cylinder will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318 - Building Code Requirements for Reinforced Concrete, Chapter 5 "Concrete Quality", and as indicated herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.
3. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement as part of the WORK.

G. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not indicated, permissible deviations will be in accordance with ACI 117 - Standard Tolerance for Concrete Construction and Materials.

1. The variation from required lines or grades shall not exceed -inch in /-feet and there shall be no offset or visible waviness in the finished surface.

1.03 STANDARDS

A. ACI 301-96 Specifications for Structural Concrete
B. ACI 318-95 Building Code Requirements for Reinforced Concrete
C. Florida Building Code, latest edition.
D. ACI 117-90 Standard Specifications for Tolerances for Concrete Construction and Materials

Part 2 - PRODUCTS

2.01 MATERIALS

A. Materials for Concrete:

1. Cement shall conform to the following: Portland Cement ASTM C150, normal, type I or type II. Provide domestic cement of one type and from same source for entire project.
2. Mineral Admixtures:

   (a) Fly Ash: Shall conform to ASTM C 618, with 20% maximum of total cementitious weight.
   (b) Ground Blast Furnace Slag: Shall conform to ASTM C 989-93. 30% maximum of total cementitious weight.

3. Chemical Admixtures: The following admixtures are permitted, but require written approval from the Engineer:

   (a) Air Entraining Admixture: Comply with ASTM C260. "Specifications for Air-Entraining Admixtures for Concrete.
   (b) Water Reducing Admixture: Comply with ASTM C494 "Specifications for Chemical Admixtures for Concrete", Type A, and compatible with air entraining admixture.
   (c) Water Reducing and Retarding Admixture: Comply with ASTM C494, "Specifications for Chemical Admixtures for Concrete, Type D, and compatible with air entraining admixture.
   (d) High Range Water Reducing Admixture: Comply with ASTM C494, "Specifications for Chemical Admixtures for Concrete", Type F or G, and compatible with air entraining admixture (Including superplasticizer to reduce water content.)
   (e) Admixtures containing added calcium chloride are not permitted.

4. Aggregates: Shall conform to ASTM C 33 and shall be quarried/mined in fresh water. Aggregates from saltwater or brackish water are not permitted. Coarse aggregate size shall not exceed:

Concrete Member	Size

Walls	¾”	67#
Beams or structural slabs not on ground	¾”	67#
Columns and all other concrete	1”	57#
Drilling concrete pad or slabs on ground	1”	57#

5. In sanitary sewage applications, where called for in the plans and/or specifications an antimicrobial admixture as specified below shall be utilized:

   (a) An antimicrobial agent, ConmicShield®, or approved equal, shall be used to render the concrete uninhabitable for bacteria growth.
   (b) Contractor shall mix the liquid antimicrobial additive with the total water content of the concrete mix design in a proportion of 1 gallon per cubic yard. In the case of repairs to damaged concrete a proportion of 2 gallons per cubic yard shall be utilized.
   (c) In some instances, all of the concrete in the structure in will receive the additive and in other instances only a portion of the concrete will receive the additive. Hence, the Contractor shall apply the additive only as directed in the specific instance.
   (d) Contractor shall submit a letter of certification to the OWNER, stating that the correct amount and correct mixing procedure was followed for all antimicrobial concrete.
   (e) ConmicShield® antimicrobial additive shall be as manufactured by ConmicShield® Technologies, Inc. 541 - 10th Street NW, #233, Atlanta, GA 30318. Phone: (877)543-2094.

B. Portland cement and reinforcing steel: Comply with ACI 301-96 and, with all modifications and supplements thereto listed in Part 3 of this specification.
C. Burlap mats: Conform to AASHTO Specification M182. (Burleen non-staining mats.)
D. Epoxy bonding agent: A two (2) component, solvent free, moisture insensitive structural epoxy adhesive conforming to ASTM C881-90 Type II, Sikadur 32 Hi-Mod, as manufactured by Sika Corp., Concresive 1090 Liquid by Master Builders or approved equal.
E. Anchor bolts, nuts and washers: Conform to ASTM A449-89, hot-dip galvanized.
F. Dovetail slots: Galvanized steel, 22 gauge, 1"x 1", with 5/8" throat, fiber filled.
G. Forms:

   1. Plywood Forms: PS-1, B-B Concrete Form, Class I, exterior type, mill oiled and edge sealed. Thickness shall be as required to support concrete at the rate placed, but not less than 3/4".
   2. Steel Forms: Uncoated steel, 3/16"-inch minimum thickness, fabricated to close tolerances, protected only by the specified release agent, braced so as not to dent, bend or dimple under wet concrete loads, vibrator impact and tool impact. Maintain steel forms in rust free condition by use of steel wool and light

grinding, followed by coats of the specified release agent. Forms should be adjustable to be brought into true alignment without steps or ridges.

H. Form release agent:

1. For plywood forms use a natural non-petroleum base, non-staining and non-retarding release agent that will effectively prevent absorption of moisture and prevent bond with concrete and leaves the concrete with a paintable surface.
2. For steel forms, use an approved material that will not stain, color or otherwise affect the finish of the concrete. Form coating shall not be detectable on finished surfaces.
3. Round column forms: Provide seamless fiber forms with the three plies nearest to the interior surface of the form deckled or scarfed and overlapped to minimize spiral gaps or seams on the column surface.

I. Form Ties: Steel rod type with integral waterstops and cones, and with ends or end fasteners that can be removed without spalling the concrete and which leave a hole equal in depth to the required reinforcement clearance, but not less than 2 inches from the formed face of the concrete. Wire tie, banding wire and wood spreaders will not be permitted.

J. Form Inserts:

1. Bevel or chamfer strips: Wood or non-staining plastic, 3/4" wide on each leg at exposed edges of concrete members, unless otherwise noted on plans.
2. Tongue and Groove Joint Forms: Minimum 24 gauge with steel stakes and splice plates. Forms shall be designed for joints not to receive a poured seal.
3. Pipe hangers and other utility supports: AISI Type 316 stainless steel.

K. Non-Shrink Grout: Non-shrink, non-metallic grout conforming to ASTM C 1107 Grade B or Grade C only. Grout must meet ASTM C 1107 at a temperature range of 50 F to 90 F at a flowable consistency.

L. Grout for Surface Repair and Bond Coat:

1. For repair, one-part Portland cement to two parts fine sand, and a 50%of water and 50% Acryl 60 or equal (Thoroseal or Acryl Set Bonding Agent by Master Builders) to produce a stiff mortar.
2. For bond coat, one-part Portland cement to one part sand, and a 50% of water and 50% Acryl 60 or equal (Thoroseal or Acryl Set Bonding Agent) to produce a slurry mix.

M. Moisture Barrier: Kraft paper and glass reinforcing fibers sandwiched between 2 layers of polyethylene film with a permeance rating of maximum 0.1 as per ASTM E-96, Procedure A.

N. Preformed Expansion Joint Filler: Non-extruding type, self expanding cork, 3/4", 1", and 1½" cork (not to be used for sidewalks), conforming to plans or as otherwise noted on drawings, conforming to the requirements of ASTM D1752, Type II, and compatible with joint sealant compound.

O. Joint Sealant Compound: Non-sag, 2 component, solvent free, moisture insensitive, flexible, epoxy resin conforming to the requirements ASTM C920-87 Type M, Grade NS. Additionally, the sealant must be recommended by the manufacturer to perform under continuous immersion in water.

P. Polyurethane Elastomeric Sealant: Sikaflex-2c, NS/SL or approved equal. Provide a 2- component, premium-grade, polyurethane-based, elastomeric sealant. It is principally a chemical cure in a non-sag and self-leveling consistency. Sealant shall meet ASTM C-920 and Federal Specifications TT-S-00227E.

1. Joint Movement: +50%.

Q. Waterstops:

1. Volclay Waterstop-RX or approved equal. Flexible strip of bentonite waterproofing compound in coiled form.

(a) Chemical Composition:

(1) Butyl Rubber-Hydrocarbon: 24.9% by weight; ASTM D-297.
(2) Bentonite: 75 % by weight; SS-S-210-A.
(3) Volatile Matter: Below 1 %; ASTM D-6.
(4) Waterstop shall not contain any asbestos fibers or asphaltics.

(b) Physical Properties:

(1) Specific Gravity: 1.57; ASTM D-71.
(2) Application Temperature Range: 5-125 F.
(3) Flash Point: 365; ASTM D 93-97.
(4) Accelerated Aging: Maintained 99% solids.
(5) Dimensions: 1" x 3/4" x 16'-6"

2. Polyvinyl chloride (PVC): Conforming to the requirements of U.S. Army Corps of Engineers Specification CRD-C-572 and of the following type:

(a) Expansion Joints: 9-inches by 3/8-inch, ribbed center bulb.
(b) Construction Joint: 9-inches by 3/8-inch, flat ribbed.
(c) Only where specified on Plans at construction and expansion joints: 9-inches by 3/8-inch, split ribbed.
(d) Install waterstops as shown as manufactured structures.

R. Mechanical Couplers: Mechanical couplers shall be provided where indicated and where approved by the ENGINEER. Couplers shall develop a tensile strength that

exceeds 125 percent of the yield strength of the reinforcing bars being spliced at each splice.

S. Welded Splices: welded splices shall be provided where indicated and where approved by the ENGINEER. Welded splices of reinforcement steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars that are connected. Materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

T. Fiber Reinforcement: Fiber reinforcement shall not be used in the concrete unless ordered buy the Engineer in writing. It shall consist of 100% virgin polypropylene fibrillated fiber- dosage of 2 lbs. per cubic foot.

1. Compressive Strength: 1 psi (.006895 M Pa), ASTM C-39.
2. Flexural Strength: 288 psi (2.0 M Pa) after 7 days, 390 psi (2.7 M Pa) after 28 days; ASTM C-78.
3. Splitting Tensile Strength: 194 psi (1.3 M Pa) after 7 days, and 290 psi (2.0 M Pa) after 28 days; ASTM C-496.
4. Source: Fibermesh Micro-Reinforcement System by Fibermesh Company, Division of Synthetic Industries, Inc., or approved equal.

U. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

V. A shrinkage reducing admixture (Teraguard) or equivalent at the rate of 2.2% by weight of cement may be used in the concrete to meet the shrinkage limitations.

W. To protect the concrete slab against the elements, the Engineer may direct the Contractor to spray an evaporation retarder on the finished concrete slab immediately behind the cement finishing process at no additional cost to the OWNER. This is not a curing compound.

X. Miscellaneous Materials:

1. Damproofing agent shall be an asphalt emulsion such as **Hydrocide 600** by **ChemRex Sonneborn, Emulsified Asphalt** by **Euclid Chemical Company, Sealmastic** by **W. R. Meadows Inc.**, or equal.
2. Epoxy adhesives shall be the following products:

   (a) For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation, MasterEmaco ADH 326 by BASF/Master Builders; BurkEpoxy MV by Burke by Edoco, or equal.

   (b) For bonding hardened concrete or masonry to steel, Sikadur 31 Hi-Mod Gel by Sika Corporation, BurkEpoxy NS by Burke by Edoco, Concresive Paste (LPL) by Chem Rex MBT; or equal.

(c) Epoxy grout for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in Section 03315 - Grouting.

2.02 CONCRETE DESIGN REQUIREMENTS

A. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. Mix changes shall be subject to review by the ENGINEER.

B. The CONTRACTOR is cautioned that the limiting parameters below are NOT a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability.

C. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

Type of Work	Class of Concrete Min 28-Day Compressive Strength, psi	Max Size Aggregate in	Cement Content Per cu yd, lbs	Max W/C Ratio (by weight)
Structural concrete	4,000	1	564 to 600	0.32
Sitework concrete	3,000	1	470 (min)	0.50
Lean concrete	2,000	1	376 (min)	0.60

Consistency of the concrete in successive batches shall be determined by the slump tests in accordance with ASTM C143. The slumps shall be as follows:

Part of Work	Slump (in
All concrete unless indicated otherwise	3-inches plus or minus 1-inch
Ductbank and pipe encasement	5-inches plus or minus 1-inch

Part 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work.

3.02 SUPPLEMENTAL REQUIREMENTS

A. All phases of concrete construction, including materials formwork, and all other related procedures shall comply with the most stringent allowed tolerances of ACI-301 and ACI-117 Standards (Latest Edition) - Noncompliance with these standards will cause full rejection of any work done.

B. Comply with ACI 301-96 and with all modifications and supplements thereto listed herein. In addition to the ACI Standards on finished concrete, the Engineer will only approve quality finished concrete which in his opinion is ready to receive a grout finish, paint or liquid membrane.

C. The following modifications and supplements to ACI 301-96 shall also apply to the work.

1. General

   (a) These specifications cover cast-in-place structural concrete for use in buildings and appurtenances, including foundations, curbs, sidewalks, concrete pavements and utility structures, water containment tanks, and piles.

   (b) Keep minimum two (2) copies of ACI 301-96 "Specifications for Structural Concrete" in field office at all times.

2. Proportioning and Design of Mixes

   (a) General: Proportion concrete to meet properties as specified. Prepare mix designs for each type and strength of concrete. Submit with mix design the chemical admixture manufacturer's statement that the admixture proposed complies with the requirements of this specification. Where concrete of different strengths are specified for the same location, the higher strength concrete shall be used. Concrete proportions shall be established on the basis of previous field experience, or laboratory trial batches as specified in ACI 301-96 Sections 4.2.2 & 4.2.3.

   (b) Classes of Concrete:

      (1) Structural concrete of normal weight for portions of the structure that are required to be watertight containments or tremie concrete, the water/cementitious ratio shall not exceed 0.45 if exposure is to be to fresh water.

(2) If the concrete is exposed to salt or brackish water, or if exposed to injurious concentrations of sulfate-containing solutions (1500 ppm or more of Sulfate in water) or other chemically aggressive solutions, use Type II cement with Rheobuild 1000 admixture by Master Builders, or approved equal; water/cementitious ratio shall not exceed 0.34.

(3) Other Concrete: (This would be slabs-on-grade, concrete thrust blocks, and miscellaneous concrete). Design shall be High Early Strength (2500-3500 psi compressive in 24 hours). Submit complete mix design data including proportions and sources of all mix ingredients, and the results of time and strength tests representing the mixes proposed for use.

(4) Minimum f'c @ 28 days shall be 4000 KSI with a Water/Cement ratio of 0.45.

(5) Minimum f'c @ 28 days shall be 7000 KSI with a Water/Cement ratio of 0.34.

(c) Slumps:

(1) All structural concrete, pumped concrete and tremie concrete shall contain a High Range Water Reducing Admixture and be designed with a maximum water content of 270 pounds per cubic yard. The initial water slump prior to addition of the High Range Water Reducing Admixture shall be 2-inch maximum. Concrete at point of placement shall not exceed 10-inches. Concrete shall be non-segregating.

(2) Slabs including slabs-on-grade, and all other concrete shall have a maximum water content of 287 pounds per cubic yard and have a 5-inch maximum slump with a water reducer, or water reducer and retarder admixture added.

3. Formwork

(a) Earth cuts are not permitted for forms for vertical surfaces. Footings, grade beams and slab edges shall be formed. Provide moisture barrier under all slabs on grade. Lap 6-inches and tape punctures.

(b) The contractor is responsible for the adequacy of forms and shoring including placing, fill and equipment on roof, and for safe practice in their use and removal. Submit formwork calculations, and shop drawings including shoring and reshoring. In addition, the calculations and shop drawings for formwork, shoring, and reshoring, if required by the Engineer or Building Department, shall be signed and sealed by a Professional Engineer registered in the State of Florida.

(c) Design forms for the loads and lateral pressures resulting from the placement and vibration of concrete and for design considerations, wind loads, allowable stresses, and other applicable requirements of the Florida Building Code.

(d) Provide form facing materials as required by the specified finish of the formed surface. Do not use facing material with raised grain, torn surfaces, worn edges, patches, dents or other defects. No form may be reused more than three times without the OWNER's approval. The maximum deflection permitted of facing materials reflected in concrete surfaces exposed to view is 1/240 of the span between structural members.

(1) Forms shall be free from surface defects, tight to prevent leakage and braced to keep its position and shape when filled with concrete. Adjacent edges and end panels and sections shall be held together to provide accurate alignment and prevent forming ridges, fins, offsets or similar type defects in finished concrete. It shall be tight to prevent loss of water, cement or fines during placing and vibrating concrete. The bottom of the forms placed in continuous straight even footings or slabs shall be watertight to prevent loss of water, cement and fines during placement and vibration of concrete, a gasket may be required by the Engineer under the forms to provide water tightness at the Contractor expense. The Contractor shall not proceed to place forms for concrete work adjacent to or on top of previous placed concrete without the Engineer's approval, if the stripped forms reveals columns, walls or beams are out of level or plumb or there are cold joints or other objectionable work in the opinion of the Engineer. Contractor shall submit to the Engineer for approval, how he intends to correct or remove the defective work promptly at his expense. Contractor shall perform such corrections prior to proceeding to place concrete in the next Section.

(e) Provide positive means of adjustment (wedges or jacks) of shores and struts, and all settlement shall be taken up during concrete placing operation. Brace forms securely against lateral deflection. Do not anchor form bracing to poured concrete floors or make holes in floor.

(f) Provide temporary openings in columns and wall forms to limit the free fall of concrete to five (5) feet. Place such openings at no more than eight (8) feet apart to facilitate placing and consolidation of concrete. Elephant trunks may be used to vertical heights of fifteen (15) feet for tremie and other purposes, if approved by the Engineer. Provide temporary openings at the bottom of wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately before concrete is placed.

Blow formwork entirely clean of all saw dust, dirt, or other items not specifically intended to be a part of the final concrete. Any evidence of non-intended items in the forms is considered sufficient cause to stop concreting operation and/or require removal of concrete placed in such contaminated forms.

(g) Provide inserts, conduits, boxes, sleeves, anchors, ties, bolts, hangers, dowels, thimbles, nailers, grounds and other devices in coordination with other trades.

(h) Set anchor bolts and other embedded items accurately and hold securely until concrete is placed and set. Anchor bolts shall be galvanized and of size and length as indicated on the Contract Drawings. Bolts not sized shall be 3/4-inch diameter.

(i) Insert galvanized dovetail anchor slot in forms, in columns, beams and slabs completely around in-fill masonry panels.

(j) Install wall spools, wall flanges and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.

(k) Do not use pinch bars, wrecking bars or other metal tools against as-cast concrete to wedge forms loose; use only wooden wedges carefully and gradually. Driving shall be accomplished by light tapping.

(l) The Contractor is responsible for the removal of forms and shores. Do not remove forms or shores before the member has attained sufficient strength to support its weight and the loads imposed, nor sooner than listed below

(1) Wall forms: 24 hours
(2) Column forms: 24 hours.
(3) Beam and girder side forms only (not bottom form): 24 hours.
(4) Beam and Girder bottom forms: 7 days minimum unless otherwise approved by the Engineer.
(5) Slab forms: 14 days.
(6) Arch centers: 7 days.
(7) Pan joist forms: 4 days.

4. Reinforcement

(a) Prior to fabrication, submit for review shop drawings showing all fabrication dimensions, bar lists and location for placing of the reinforcing steel and accessories, including spacing of reinforcing, splices (lap, welded, Cadweld and/or mechanically threaded), grade of reinforcing and name of manufacturer. Note all deviations from the Contract Drawings and use the same designation mark as shown on the Contract Drawings where possible.

(b) Reinforcing bars: ASTM A615, Grade 60, deformed bars of USA manufacturer.
(c) Welded wire fabric: ASTM A185, galvanized.
(d) Metal bar supports: CRSI MSP-1, Chapter 3, Class 2, Type B stainless steel protected bar supports.
(e) Coupler Splice Devices: Cadweld, tension couplers capable of developing the ultimate strength of the bar.
(f) Reinforcing steel upon which unauthorized welding has been done, shall be removed and replaced at no additional cost to the OWNER.
(g) Place reinforcing bars to the most stringent tolerances indicated in ACI 301 and ACI 117 (Latest Edition). Tolerances specified in those standards shall govern over any other reference code or standard.
(h) All reinforcement at time concrete is placed, shall be free of mud, oil or other materials that may affect or reduce the bond. Reinforcing with rust or mill scale will not be accepted without cleaning and/or brushing to remove scale and rust.
(i) Support rebar and mesh reinforcing for slabs on grade 1½ inches from top of slab on masonry blocks not less than 4 sq. in., having a compressive strength equal to or greater than the specified strength of the concrete being placed. Space blocks at no more than 4 feet apart each way for rebars, and no more than 3 feet apart for mesh reinforcement.
(j) Support reinforcing off from formwork for columns, walls and beams with stainless steel protected bar supports. Support slab reinforcing on #5 bars, or larger, spaced at no more than 48 inches on center. Space individual high chairs no more than 48 inches apart and support bars shall not exceed 24 inches past outermost chairs.
(k) Overlap welded wire fabric in such a manner that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches or 6 inches, whichever is greater. Do not extend fabric through expansion and/or contraction joints, unless otherwise noted on the Contract Drawings.
(l) The minimum clear distance between parallel bars, both vertical and horizontally, shall not be less than the nominal diameter of the bars, or less than 1½ times the maximum size of the aggregate, or 1-inch in beams, or 1½ inches in columns, whichever is greater. Where reinforcement in beams is placed in two or more layers, the upper layer shall be placed directly above the bars in the bottom layer. Misplacement, misalignment or improper length of dowels shall be sufficient cause to require removal and reconstruction of affected work.
(m) Unless allowed by the Engineer, bending of reinforcing partially embedded in concrete is not permitted. When permitted, bending shall be in accordance with CRSI Manual of Standard Practice.

5. Joints and Embedded Items

(a) Provide premolded expansion joint filler strips of proper width and length as specified in the Contract Drawings. Place ½" expansion joint fillers every 20 feet in straight runs of walkways or sidewalks, at right angle turns and wherever concrete butts into vertical surfaces, unless otherwise noted on the Contract Drawings.

(b) Provide waterstops in all construction joints, unless otherwise indicated on the Contract Drawings.

(c) Join all waterstops at all intersections so that a continuous seal is provided. Center the waterstop in the joint. Hold water stop positively in correct position. In the event of damage to the waterstop, repair the water stop in an acceptable manner. Vibrate concrete to obtain impervious concrete in the vicinity of all joints.

(d) Install waterstop in accordance with instructions of the manufacturer. Prior to use of the waterstop material in the field, submit to the Engineer for approval a sample of each size and shape to be used. Fabricate sample so that the material and workmanship represent in all respects the fittings to be furnished under this Specification.

(e) Place all sleeves, inserts, anchors, and other embedded items prior to placing concrete. Anchors and bolts cast in concrete shall be hot dip galvanized or stainless steel. Where permitted by the Engineer, concrete expansion bolts shall be stainless steel and of the wedge anchor type. Take all necessary precautions to prevent embedded items from being displaced, broken or deformed during concreting operation. Protect drains from intrusion of concrete.

6. Placing

(a) Equipment for mixing and transporting concrete must be clean. Forms shall be thoroughly clean and damp, and reinforcing shall be secured in place. Runaways for transporting concrete shall not rest on reinforcing. When concrete is placed against earth, sprinkle sufficiently before placing.

(b) Deposit of concrete in forms no longer than ninety (90) minutes after the initial design water has been added to the cement and aggregates. Concrete which cannot be so placed shall not be used and shall be wasted. **No additional water shall be added**. No retempering with water is permitted.

(c) In addition to the requirements of ASTM C94, the concrete delivery tickets shall indicate the cement content and water/cement ratio.

(d) During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing. Comply with ACI 305R "Hot Weather Concreting" recommendations.

(e) Do not place concrete in forms unless the water level is below the concrete to be placed, even if it is necessary to maintain the dewatering, or under rain.

(f) Do not place concrete under water except for tremie concrete as called for on the Contract Drawings. Submit for approval plan and details of means and methods for installation of seal tremie concrete prior to commencement of work. Seal concrete which subsequently fails to perform, shall be repaired or replaced at no additional cost to the OWNER.

(g) Place seal concrete under water in the space in which it is to remain, by means of a tremie, a closed-bottom dump bucket of not less than one cubic yard capacity, or other approved method, and do not disturb after it is deposited. Deposit all seal concrete in one continuous pour. Do not place concrete in running water. Design all formwork, to retain concrete under water, to be watertight. Submit shop drawings for the design of formwork and excavation sheeting signed and sealed by a Florida Registered Professional Engineer.

(h) The tremie shall consist of a tube having a minimum inside diameter of ten (10) inches and shall be constructed of sections having tight joints. No aluminum parts which have contact with the concrete will be permitted. The discharge end shall be entirely seated at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper, after which the flow shall be stopped by lowering the tremie. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the work and shall permit it being lowered rapidly when necessary to choke off or retard the flow. The flow shall preferably be continuous and in no case shall be interrupted until the work is completed. Exercise special care to maintain still water at the point of deposit.

(i) When the concrete is placed by means of a bottom dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. The bucket shall then be raised very slowly during the discharge travel; the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Aluminum buckets will not be permitted.

(j) Do not commence pumping, to dewater a sealed cofferdam, until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72 hours after placement of concrete.

(k) Notify Engineer a minimum of 24 hours prior to concreting and request a specific time for observation of reinforcing and formwork for portions of concrete work to be placed. No observation will made by the Engineer until rebar installation for all work to be done and all formwork has been completed and approved by the Contractor's field superintendent. Do not order concrete until all correction and additions indicated by the Engineer have been made. Should the Engineer's observation reveal that work is

improperly prepared and an additional observation will be required, he will so inform the Contractor and all above requirements shall also govern.

7. Repair of Surface Defects

(a) Repair all concrete surface defects, which includes, but not limited to cracks, tie holes (no plastic cones), uneven holes, honeycombs, rough framework and other objectionable conditions deemed unacceptable to the Engineer immediately after form removal. This repair work is to be done for all concrete expose surfaces, liquid applied surface or painted surfaces in or out of the water. Repair all cracks and defects in the concrete floors, beams, joists, columns, and other structural members, roof and walls, to the satisfaction of the Engineer, that may occur up to one year after acceptance of work regardless of the cause. Test unformed, surfaces such as monolithic slabs, for smoothness and verify placement tolerances specified for each surface and finish. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness. Repair unformed surfaces that contain surface defects which affect durability of concrete. Surface defects, as such, include cracking, cracks which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable and rough conditions.

(b) Proprietary compounds for adhesion or as patching ingredients may be used, if approved by the Engineer. All structural repair of surface defects to be made require the approval of the Engineer, as to the method and procedure. Approval of the completed work must be obtained from the Engineer.

8. Finishing of Formed Surfaces

(a) Apply rough form finish to exterior walls below grade not exposed to water.

(b) Apply smooth form finish to exterior and interior walls and columns exposed to water.

(c) Apply smooth form finish to interior walls and underside of floors, stairs and slabs.

(d) In addition to the smooth form finish, apply a grout cleaned finish to concrete walls and surfaces exposed to public view and underside of formed floors, stairs or slabs.

(e) Apply a rubber float grout mix to properly prepared concrete surface, only when approved by the Engineer. Mix shall have one-part Portland cement to two parts fine sand in a 50% water and 50% Acryl #60 (Thoroseal or Acryl Set) mix or Acryl Set by Master Builders. Make a 10' by 10' sample on the concrete wall for the approval of the Engineer. Finished surface shall be a non dusting hard finish, when scratched with a ¼" metal edge.

(f) Finish concrete surface, interior or exterior, below or above water shall include all:

(1) Exposed concrete.
(2) Grout finished concrete.
(3) Painted surface concrete.
(4) Liquid membrane finished concrete shall comply with manufacturer's requirements.
(5) The entire surface of finished concrete shall have a smooth uniform surface, there shall be no offsets, visually bulges, or wavering in the finished surfaces. The joints must be accurately aligned, they cannot be uneven or in or out, a higher and lower, there shall be no fins, projection or unevenness between forms.
(6) If after stripping the forms the Engineer determines that the finished concrete does not comply with any or all of the above requirements, the Contractor shall submit his proposal in writing to the Engineer as to his methods of correcting the work at no added cost to the OWNER, which shall include, but not limited to all grinding of fins, projections, unevenness between joints, form high spots and uneven spots.
(7) In addition to all other requirements, concrete surfaces exposed to public view, irrespective of size, area or location shall be completely clean and free of: (1) Stains of any nature, (2) Parts of forms or other wood of any nature, (3) laitance, (4) "Run-downs" of leaked water from secondary pours, (5) Nails, (6) Strips, (7) Ties and (8) all other extraneous, deleterious materials and/or substances which may affect the finished appearance and condition of exposed concrete. Surfaces not meeting the above requirements are to be repaired and treated at no additional cost to the OWNER.

9. Slabs

(a) Unless otherwise noted on the Contract Drawings, place strips alternately at maximum 20 feet center-to-center and to align with column centerline. Do not place adjacent strips until elapse of twenty-four hours after first strip is placed. Place slabs on grade by the "strip-cast" method. Method to be reviewed by the Engineer. Provide saw-cut joints at maximum 20 feet center-to-center and to align with column center lines within four hours of final finishing.
(b) Provide doweled construction joints where shown on the Contract Drawings.
(c) Provide a hard steel troweled finish, free from trowel marks and irregularities, to slabs and floors.

(d) Provide a light hair-broom finish to exterior slabs and floors exposed to public view. Leave hair-broom lines parallel to direction of the slab drainage.
(e) Provide a stiff bristle broom finish to slabs and floors with slopes greater than 10 percent. Leave broom lines parallel to slope drainage.
(f) Finish exposed edges of slabs, floors and tops of walls with a ¼-inch radius edge unless a chamfer is called for on the Contract Drawings.

10. Curing and Protection

(a) Comply with ACI 305 "Hot Weather Concreting", Chapter 4, with the supplements and modifications to ACI 301 listed herein.
(b) Only concrete water curing for not less than 7 days (24 hours/day continuously) will not be accepted; Burleen mats shall be used in curing. Water cure by ponding or continuous sprinkling covering complete surface with minimum runoff. The application of water to wall may be interrupted for grout cleaning only over the areas being cleaned at the time, and the concrete surfaces shall not be permitted to become dry during such interruption.
(c) Begin all water curing as soon as concrete is set, and concrete will not be damaged. Keep concrete and wall forms wet the first 24 hours. Remove forms as indicated in Formwork, Section 3.02-C.4, and continue with 7-day water curing. Recoat damaged surfaces subject to heavy or surfaces damaged by construction procedures within 3 hours of damage. Method of repair shall be approved by the Engineer.

11. Testing

(a) Testing laboratory will be selected and paid for by the OWNER. Send results of all tests to the OWNER and to the Contractor. The Contractor shall notify the Testing laboratory at least 24 hours before each concrete placing.
(b) Obtain and mold 3 specimens for each fifty (50) cu. yds., or fraction thereof, of each class of concrete placed each day or as directed by the Engineer.
(c) Cure specimens from each sample in accordance with ASTM C31. Record in test report any deviations from this Standard.
(d) Test specimens in accordance with ASTM C39. Test one specimen at twenty-eight (28) days for acceptance and, one specimen at three (3) days and seven (7) days respectively, for information. If one specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded, and the strength of the remaining cylinders shall be considered the test result.

(e) Contractors Superintendent shall color code on a set of structural drawings the extent of days work and date to conform to cylinders test.

(f) Perform slump test at discharge of mixer, one for each strength test in accordance with ASTM C143. In the event slump is excessive, testing laboratory will immediately notify the Contractor's superintendent and the Engineer's representative on site. The Contractor shall then reject all concrete with excessive slump and/or deposit time.

(g) Drying Shrinkage Test: A drying shrinkage test shall be conducted on the preliminary trial batch with the maximum water-cementitious materials ratio used to qualify each proposed concrete mix design using the concrete materials, including admixtures, that are proposed for the project. Three test specimens shall be prepared for each test. Drying shrinkage specimens shall be 4 x 4 x 11 inch prisms with an effective gauge length of 10 inches fabricated, cured, dried, and measured in accordance with ASTM C 157 except with the following modifications:

(1) Specimens shall be removed from the molds at an age of 23 hours ± 1 hour after trial batching, shall be placed immediately in water at 73° F ± 3°F for at least 30 minutes, and shall be measured within 30 minutes thereafter to determine original length and then submerged in lime-saturated water as specified in ASTM C157. Measurement to determine expansion expressed as a percentage of original length shall be taken at age 7 days. The length at 7 days shall be the base length for drying shrinkage calculations (“0" days drying age). Specimens then shall be stored immediately in a humidity-controlled room maintained at 73° F ± 3°F and 50% ± 4% relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be reported separately for 7, 14, and 21 days ±4 hours of drying from “0" day after 7 days of moist curing.

(2) Drying shrinkage deformation for each specimen shall be computed as the difference between the base length (at “0" days drying age) and the length after drying at each test age. Results of the shrinkage test shall be reported to the nearest 0.001 percent. If drying shrinkage of any specimen deviates from the average for that test age more than 0.004 percent, the results for that specimen shall be disregarded.

(3) The average drying shrinkage of each set of test specimens cast in the laboratory from a trial batch as measured at the 21 days drying age shall not exceed 0.036 percent and 0.042 percent at the 28-day drying stage for all concrete.

(4) The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

(5) If the required shrinkage limitation is not met during construction, the Contractor shall take any or all of the following actions at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures, including Tetra Guard AS 20 or approved equal; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

(6) Alkali-aggregate reactivity potential shall be determined in accordance with Appendix XI of ASTM C 33. Aggregates shall be tested in accordance with ASTM C 289 and C295 to determine potential reactivity. Aggregates which do not indicate a potential for alkali reactivity or reactive constituents may be used without further testing. Aggregates which indicate a potential for alkali reactivity shall be further tested in accordance with ASTM C227 or C1105, as appropriate, using a cement containing less than 0.6 percent alkalies. At the discretion of the Engineer, testing in addition to that indicated in Appendix XI of ASTM C33 may be performed on potentially reactive aggregates. Nonreactive aggregates shall be imported if, in the opinion of the Engineer, local aggregates exhibit unacceptable potential reactivity.

12. Evaluation and Acceptance of Concrete

(a) If tests are insufficient or inadequate, test and evaluate by core tests. Failure of any concrete cylinder to meet specified requirements shall be deemed as non- complying and costs of additional tests to determine the adequacy or inadequacy shall be borne by the Contractor. Concrete rejected for any reason is to be removed and replaced, including labor, forms and reinforcing, to meet specifications at no additional cost to the OWNER and no additional time extension.

13. Additional Requirements

(a) Submit shop drawings as required per General Conditions and elsewhere in these specifications. Prime Contractor shall check and approve all shop drawings prior to submission. Do not fabricate any item requiring shop drawings until approval of shop drawings has been granted by the OWNER. Partial shop drawings are not accepted, submit drawings for complete submittal.

(b) Provide precast or cast-in-place reinforced concrete lintels at all masonry openings and sills at all windows. Reinforce to suit loads and span.

Provide minimum 8" bearing at each end and, pour integral with columns where opening abuts columns.

(c) Sidewalks in R.O.W.: Sidewalks shall be poured-in-place concrete slabs and either 4"-thick, or 6”-thick across driveways and within areas that may experience vehicular traffic. Use 3000 psi concrete, with continuous 8" deep thickened slab edges. Isolate walks from vertical surfaces with ½" expansion joint material. Provide ½" expansion bituminous joint material flush with top of concrete slabs at 20 feet on center and tooled joints at 5 feet on center. Tool all open edges to a smooth radius and all edges adjacent to the forms.

END OF SECTION

SECTION 03 60 00 - GROUTING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.

B. Grout provided as a base support for mechanical and electrical equipment shall conform to manufacturer's requirements and the requirements of this section.

C. The following types of grout are covered in this Section:

1. Cement Grout

2. Non-Shrink Grout – Class I (Cement Based)

3. Non-Shrink Grout – Class II (Cement Based)

4. Non-Shrink Epoxy Grout

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

B. ASTM C307 -- Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

C. ASTM C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

D. ASTM C496 – Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.

E. ASTM C579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

F. ASTM C580 – Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

G. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

H. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

I. ASTM C1090 – Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout

J. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Required Submittals:

1. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use.

2. Documentation indicating that the grouts contain no chlorides or other chemicals that cause corrosion.

3. Manufacturer's Safety Data Sheet documenting composition of grouts.

PART 2 -- PRODUCTS

2.1 APPLICATION

A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Motorized equipment over 30 horsepower and equipment under 30 horsepower but subject to severe shock loads and high vibrations	Non-Shrink Epoxy
Casing installation and base plates less than 16 inches in the least dimensions	Non-shrink cement grout
Base plates (larger than 16-inches in the least dimension)	High Strength Non-Shrink
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout

2.2 NON-SHRINK GROUTS

A. General

1. All non-shrink grout shall be cement based unless otherwise noted.

2. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

3. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each non-shrink grout shall be as recommended by the manufacturer for the particular application.

4. The manufacturer's product information shall state the acceptability of the non-shrink grout for the intended purpose and location.

5. Grout shall not contain chlorides or additives that may contribute to corrosion.

6. Grout placed in continuously wet environments or in exterior conditions shall not contain gypsum or calcium salt.

7. Grout shall be formulated to be used at any consistency from fluid to plastic.

8. All cement-based non-shrink grout shall have the following general properties when tested at a fluid consistency, at 28 days:

    a. Meet the requirements of ASTM C1107.

    b. Have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827. The grout when tested shall not bleed or segregate at maximum allowed water.

    c. No shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.

    d. A minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

    e. Minimum tensile splitting strength of 500 psi per ASTM C 496 – Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.

    f. Minimum flexural strength of 1000 psi per ASTM 580 – Standard Test Method for Flexural Strength and Modulus Elasticity of Chemical -Resistant Mortars, Grouts, Monolithic Surfacings, and Plymer Concretes.

9. Environmental and ambient conditions shall be a factor in the selection of non-shrink grout. If a non-shrink grout is to be used in a high sulfate environment, marine environment, high temperature environment, or freeze/thaw environment, the manufacturer's product information shall state the acceptability for each environmental condition.

10. Grout shall be suitable for use in high sulfate environments.

B. Non-Shrink Grout

1. Non-Shrink Grout shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. Non-Shrink Grout shall be **Five Star Grout** by **Five Star Products, Five Star Fluid Grout 100** by **Five Star Products, Sikagrout 212** by **Sika Corporation,** or approved equal.

C. High Strength Non-Shrink Grout

1. High Strength Non-Shrink Grout shall have a minimum 28-Day compressive strength of 10,000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. High Strength Non-Shrink Grout shall be **Five Star High Strength Grout** by **Five Star Products, Sikagrout 428 FS,** or approved equal.

D. Non-Shrink Grout for High Sulfate Environments

1. Non-Shrink Grout for High Sulfate Environments shall have a minimum 28 Day compressive strength of 7000 psi when mixed at a fluid consistency and tested per ASTM C109.

2. Non-Shrink Grout for High Sulfate Environments shall be **Five Star Special Grout 150** by **Five Star Products,** or approved equal..

2.3 NON-SHRINK EPOXY GROUT

A. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents.

B. The manufacturer’s product information shall state the acceptability of the epoxy grout for the intended purpose and location.

C. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

D. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.

E. Non-shrink epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested in accordance with ASTM C531.

F. Non-shrink epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.

G. The effective bearing area shall be a minimum of 85 percent effective bearing area (EBA) in accordance with ASTM C1339, for bearing area and flow.

H. The chemical formulation of the non-shrink epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:

1. Minimum bond strength to concrete of 3000 psi per ASTM C882 modified.

2. Minimum bond strength to steel of 1700 psi per ASTM C882 modified.

3. Minimum flexural strength of 2500 psi per ASTM C580.

4. Minimum tensile strength of 2000 psi per ASTM C307.

J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout** by **Five Star Products, Inc.**, **Masterflow 648** by **BASF Corporation**, **Sikadur 42 Grout-Pak** by **Sika Corporation**, or approved equal.

2.4 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water/cement ratio of 0.45.

2.5 CURING MATERIALS

A. Curing materials shall be as recommended by the manufacturer of prepackaged grouts.

2.6 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.7 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Grout shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with manufacturer’s recommendation The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted by the CONTRACTOR for acceptance by the ENGINEER.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping grout and grout fill. No topping grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff

brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

6. As soon as topping or fill finishing is completed, coat surface with curing compound.

3.4 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 03 70 00 - CONCRETE CURING

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and excessively hot or cold temperatures and maintain with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with requirements specified herein.

1.02 RELATED WORK

A. Section 03300 - Cast-in-Place concrete, Reinforcement, and Formwork

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the contractor shall submit the following:

1. Request for acceptance along with procedures for protection of concrete under wet weather placement conditions.
2. Request for placement along with proposed procedures for hot weather placement.
3. Request for acceptance and proposed materials and procedures for moisture preservation.

1.04 REFERENCE SPECIFICATIONS, COFDES AND STANDARDS

A. Without limiting the generality of other requirements of these specifications all work here under shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. Specifications for Structural Concrete for buildings, ACI 301.
2. Guide for Measuring, Mixing, Transporting, and Placing Concrete, ACI 304.
3. Hot Weather Concreting, ACI 305.
4. Specifications for Sheet Materials for Curing Concrete C171.
5. Specification for Liquid Membrane - Forming Compounds for Curing Concrete, ASTM C309.
6. Federal Specification TT-C-800.

1.05 QUALITY ASSURANCE

A. Curing compound shall not be used on any surface where concrete or other material will be bonded unless the manufacturer certifies that the curing compound will not prevent bond or indicates measures to be taken to completely remove the curing compound from areas to receive bonded applications.

B. Care shall be taken to ensure that curing compounds are compatible with all finish

concrete castings.

PART 2 - PRODUCTS

2.01 CURING COMPOUNDS

A. All materials shall meet the ASTM specifications C309, Type 1-D, Class B or Federal Specification TT-C-800 and shall have a minimum solids content of 30 percent.

PART 3 - EXECUTION

3.01 PROTECTION AND CURING

A. All concrete work shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Protect concrete during the curing period such that the concrete temperature does not fall below the requirements of Section 3.02 - Concrete Temperature. Cure concrete in accordance with paragraph E or paragraph F.

C. When concrete is placed in cold weather as defined in ACI 306, the concrete shall be protected in accordance with requirements of ACI 306, Cold Weather Concreting. When concrete is placed in hot weather as defined in ACI 305, the concrete

D. Concrete shall be protected in accordance with the requirements of ACI 305, Hot Weather Concreting.

E. After placing and finishing, use one or more of the following methods to preserve moisture in concrete:

1. Ponding or continuous fogging or sprinkling.
2. Application of mats or fabric kept continuously wet.
3. Continuous application of steam (under 150 degrees Fahrenheit).
4. Application of sheet materials conforming to ASTM C171.
5. Application of a curing compound conforming to ASTM C309 or Federal Specification TT-C-800. Apply the compound in accordance with the manufacturer's recommendation after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

F. Keep absorbent forms wet until they are removed. After form removal, cure concrete by one of the methods in paragraph E. Frames may be “cracked” within twenty-four hours and kept moist until they are required to be kept in place per Section 03300.

3.02 CONCRETE TEMPERATURE

A. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40 F for more than three successive days, concrete shall be delivered to meet the following minimum temperature immediately after placement:

1. 55 degrees Fahrenheit for sections less than 12 in. in the least dimension.
2. 50 degrees Fahrenheit for sections 12 in. to 36 in. in the least dimension.
3. 45 degrees Fahrenheit for sections 36 in. to 72 in. in the least dimension.
4. 40 degrees Fahrenheit for sections greater than 72 in. in the least dimension.

B. The temperature of concrete as placed shall not exceed these values by more than 20 degrees Fahrenheit.

C. These minimum requirements may be terminated when temperatures above 50 degrees Fahrenheit occur during more than half of any 24-hour duration.

D. Unless otherwise specified or permitted, the temperature of concrete as delivered shall not exceed 90 degrees Fahrenheit.

E. During and following curing, do not allow the surface of the concrete to change temperature more than the following:

1. 50 degrees Fahrenheit in any 24-hr period for sections less than 12 in. in the least dimension.
2. 40 degrees Fahrenheit for sections from 12 to 36 in. in the least dimension.
3. 30 degrees Fahrenheit for sections 36 to 72 in. in the least dimension20 degrees Fahrenheit for sections greater than 72 in. in the least dimension.

F. Cure for at least the first seven days after placement for all concrete except high early strength concrete, for which the period shall be at least the first three days after placement.

1. Alternatively, moisture retention measures may be terminated when:

a. Tests are made on at least two additional cylinders kept adjacent to the structure and cured by the same methods as the structure and tests indicate 70 percent of the specified compressive strength, f'c, as determined in accordance with ASTM C39.
b. The temperature of the concrete is maintained at 50 degrees Fahrenheit or higher for the time required to achieve 85 percent of f'c in laboratory-cured cylinders representative of the concrete in place.
c. The strength of concrete reaches f'c as determined by accepted nondestructive methods or laboratory-cured cylinder

test results.

G. When one of the curing procedures in Paragraph 3.01E is used initially, the curing procedure may be replaced by one of the other procedures when concrete is one day old, provided concrete is not permitted to become surface dry at any time.

END OF SECTION

SECTION 05 50 00 – MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-PRF-907F	Antiseize Thread Compound, High Temperature

B. Commercial Standards

AA-M32C22A41	Aluminum Assn.
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM F 1554	Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS D1.2	Structural Welding Code - Aluminum
ANSI/AWS QC1	Qualification and Certification of Welding Inspectors

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of **Section 01 33 00 - Contractor Submittals**.

B. Shop Drawings

1. Shop Drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the WORK.

2. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

3. Anchors

a. Submit an ICBO report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor.

b. Submit manufacturer's recommended installation instructions and procedures for adhesive anchors. All installations shall strictly follow the manufacturer's recommendations, unless directed otherwise by the ENGINEER.

c. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICBO report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.4 QUALITY ASSURANCE

A. Weld procedures and welder qualifications shall be available in the CONTRACTOR's field office for review. Welding shall be inspected by a CONTRACTOR-furnished, ENGINEER approved, inspector qualified in accordance with AWS requirements.

B. Welding Special Inspection shall be performed by the OWNER in accordance with the enforceable Building Code.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

Product	Standard
Wide Flange Shapes	ASTM A 992
Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless indicated otherwise
HSS	ASTM A 500 Grade B

B. Corrosion Protection

1. Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water or wastewater shall be coated in accordance with the requirements of Section 09 96 00 - Protective Coating, and shall not be galvanized prior to coating.

2. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. Stainless Steel

1. Unless otherwise indicated, stainless steel metalwork and bolts shall be fabricated from Type 316 stainless steel.

D. Aluminum

1. Unless otherwise indicated, aluminum metalwork shall be fabricated from Alloy 6061-T6.

2. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with the requirements of Section 09 96 00 - Protective Coating.

E. Cast Iron

1. Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B, or better.

2.2 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application)

1. Bolts, anchor rods, anchor bolts, washers, and nuts shall be fabricated from steel as indicated.

2. Threads on galvanized bolts, rods and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

3. Except as otherwise indicated, steel for bolt material, anchor rods, anchor bolts, and cap screws shall be in accordance with the following requirements:

a. Structural Connections: ASTM A 307, Grade A or B, hot-dip galvanized

b. Anchor Bolts: ASTM A 307, Grade A or ASTM A 36, hot-dip galvanized

c. High-Strength Bolts, where indicated: ASTM A 325

d. Pipe and Equipment Flange Bolts: ASTM A 193, Grade B-7

e. Wellhead Flange bolts and nuts: Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts

B. Corrosive Service

1. Bolts, anchor rods, anchor bolts, nuts, and washers in the locations listed below shall be fabricated from stainless steel as indicated.

    a. buried locations

    b. submerged locations

    c. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

    d. locations indicated or designated by the ENGINEER to be provided with stainless steel bolts

C. Unless otherwise indicated, stainless steel bolts, nuts, anchor rods, and washers shall be fabricated from Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

D. Buried pipe flange bolts and nuts on pipe of Class 275 and greater shall be in accordance with ASTM A193/A194, Grade B7.

E. Coating

1. Threads on stainless steel bolts and rods shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, meeting government specification MIL-A-907E.

2. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

3. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

4. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology,** Franklin Park, IL, 60131, **AS-470** by **Dixon Ticonderoga Company,** Lakehurst, NJ, 08733, or equal.

F. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts.

3. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.

4. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

5. Bolts and nuts shall be installed with washers fabricated from material matching the base material of bolts, except that hardened washers for high-strength bolts shall conform to the requirements of the AISC Specification.

6. Lock washers fabricated from material matching the bolts shall be installed where indicated.

7. The length of each bolt shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

G. Adhesive Anchors

1. General

a. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors.

b. No substitutions will be considered unless accompanied with an ICBO report verifying strength and material equivalency.

2. Epoxy Anchors

a. Epoxy adhesive anchors are required for drilled anchors for outdoor installations, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring handrails and reinforcing bars.

b. Epoxy shall be in accordance with the requirements of Section 03 60 00 – Grouting.

c. Threaded rod shall be galvanized for general purpose applications and fabricated from Type 316 stainless steel for use in corrosive applications.

d. Epoxy anchors shall not be permitted in areas where the concrete temperature is in excess of 100 degrees F or higher than the limiting temperature recommended by the manufacturer, whichever is lower.

e. Epoxy anchors shall not be used where anchors are subject to vibration or fire.

f. Embedment depth shall be as the manufacturer recommends for the load to be supported.

3. Unless otherwise indicated, glass capsule, polyester resin adhesive anchors will be permitted in locations not included above, and shall be Hilti HVA, Cobra Anchors, or equal.

4. Threaded rod shall be fabricated from galvanized steel.

H. Expanding-Type Anchors

1. Expanding-type anchors, if indicated or permitted, shall be fabricated from galvanized steel, shall be of the expansion type, and shall be **ITW Ramset/Redhead Trubol**t anchors, **Hilti Kwik-Bolt TZ**, or equal.

2. Lead caulking anchors will not be permitted.

3. Size shall be as indicated.

4. Embedment depth shall be as the manufacturer recommends for the load to be supported.

5. Expansion-type anchors that are to be embedded in grout may be fabricated from steel.

6. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

I. Non-Shrink Grouted Anchors

1. Anchors, if indicated or permitted, shall be grouted with a non-shrink cementitious grout in accordance with the manufacturer's recommendations.

2. Embedment depth shall be as the manufacturer recommends for the load to be supported.

3. Non-shrink grout material shall be Class B or C in accordance with **Section 03 60 00 – Grouting**.

J. IMPACT ANCHOR

1. Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force.

2. The pin shall be provided with a zinc sleeve with a mushroom-style head and stainless steel nail pin.

3. Anchors shall be **Zinc Nailon Anchors**, manufactured by **Simpson Strong-Tie, Inc.**, **Metal Hit Anchors,** manufactured by **Hilti, Inc., Rawl Zamac Nailin,** manufactured by the **Rawlplug Company,** or equal.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

3.2 WELDING

A. Method

1. Welding shall be performed by the metal-arc method or gas-shielded arc method as described in the American Welding Society "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. The qualification of the welders shall be in accordance with the AWS Standards.

B. Quality

1. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained in order to minimize distortion and for control of dimensions.

2. Weld reinforcement shall be as indicated by the AWS Code.

3. Upon completion of welding, remove weld splatter, flux, slag, and burrs left by attachments.

4. Welds shall be repaired in order to produce a workmanlike appearance, with uniform weld contours and dimensions.

5. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

3.3 GALVANIZING

A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123.

B. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.

C. Bolts, anchor rods, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

D. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.

2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.

3. The coating shall be applied to at least 3 mils dry film thickness, and shall be **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, **Galvite** by **ZRC Worldwide**, or equal.

3.4 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions.

B. Holes shall be roughened with a brush on a power drill, and then cleaned and dried.

C. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength.

D. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

END OF SECTION

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SECTION 09 96 00 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

8. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating WORK:

1. Manufacturer's Information: For each coating system to be used, the following data:

a. Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

c. Paint manufacturer's instructions and recommendations on surface preparation and application.

d. Colors available for each product (where applicable).

e. Compatibility of shop and field applied coatings (where applicable).

f. Material Safety Data Sheet for each product proposed.

C. Samples

1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the ENGINEER from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER. The color formula shall be shown on the back of each color sample.

D. Experience Requirements of the Field Applicator:

1. Three references which verify that the coating CONTRACTOR has demonstrated successful application of the specified coating system in the past 3 years. Provide the size (area of coating), time of completion, name, the owner’s address, and telephone number for each installation referenced.

2. A written statement from the CONTRACTOR stating that they are qualified and experienced in the application of the specified coating systems. The letter shall state the manufacturer and model number of mixing, heating, and pumping equipment to be used to apply the specified coating systems.

3. A written statement from the manufacturer certifying that the coating CONTRACTOR’s onsite foreman and each applicator performing WORK on the project has been trained and approved to apply the selected coating system.

4. CONTRACTOR shall provide SSPC QP 1 Certification or the manufacturer’s certification of the applicator for the specified coating system.

E. Experience Requirements of the Shop Applicator

1. NACE Coating Inspector Program certification documents for the person responsible for Quality Assurance/Quality Control at the facility. This person will be responsible for submitting inspection reports to the OWNER.

2. A copy of a typical Quality Assurance/Quality Control inspection report containing items listed in 3.18 of this Specification.

3. Three references which verify that the shop painting facility has demonstrated successful application of the specified coating systems in the past 3 years. Provide the structure name and size (area of coating), time of completion, the owner's name, address, and telephone number for each installation referenced.

4. The manufacturer shall provide written certification that the shop painting facility's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system.

5. The manufacturer shall state whether or not it has verified that the CONTRACTOR is going to use the proper mixing, coating application, heating, and environmental control equipment for the specified coating products. Only heated plural component equipment shall be used for the 100% solids coating application. Equipment shall be capable of performing a ratio test.

6. The Shop Coating Applicator shall provide SSPC QP 3 Certification or the coating manufacturer's certification of the applicator for selected coating system.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Inspection: An inspection may be conducted during the eleventh month following completion of coating WORK. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the inspection to another date within the one year correction period or may cancel the inspection altogether. The CONTRACTOR is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Suitability: The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the ENGINEER. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER.

F. Substitute or "Or-Equal" Products

1. To establish equality under Section 01 60 00 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

   a. Minimum and maximum recoat times

   b. Minimum and maximum cure time for immersion

   c. Abrasion resistance per ASTM D4060 using CS17 Wheel

   d. Maximum and minimum dry film thickness per coat

   e. Compatibility with other coatings

   f. Suitability for the intended service

   g. Resistance to chemical attack

   h. Temperature limitations during application and in service

   i. Type and quality of recommended undercoats and topcoats

   j. Ease of application

   k. Ease of repairing damaged areas

   l. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.2 INDUSTRIAL COATING SYSTEMS

A. System 1 - Not Used

B. System 2 - Not Used

C. System 3 - Not Used

D. System 4 - Epoxy/Polyurethane

1. Materials

Primer type	Rust-inhibitive, 2 component epoxy
Finish type	2 component aliphatic polyurethane
Demonstrated suitable for	Ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	**Finish Coat (DFT = 3 - 4 mils)**	**TOTAL SYSTEM DFT**
PPG- Amerlock 400/2	PPG- Amershield	6 - 9 MILS
Carboline Carboguard 893	Carboline Carbothane 134 HG (2 coats)	
Devoe Devran 224V	Devoe Dethane 379H	
Tnemec Hi-Build Epoxoline II Series L69	TNEMEC SERIES 750UVX	
Sherwin Williams Macropoxy 646	Sherwin Williams Hi-Solids Polyurethane	

E. System 5 - Not Used

F. System 6 - Not Used

G. System 7 - Acrylic Latex

1. Material

Primer	Product, surface preparation, and DFT as recommended by manufacturer for the surface
Finish Type	Single component, water based acrylic latex, with fungicide
Demonstrated suitable for	PVC piping, weather and mild chemical resistance, excellent color, and gloss retention

2. Application and manufacturers

Finish (at least 2 coats required)	Total System DFT
PPG- Amercoat 220	Primer plus 6 mils
Carboline Carbocrylic 3359	
Tnemec Series 1028 Enduratone	
Sherwin Williams Metalatex	
Devoe Devcryl 530	

H. System 8 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy, recoatable up to one year
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required

2. Application and manufacturers

Prime Coat (DFT = 4 to 6 mils)	FINISH COAT (DFT = 3 TO 4 MILS)	TOTAL SYSTEM DFT
PPG-Amerlock 400	Amerlock 400	7 to 10 mils
Tnemec Series L69	Tnemec Series L69	
Devoe Devran 224V	Devran 224V	
Carboline Carboguard 888	Carboguard 888	
Sherwin Williams Macropoxy 646	S W Macropoxy 646	

I. System 9 - Not Used

J. System 10 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	As recommended by manufacturer
Finish Type	Single component waterborne acrylic, industrial grade, high molecular weight
Demonstrated suitable for	Concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat (Filler-Sealer)	**Finish Coat (DFT = 5 - 7 mils) (2 or more coats)**	**Total System DFT**
Tnemec EnviroFill 130	Tnemec-Crete 180 Series	5 - 7 mils plus primer
PPG- Amerlock 400BF and Amercoat 114A	Amercoat 220P	
Carboline Sanitile 500	Carbocrylic 3359DTM	
Sherwin Williams Cement Plex 875 (acrylic) and Kem Cati Coat (epoxy)	S W Metalatex	
Devoe Tru-Glaze 4015	Devoe Devcryl 1449	

K. System 11 - Not Used

L. System 12 - Not Used

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	High build, amine cure epoxy
Demonstrated suitable for	Steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 133	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891HS	
International Bar-Rust 233H	
Tnemec Epoxoline Series L69	
Sherwin Williams Macropoxy 646 PW	

B. System 101 - Not Used

C. System 102 - Polyamide Epoxy

1. Materials

Type	High build polyamide cure epoxy
Demonstrated suitable for	Long term immersion in water and wastewater, resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products **(3 coats or more)**	**Total System DFT**
PPG- Amercoat 370	11 - 13 mils
Tnemec Pota-Pox Series 20	
Carboline Carboguard 61	
Sherwin Williams Macropoxy 646 PW for water and Dura-Plate 235 for wastewater	

Devoe Bar-Rust 233H	

D. System 103 - Not Used

E. System 104 - Not Used

F. System 105 - Not Used

G. System 106 - Fusion Bonded Epoxy

1. Material

Type	100 percent solids fusion bond epoxy
Demonstrated suitable for	fluidized bed or electrostatic spray application, recommended for pumps, valves, pipe appurtenances, tanks, pipe hangers, flow meters, and hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

H. System 107 -Not Used

I. System 108 - Not Used

J. System 109 - Not Used

K. System 110 - Not Used

L. System 111 - Not Used

2.4 SPECIAL COATING SYSTEMS

A. System 200 - Not Used

B. System 201 - Rich Portland Cement Mortar: Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.

C. System 202 - Not Used

D. System 203 - Not Used

E. System 204 - Not Used

F. System 205 - Not Used.

G. System 206 - Not used.

H. System 207 - Not Used

I. System 208 - Aluminum Metal Isolation

1. Material

Type	High build polyamide epoxy with chemical and abrasion resistance
Demonstrated suitable for	Concrete and aluminum substrates, to isolate aluminum from contact with concrete and the resulting chemical degradation

2. Application and manufacturers

Coating **(DFT = 16 - 20 mils)**
PPG- Sigma, Novoguard 840
Sherwin Williams Macropoxy 646
Tnemec Epoxoline Series L69
Carboline 890
Devoe Bar-Rust 231

J. System 209 - Not Used

K. System 210 - Not Used

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating WORK.

B. Coating shall be done in a workmanlike manner to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special

attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected using drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations**:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.

B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.

E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.5 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.6 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).

9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.7 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. The Shop Painting Facility shall use a minimum blast material mixture of 75% grit and 25% shot material to achieve the proper surface profile.

C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.

D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.

E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.

F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu g/cm^2$). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate’s surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

I. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

N. If the required abrasive blast cleaning will damage adjacent WORK, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.

O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.

P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.8 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.

B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.9 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed.

B. At the discretion of the Inspector, the Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter (µg/cm2). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

C. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate's surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

D. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is outside the range recommended by the coating manufacturer, then the surface must be neutralized by removing concrete until the surface pH of 7 or greater is obtained prior to any coating application. One pH test shall be performed every 200 square feet, or less, and at locations determined by the Inspector.

E. The Contractor shall test for capillary moisture in accordance with ASTM D4263. Moisture tests shall be taken every 200 square feet or less and at locations determined by the Inspector. If capillary moisture is present, the coating manufacturer shall be consulted to determine primer requirements and special coating application criteria.

F. For below grade structures with surface areas greater than 2,000 square feet, the Contractor shall install three anhydrous calcium chloride test kits on bare concrete to measure the Moisture Vapor Transmission Rate (MVTR) on a flat horizontal surface. Testing and calculations shall be performed according to ASTM F1869. The MVTR shall be less than 3 lbs per 1,000 square feet per 24 hours. If the MVTR is greater than 3 lbs per 1,000 square feet per 24 hours, the Contractor shall apply a concrete sealant to reduce the MVTR through the concrete. The test kits shall be undisturbed for a minimum of 60 hours.

G. Surface Voids: Bugholes, honeycomb, or other surface voids greater than 1/4 inch in depth or 1/4 inch in diameter shall be filled in with a resurfacing mortar prior to the application of any primer or finish coat.

H. Holes or other joint defects in masonry shall be filled with mortar and repainted. All voids and cracks shall be repaired as specified. Loose or spatter mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.

I. Coating Pipe Penetrations: A 1/4-inch wide by 3/8-inch deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

J. Coating Floor/Wall Joints: A 1/4-inch wide by 3/8-inch deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.

K. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP 1 before abrasive blast cleaning.

L. New concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to 80 Grit sandpaper or ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile No. 4.

M. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

3.11 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.

C. Surfaces shall be clean and dry prior to coating application.

3.12 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2.

Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10% of the coating manufacturer's recommended profile. If the surface profile does not meet the manufacturer's recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.

E. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

F. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

G. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.

H. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

I. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.13 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.

B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. CONTRACTOR shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp conditions or wet weather.

4. Wind conditions are not calm.

I. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

J. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.14 CURING OF COATINGS

A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

3.15 SHOP AND FIELD INSPECTION AND TESTING

A. General: The CONTRACTOR shall give the ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Such WORK shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such WORK in its absence.

C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the WORK in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

E. Inspection Devices: The CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the ENGINEER's use while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.

F. Holiday Testing: The CONTRACTOR shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.

1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as **Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20,** or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings with thickness of 20-mils or less total DFT: **Tinker & Rasor Model M1** non-destructive type holiday detector, **K-D Bird Dog,** or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo** or equal, shall be added to the water prior to wetting the detector sponge.

G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ,** or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.16 Coating System Schedule, Ferrous Metal - Not Galvanized

Type	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(4) epoxy/ polyurethane
FM-7	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC SP 5/NACE 1	(102) polyamide epoxy
FM-8	Where indicated, ferrous surfaces in water passages and submerged surfaces of all	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy

	pumps which have discharge size of 4 inches or larger.		
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(106) fusion bond epoxy
FM-11	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC SP 10/NACE 2	(100) amine cure epoxy

3.17 Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated.

Type	Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1	(4) epoxy/ polyurethane

3.18 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames, or hatches. Only primers recommended by the coating manufacturer shall be used.

Type	Item	Surface Prep.	System No.
NFS-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1	(4) epoxy/polyurethane
NFS-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC	(208) aluminum metal isolation
NFS-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC	(7) acrylic latex

3.19 COATING SYSTEM SCHEDULE-CONCRETE

Type	Item	Surface Prep.	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.9	(10) acrylic, concrete

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SECTION 26 00 00 – ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide the electrical WORK, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.

C. The WORK of this Section is required for operation of electrically driven equipment provided under Specifications in other Divisions.

D. The CONTRACTOR'S attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment Specifications, the WORK of instrumentation Sections, and the WORK of Section 26 05 10 – Electric Motors.

E. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various Sections of Division 26 is included as a part of the WORK under the respective Sections, including duct banks, manholes, handholes, equipment housekeeping pads, and light pole bases.

1.2 REFERENCE STANDARDS

NEC (NFPA 70)	National Electrical Code: 2017 Edition
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)

A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory listed on the Occupational Safety and Health Agency (OSHA) website and acceptable to the local code enforcement agency having jurisdiction.

B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

A. Identification

1. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements.

B. Local Disconnect Switches

1. Legibly mark each local disconnect switch for motors and equipment in order to indicate its purpose, unless the purpose is indicated by the location and arrangement.

C. Warning Signs

1. 600 Volts Nominal, or Less

a. Mark entrances to rooms and other guarded locations that contain live parts with conspicuous signs prohibiting unqualified persons from entering.

1.4 PERMITS AND INSPECTION

A. Obtain permits and pay inspection fees according to the General Conditions.

1.5 CONTRACTOR SUBMITTALS

A. General

1. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

2. Custom-prepare Shop Drawings.

3. Drawings or data indicating "optional" or "as required" equipment will not be accepted.

4. Cross out options not proposed or delete from the Shop Drawings.

B. Shop Drawings: Include the following:

1. complete material lists stating manufacturer and brand name of each item or class of material.

2. Shop Drawings for grounding WORK not specifically indicated

3. front, side, rear elevations, and top views with dimensional data

4. location of conduit entrances and access plates

5. component data

6. connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers

7. method of anchoring, seismic requirements, weight

8. types of materials and finish

9. nameplates

10. temperature limitations, as applicable

11. voltage requirement, phase, and current, as applicable

12. front and rear access requirements

13. test reports

14. grounding requirements

C. Catalog Cuts

1. Submit catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material.

2. Stamp the catalog data sheets in order to indicate the Project name, applicable Specifications Section and Paragraph, model number, and options.

D. Materials and Equipment Schedules

1. Within 30 Days of the commencement date in the Notice to Proceed, deliver to the ENGINEER a complete list of materials, equipment, apparatus, and fixtures that are proposed for use.

2. Include in the list the type, size, name of manufacturers, catalog number, and such other information as required to identify the item.

E. Technical Manuals

1. Submit complete information in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

2. As-Built Drawings

a. Prepare as-built drawings, showing invert and top elevations and routing of duct banks and concealed below-grade electrical installations.

b. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

1.6 AREA DESIGNATIONS

A. General

1. Designations for raceway system enclosures shall comply with the requirements of Section 26 05 33 – Electrical Raceway Systems.

2. Designations for electrical WORK specifically indicated in other Sections shall comply with the requirements of those Sections unless indicated otherwise.

3. Designations for other electrical WORK not included in the above Paragraphs shall be as follows, unless otherwise noted:

AREA	NEMA ENCLOSURE CLASSIFICATION					
	1	3R	7	9	12	Notes
Electrical Building Interior					X	

4. Designations for electrical WORK not included in the above Paragraphs shall be NEMA 4X.

B. Material Requirements

1. Construct NEMA 4X enclosures of Type 316 stainless steel.

2. Do not coat NEMA 4X enclosures.

3. Construct NEMA 1, 3R, and 12 enclosures of steel, and prime and coat with ANSI 61 light grey paint.

1.7 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests indicated in Division 26, as required by the ENGINEER, and as required by other authorities having jurisdiction.

B. Furnish necessary testing equipment.

C. Pay the costs of the tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of a faulty installation.

D. Reporting

1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.

2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.

3. Submit field test reports for review prior to Substantial Completion.

E. Remove and replace equipment or material that fails a test, or, if the ENGINEER approves, repair and retest for compliance.

F. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.8 CONSTRUCTION SEQUENCING

A. General

1. Because the continuance of plant operation during construction is critical, the CONTRACTOR shall carefully examine the WORK to be provided in, on, or adjacent to existing equipment.

2. Schedule the WORK, subject to OWNER's approval, to minimize required shutdown time.

3. Submit a written sequencing request, including the sequence and duration of activities to be performed during any shutdown.

4. Switching, safety tagging, and the like, as required for plant shutdown or to isolate existing equipment, shall be performed by the CONTRACTOR.

5. In no case shall the CONTRACTOR begin any WORK in, on, or adjacent to existing equipment without written authorization from the OWNER.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.

2. Perform modifications to existing equipment, panels, and cabinets in a professional manner.

3. Repair coatings to match existing.

4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the WORK.

C. Existing Utilities

1. Exercise extreme caution when digging trenches to not damage existing underground utilities.

2. Repairs for any damage caused during construction shall be performed by the CONTRACTOR at the CONTRACTOR'S own cost.

D. Field Verifications

1. Visit the Site before submitting a Bid to become better acquainted with the WORK of this Contract.

2. The lack of knowledge will not be accepted as justification for extra compensation to perform the WORK.

3. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use.

4. The cost for the above verifications shall be included as part of the WORK.

E. Installation of Temporary Equipment

1. To facilitate the continuous operation of existing equipment, provide the temporary equipment as indicated.

2. Submit installation and connection details for review and acceptance by the ENGINEER.

3. Costs associated with these temporary installations shall be included as part of the WORK.

4. Temporary wiring and equipment shall remain the property of the CONTRACTOR unless indicated otherwise.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Provide equipment and materials that are new and are the products of experienced and reputable manufacturers in the industry.

B. Provide equipment and materials listed by UL and bearing the UL label, where UL requirements apply.

C. Provide similar items in the WORK as products of the same manufacturer.

D. Provide equipment and materials of industrial grade standard of construction.

E. Where a NEMA enclosure type is indicated in a non-hazardous location, use that type of enclosure despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.

F. On devices indicated to display dates, display the year as 4 digits.

G. Temperature Ratings of Equipment Terminations

1. Provide terminations and lugs rated for use with 75-degree C conductors.

2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Provide nuts, bolts, and washers constructed of stainless steel.

2. Provide threaded rods for trapeze supports constructed from continuous threaded stainless steel, 3/8-inch diameter minimum.

3. Struts

a. Construct struts for mounting of conduits and equipment of 304 stainless steel.

b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.

c. Strut Manufacturer, or Equal: **Unistrut**; **B-Line**

4. End Caps

a. Provide plastic protective end caps for all exposed strut ends below 8’ AFF.

b. End Caps Manufacturer, or Equal: **Unistrut, Model P2860**

5. Anchors

a. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings.

b. Wood plugs will not be accepted.

c. Anchor Manufacturer, or Equal: **"Power-Bolt"** or **"Power-Stud"** as manufactured by **Power Fasteners, Inc.**; similar by **Star**.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates

1. Fabricate nameplates from black-letter, white-face laminated plastic engraving stock, such as **Formica Type ES-1** or equal.

2. Securely fasten each nameplate, using fasteners constructed of brass, cadmium-plated steel, or stainless steel, and screwed into inserts or tapped holes as required.

3. Provide engraved characters of the block style, with no characters smaller than 1/8 inch top to bottom.

B. Conductor and Equipment Identification

1. Provide imprinted plastic-coated cloth marking devices, such as manufactured by Brady, Thomas & Betts, or equal.

2. Alternatively, provide heat-shrunk plastic tubing, imprinted split-sleeve markers cemented in place.

PART 3 -- EXECUTION

3.1 GENERAL

A. Incidentals

1. Provide materials and incidentals required for a complete and operable system, even if not required explicitly by the Contract Documents.

B. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items.

2. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions, unless otherwise indicated.

3. Follow the locations on the Drawings, however, as closely as possible.

4. Conduits

a. Provide exposed, concealed or encased routings as indicated, except conceal conduit in finished areas unless indicated otherwise.

b. Size conduits encased in a slab for conduit OD not to exceed 1/3 of the slab thickness. Provide spacing between conduits, center to center, equal to 8 times diameter of conduit, minimum.

5. Placement

   a. Install conduit and equipment in such a manner as to avoid obstructions, to preserve headroom, and to keep openings and passageways clear.

   b. Where exact locations are not indicated, such locations will be determined by the ENGINEER.

   c. If equipment is installed without instruction and must be moved, the cost of moving shall be included as part of the WORK.

   d. Slightly adjust luminaire locations in order to avoid obstructions and to minimize shadows.

6. Circuits

   a. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR'S responsibility to provide lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations indicated.

   b. Provide No. 12 AWG minimum conductor size for power circuits, 3/4-inch conduits minimum for exposed runs and one-inch conduits minimum for encased or direct-buried runs.

   c. Where circuits are combined in the same raceway, derate conductor ampacities in accordance with NEC requirements.

7. Workmanship

   a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer using workers skilled in the WORK.

   b. Coordinate installation in the field with other trades in order to avoid interferences.

8. Protection of Equipment and Materials

   a. Fully protect materials and equipment against damage from any cause.

   b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, paint or other contaminants.

   c. Keep moving parts clean and dry.

   d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

3.2 CORE DRILLING

A. Perform core drilling as required for the installation of raceways through concrete walls and floors.

B. Base the locations of floor penetrations on field conditions.

C. Verify exact core drilling locations based on equipment actually furnished.

D. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities.

E. Repair damage to encased conduits, wiring, and piping as part of the WORK.

3.3 CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.

B. Extend housekeeping pads for equipment, including future units, 4 inches above the surrounding finished floor or grade, and 3 inches larger in both dimensions than the equipment, unless otherwise indicated.

C. Provide concrete housekeeping curbs for conduit stub-ups in indoor locations that are not concealed by equipment enclosures. Extend housekeeping curbs to 3 inches above the finished floor or grade.

3.4 EQUIPMENT ANCHORING

A. Manufacturer's Recommendations

1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract.

2. Submit such recommendations as Shop Drawings as indicated.

3.5 EQUIPMENT IDENTIFICATION

A. Provide nameplates for panelboards, control and instrumentation panels, starters, switches, and pushbutton stations.

B. In addition to nameplates, equip control devices with standard collar-type legend plates.

C. Identify control devices within enclosures as indicated and similar to the subparagraph above.

D. Provide suitably inscribed finish plates for toggle switches that control loads out of sight of switches and for multi-switch locations of more than 2 switches.

E. Use equipment names and tag numbers, where indicated, on nameplates.

F. Provide typewritten circuit directories for panelboards that accurately reflect the loads supplied from each circuit.

G. Terminal Blocks

1. Label termination points on terminal blocks by identifiers on the blocks.

2. Provide identifiers that have been preprinted by the terminal manufacturer or custom-printed.

3. Hand-lettered markers will not be accepted.

3.6 CLEANING

A. Before final acceptance, thoroughly clean the electrical WORK of cement, plaster, and other materials.

B. Remove temporary tags, markings, stickers, and the like.

C. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.

D. Apply touch-up paint to scratches on panels and cabinets.

E. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets.

F. Properly dispose cleaning debris and refuse off-site.

END OF SECTION

SECTION 26 01 26 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein, and functional testing of power and controls not tested under Division 40 - Instrumentation, shall be completed before commencement of the 7 Day demonstration test of Section 01 75 00 – Equipment Testing and Plant Startup. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.

C. The requirements of Section 26 00 00 - Electrical Work, General - apply to the WORK of this Section.

D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

E. Testing shall be performed by NETA certified technicians employed by NETA accredited, independent third party testing company.

1.2 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American National Standards Institute (ANSI)

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

D. IEEE 400- (Latest version at the time of Bid), Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

E. IEEE 576- (Latest version at the time of Bid), Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

F. InterNational Electrical Testing Association (NETA)

G. NFPA 70, National Electrical Code (NEC)

1.3 SUBMITTALS

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

B. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section.

3. Detailed comprehensive testing schedule including:

a. Duration of each test.

b. Milestone test completion date.

c. Ambient Conditions at time of test

d. Date of test results submittals following completion of the tests.

e. Names and qualifications of the individual(s) responsible for performing the testing.

C. Following completion of the test, submit the completed test results to the ENGINEER for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

D. Test result shall be submitted in one submittal

E. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

1.4 COMMISSIONING

A. Commissioning during the 7 Day test in Section 01 75 00 shall not be attempted until all subsystems have been found to operate satisfactorily. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable.

PART 2 -- TESTING & REPORTS

2.1 PRE-ENERGIZATION AND OPERATING TESTS

A. The portion of the electrical system included in the WORK shall be performance tested when first installed on-site. The pump motor starter settings shall be adjusted using manufacturer-furnished motor starting current and rated load current characteristics. Test the circuit using current injection to ensure that the circuit operates correctly.

1. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.

2. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.

3. Acceptance Tests. Complete acceptance tests shall be performed, after the installation is complete, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.

B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be submitted. Acceptance Testing shall be in accordance with NETA ATS-2017, *For Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

2.2 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

2. Low Voltage Cables-600 volts Maximum

a. Visual and Mechanical Inspection

1) Compare cable data with drawings and specifications.

2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

3) Inspect bolted electrical connections for high resistance using one of the following methods:

a) Use of low-resistance ohmmeter

b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS- 2017, Table 100.12.

4) Inspect compression-applied connectors for correct cable match and indentation.

5) Inspect for correct identification and arrangements.

6) Inspect cable jacket insulation and condition.

b. Electrical Tests

1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.

a) Motor feeders tested with motors disconnected and controller open.

b) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.

c) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid-state device.

d) Equipment which may be damaged during this test shall be disconnected.

e) The Engineer shall be consulted if minimum insulation values cannot be obtained.

2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3) Perform continuity test to insure correct cable connection.

c. Test Values – Visual and Mechanical

1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels should be in accordance with NETA ATS-2017, Table 100.12 unless otherwise specified by the manufacturer.

d. Test Values – Electrical

1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS-2017 Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3) Cable shall exhibit continuity.

4) Deviations in resistance between parallel conductors shall be investigated.

3. Test ground interrupter (GFI) receptacles for proper operation by methods sanctioned by the receptacle manufacturer.

4. A functional test and check of electrical components is required prior to performing testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

a. Visual and physical check of cables, starters, circuit breakers, control panels, and connections associated with each item of new and modified equipment.

b. Setting of motor starter settings in conformance motor current characteristics.

5. Complete ground testing of grounding electrodes per requirements below prior to operating the equipment.

B. Well pump testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. Alarm conditions shall be simulated for each alarm point, and alarm indicators shall be checked for proper operation. Adjust limit switches and level switches to their operating points prior to testing and set pressure switches, flow switches, and timing relays as dictated by operating results.

C. Metering and indication lights for motors and other devices shall be tested for proper operation.

D. All control circuits such as motor, interlock and remote shall be tested for proper operation.

E. After initial settings have been completed, the well pump shall be operated in the manual mode and it shall be demonstrated that operation and safety interlocks are in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence and safety interlock operation. Coordinate this effort with the WORK in Section 40 91 00 – Process Controls and Instrumentation System.

F. Provide ground resistance tests on the well pump grounding system in the presence of the ENGINEER and submit results.

1. Visual and Mechanical Inspection

a. Verify ground system is in compliance with drawings and specifications.

2. Electrical Tests

a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the well pump grounding electrode or system.

b. Perform point-to-point tests to determine the resistance between the well pump grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

3. Test Values

a. The resistance between the well pump grounding system and ground shall be no greater than five ohms unless otherwise specified by the owner.

b. Investigate point-to-point resistance values which exceed 0.5 ohm.

2.3 TEST REPORTS

A. The test report shall include the following:

1. Summary of project.

2. Description of equipment tested.

3. Description of test.

4. Test data.

5. Analysis and recommendations.

B. Test data records shall include the following minimum requirements:

1. Identification of the testing organization.

2. Equipment identification.

3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.

4. Date of inspections, tests, maintenance, and/or calibrations.

5. Identification of the testing technician.

6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

7. Indication of expected results when calibrations are to be performed.

8. Indication of “as-found” and “as-left” results.

9. Sufficient spaces to allow all results and comments to be indicated.

C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

PART 3 -- TEST RECORD SHEETS

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power, Control Wire, and Cable) Test Record
2	Insulation Resistance (Instrument Wire and Cable) Test Record
3	Ground Electrode Testing Test Record
4	Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record
5	Bonding Resistance Readings (Electrical Equipment) Test Record
6	Insulation Resistance (Rotating Equipment) Test Record
7	Equipment Absorption Ratio and Polarization Index Test Record
8	460 V Motor Circuit (480 V Pump Control Panel) Test Record
9	Electric Motor Run-In Test Record

Sheet 1

INSULATION RESISTANCE
(POWER, CONTROL WIRE, AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: ___ ºC _____ ºF DATE: _____

NOTES:
1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.
2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.
3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Panel No.		Cable	Wire or Cable	Insulation				
Circuit No. Feeder No.	Wire Tagging	Rated Voltage	Quantity	Size	From	To	Resistance (megohms)*	Initials

*Minimum acceptable values:

Cable Rated Voltage	Test Duration	Resistance for Cable Only	Cable/Wire Size or Amperage (megohms)	Resistance When Cable Connected to Equipment (ohms)

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 2

INSULATION RESISTANCE
(INSTRUMENT WIRE AND CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____

NOTES:
1. Record only the lowest value.
2. MP - Multi-pair cable. SP - Single pair cable.
3. Megger with instruments disconnected.
4. Use 250 volt (or lower voltage, when specified) range on DC test set.
5. Readings will vary with temperature and cable length.*

Cable Number or Instrument Number	Indicate MP or SP Type (2)	Conductor to Conduit (Single Pair Non-Shielded Cables) (megohms)	Conductor to Conductor (megohms) (1)	Shield to Conductor to Shield (megohms) (1)	Overall Shield to Shield (Multipair Cables Only) (megohms) (1)	Lead and Armor (Multipair Cables Only (megohms)	Shield to Conduit (Single Pair Cables Only) (megohms)	Initials

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 3

GROUND ELECTRODE TESTING
TEST RECORD

TEST EQUIPMENT: _____ _____
(Note 1) (Note 2)

REFERENCE DRAWING: _____ _____

NOTES: 1. Record resistance-to-earth for each electrode with all other conductors disconnected. Resistance not to exceed 25 ohms for any single anode.

2. Check continuity from each electrode to any test bar or other electrode such that the complete ground loop is tested.

Rod Number	Resistance to Earth (ohms)	Ambient Temperature (ºC/ºF)	Weather	Taps (□)	Initials/Date

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 4

BONDING RESISTANCE READINGS
(NONELECTRICAL EQUIPMENT/STRUCTURES)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.

2. Measure resistance from ground wire tap (or anchor bolt) to tagged equipment frame or structural steel.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 5

BONDING RESISTANCE READINGS
(ELECTRICAL EQUIPMENT)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.

2. Measure resistance from ground wire tap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 6

INSULATION RESISTANCE (ROTATING EQUIPMENT)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____

EQUIP. TEMP., IF KNOWN: _____ ºC _____ ºF HOW KNOWN: _____

NOTES:
1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. Test duration shall be 1 minute, note if otherwise: _____.
3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.
4. Document testing of low voltage and medium voltage equipment on separate sheets.
5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Equipment Tag No.	INSULATION RESISTANCE (megohms) *						Rated Voltage	Equipment Initial/Date
	∅A to G	∅B to G	∅C to G	∅A to ∅B	∅B to ∅C	∅C to ∅A		

*Minimum acceptable values:

VOLTAGE CLASS	RESISTANCE (megohms)

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 7

EQUIPMENT ABSORPTION RATIO AND POLARIZATION INDEX TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: _____ ºC _____ ºF DATE: _____

EQUIP. TEMP., IF KNOWN: _____ ºC _____ ºF REL. HUMIDITY: _____

NOTES: 1. Perform test as indicated on Test Records for each individual equipment type. Reference the following sheets:

Transformers	8
Equipment	9
Motors and Generators	10

2. Absorption Ratio = $\frac{\text{1-Minute Resistance Value}}{\text{30-Second Resistance Value}}$

3. Polarization Index = $\frac{\text{10-Minute Resistance Value}}{\text{1-Minute Resistance Value}}$

OHMS TO GROUND 30-SECOND READING ∅A TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅A TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅A TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅B TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅B TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅B TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX
OHMS TO GROUND 30-SECOND READING ∅C TO GROUND	OHMS TO GROUND 1-MINUTE READING ∅C TO GROUND	OHMS TO GROUND 10-MINUTE READING ∅C TO GROUND	DIELECTRIC ABSORPTION RATIO	POLARIZATION INDEX

TESTER'S INITIALS/DATE _____

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 8

460 V MOTOR CIRCUIT (480 V PUMP CONTROL PANEL) TEST RECORD

EQUIPMENT DESIGNATION			
MOTOR TAG NO.		VOLTAGE	F.L.A.
KW/HP		RPM	S.F.
CIRCUIT BREAKER MFG.		RATING	SETTING
STARTER MFG.		SIZE	O/L HTR. SIZE
C.T. RATIO		O/L RELAY SETTING	
CONDUCTOR SIZE	POWER	GROUND	

1. Check motor starter for cleanliness. _____

2. Check nameplate data and tagging of motor starter components for conformance to approved vendor drawings. _____

3. Check conduits and/or cables for correct tagging. _____

4. Check equipment and installation for conformance to area classification. _____

5. Check main and auxiliary contacts of breaker and contactors. _____

6. Manually check mechanical operation of breaker, contactor, O/L relay, and O/L reset device. _____

7. Check continuity of power and control cables. _____

8. Complete functional operation check of the motor control circuit using the contract drawings and approved vendor drawings. Close and open the starter using all control devices. _____

9. Verify proper operation of motor winding space heater unit. _____

DISTRIBUTION:

CONTRACTOR/Date _____

Sheet 9

ELECTRIC MOTOR RUN-IN
TEST RECORD

TEST EQUIPMENT: _____ REFERENCE DRAWING: _____

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
RESISTANCE: Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
VOLTAGE: Actual voltage measured at Motor Control Center. _____ volts		
ROTATION CHECK: Bump motor to verify rotation. Motor to be uncoupled.		
NO LOAD CURRENT: At beginning of test _____ amps At end of test _____ amps		
TEMPERATURE OF BEARING: Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
VIBRATION: Make visual inspection during run-test. Record any unusual vibration in remarks column.		
NOISE: Record any unusual noise in remarks column.		

DISTRIBUTION:

CONTRACTOR/Date _____

END OF SECTION

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SECTION 26 05 10 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance to the Contract Documents.

B. The provisions of this Section apply to low voltage, AC squirrel cage induction motors throughout the Contract Documents, except as indicated otherwise.

C. The CONTRACTOR shall assign, to the equipment supplier, the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00- Contractor Submittals.

B. Complete motor data shall be submitted with the driven machinery Shop Drawings. Motor data shall include:

1. Machine name and specification number of driven machine
2. Motor manufacturer
3. Motor type or model and dimension drawing. Include motor weight.
4. Nominal horsepower
5. NEMA design
6. Enclosure
7. Frame size
8. Winding insulation class and temperature rise class
9. Voltage, phase, and frequency ratings
10. Service factor
11. Full load current at rated horsepower for application voltage
12. Full load speed
13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.
14. Type of thermal protection or overtemperature protection, where included

15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable

16. Bearing data. Include recommendation for lubricants of relubricatable type bearings.

17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding details and information. Provide insulated bearing details and information.

18. Power factor at 1/2, 3/4 and full load.

19. Recommended size for power factor correction capacitors to improve power factor to 0.95 percent lagging when operated at full load.

C. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electric motors driving identical machines shall be identical.

B. Maximum motor loading shall be equal to nameplate horsepower rating or less, exclusive of service factor and shall be verifiable from the submittal data of the driven machinery.

C. Motor Capacity

1. The CONTRACTOR shall size motors for the larger of the following criteria:

a. Size motors to continuously carry the maximum load that develops across the full range of driven equipment operation.

b. Size motors for minimum size indicated

2. In every case, motor size shall be derated from nameplate values as follows:

a. Ambient Temperature

1) For ambient temperatures up to but not exceeding 40 degrees C, no derating is required.

2) For ambient temperatures exceeding 40 degrees but less than 50 degrees C, derate nameplate HP ratings to 85 percent.

b. Site Altitude: No derating is required for altitudes less than 3300 feet (1000 meters). Higher altitudes require the following derating factors:

Altitude	Derating Factor

3,300 to 5,000 ft	97 percent
5,001 to 6,600 ft	94 percent
6,601 to 8,300 ft	91 percent
8,301 to 9,900 ft	88 percent
9,901 to 11,500 ft	85 percent

3. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the WORK.

D. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

A. General: Electric motors shall comply with NEMA MG-1 - Motor and Generator. Motors used with adjustable frequency drives shall comply with NEMA MG-1, Part 31, and shall be clearly identified as “Inverter Duty.”

B. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated or required by the driven equipment. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. Motor Voltage Ratings: Low voltage motors shall have voltage ratings in accordance with the following, unless otherwise indicated:

1. Motors below 1/2 HP shall be rated 115 volts, single phase, 60 Hz. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.

2. Motors 1/2 HP and larger shall be rated 460 volts, 3 phase, 60 Hz. Dual voltage motors rated 230/460 volts are acceptable, provided every lead is brought out to the conduit box.

D. Insulation: Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer’s written instructions.

E. Motors shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 unless otherwise indicated.

F. Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.

G. Motors larger than 50 HP installed outdoors shall be provided with 120 volt AC space heaters, wired to a terminal strip in a low voltage motor junction box. If provided by the manufacturer when not specified, the manufacturer shall not require that they be connected or the CONTRACTOR shall connect them at no extra cost to the OWNER, in order to keep the warranty in force.

H. NEMA Premium Efficiency Motors

1. Motors with a nameplate rating of 1 HP and larger shall be NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

2. Efficiency: Nominal efficiency and minimum efficiency shall be defined in accordance with the following tables. Both efficiencies shall be included in the Shop Drawing submittal.

OPEN DRIP-PROOF (ODP)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2	85.5	82.5	86.5	84.0	87.5	85.5
3	85.5	82.5	89.5	87.5	88.5	86.5
5	86.5	84.0	89.5	87.5	89.5	87.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.8	95.0
300	95.4	94.5	95.8	95.0	95.8	95.0
350	95.4	94.5	95.8	95.0	95.8	95.0
400	95.8	95.0	95.8	95.0	--	--
450	96.2	95.4	96.2	95.4	--	--
500	96.2	95.4	96.2	95.4	--	--

Source: NEMA MG1 - 2011, Table 12-12

TOTALLY ENCLOSED - FAN COOLED (TEFC)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	--	--
450	95.8	95.0	96.2	95.4	--	--
500	95.8	95.0	96.2	95.4	--	--

Source: NEMA MG1 - 2011, Table 12-12

I. Two speed motors shall be of the 2 winding type.

2.3 ACCESSORY REQUIREMENTS

A. General: Horizontal motors 3 HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Where conduit sizes indicated do not match the motor terminal box, the CONTRACTOR shall provide means to accommodate the motor requirements. Motor boxes other than open drip-proof shall be gasketed.

B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. Special Requirements: The CONTRACTOR shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.

D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

E. Nameplate: Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40. Inverter duty motors shall be clearly identified as such.

F. Where motors are indicated by elementary schematics or specifications to have zero speed switches, the switches shall be factory mounted integral to the motors. Switches shall close the contacts when the motor is at zero speed.

G. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be manufactured by Aegis, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.

2.4 MOTOR THERMAL PROTECTION

A. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.

B. Thermostats: Where indicated or specified, winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Install normally open thermostat in each each winding and wire in parallel. The thermostat switch point shall be precalibrated by the manufacturer. All inverter duty motors shall be provided with winding thermostats, unless RTDs are specified. All explosion-proof motors shall be provided with winding thermostats.

2.5 MOTOR BEARINGS

A. General: Bearings shall conform to Section 46 01 00 - Equipment General Provisions, except as indicated herein.

B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

C. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with lubricated-for-life ball bearings.

D. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve, and, (where subject to freezing), insulation with heat tracing.

G. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

2.6 MANUFACTURERS, OR EQUAL

A. U.S. Motors/Nidec

B. Baldor

C. WEG

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment. Shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer’s recommendations.

B. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

3.2 FACTORY TESTING

A. Motors rated 100 HP and larger shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.

3.3 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests (see also Section 26 01 26 – Electrical Testing):

1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.

6. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

SECTION 26 05 19 - WIRE AND CABLING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide wire and cable, complete and operable, in accordance with the Contract Documents.

B. In the event that motors provided are larger horsepower than the motors indicated, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the larger motor, and to limit voltage drop on the motor branch circuit to no more than 3 percent. Revisions are part of the WORK of this Section.

1.2 ACTION SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with Sections 01 33 00 – Contractor Submittals and 26 00 00 – Electrical Work, General. Submit cable test results in accordance with this Section as well as Section 26 01 26 – Electrical Tests.

B. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

1.3 DELIVERY, STORAGE AND HANDLING

A. The CONTRACTOR shall protect all cables from damage at all times.

B. Cable ends shall be protected from water entry in accordance with the manufacturer's recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become submerged prior to splicing or termination, the cables shall be replaced in their entirety.

C. Cables shall be pulled into raceways in accordance with the manufacturer's requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer's written instructions.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. Conductors, including grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the 2017 National Electric Code for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

B. Low Voltage Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for power and lighting circuits shall be single conductor, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any power or control wiring in this project.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600 volt class power and lighting shall be as manufactured by **Okonite**, **General Cable**, **Southwire**, or equal.

C. Low Voltage Control Wire

1. Low voltage control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by **American, General Cable,** or equal.

D. Instrumentation Cable

1. Instrumentation cable shall be rated at 600 volts.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-clear for 2 conductor cable and black-red-clear for 3 conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 or larger AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.047-inches.

4. Single pair, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8719,** similar by **General Cable,** or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8618,** similar by **General Cable,** or equal.

E. Low Voltage Power and Control, Multi-Conductor/Tray Cable

1. Multi-conductor tray cable shall be rated 600 volts, listed by UL as Type TC cable per Article 336 of the NEC. The individual conductors shall be UL listed as Type XHHW or XHHW-2, with a sunlight-resistant PVC overall jacket.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Minimum conductor sizes shall be the same as for power and lighting wire and control wire as specified above.

5. Multiple conductor power cables include the following:

Phase Conductor Size (AWG)	**Minimum Ground Wire Size (AWG)**	**No. of Conductors (not incl. Ground)**
12	12	2 3
10	10	2 3
8	10	3
6	8	3
4	6	3
2	6	3
1/0	6	3
2/0	4	3
4/0	4	3

6. Multi-conductor control cables include the following:

Conductor Size (AWG)	No. of Conductors (Including 1#14 AWG Ground)
14	3
14	4
14	5
14	7
14	9
14	12
14	19
14	37

F. Cable Terminations

1. Where cable lugs are required for power cable terminations, utilize compression lugs – **3M** Scotchlok 30000 and 31100 Series, **Penn Union** HBBLU and BLU, **Burndy** Hylug, or equal. Utilize compression tools as recommended by the manufacturer. Pressure type, twist-on connectors (wire nuts) will not be acceptable.

2. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or equal.

3. General purpose insulating tape shall be **Scotch No. 33**, **Plymouth Slip-knot**, or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M,** or equal.

4. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **W.H. Brady, 3M**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall provide, terminate and test all power, control, and instrumentation conductors.

B. The CONTRACTOR shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.

C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.

D. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

E. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.

3.2 FIELD ASSEMBLY

A. General

1. Splices are not accepted, except where specifically indicated on the drawings.

2. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

3. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin, and be neatly coiled.

B. Control Wire and Cable

1. Control conductors shall be terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

3. The CONTRACTOR shall provide as a minimum the number of control wires listed in the conduit schedule or as indicated in the Contract Documents. Excess wires shall be treated as spares.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4 - 20 mA system.

D. Power Wire and Cable

1. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

E. Cable Identification

1. General: Wire and cable shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall be installed at every termination and pull point.

2. Identification Numbers: The CONTRACTOR shall assign to each control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals. "Control and Instrumentation Conductors" shall be defined as any conductor used for control, interlock, alarm, annunciator, or signal purposes.

   a. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. The cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at

pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

b. 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 120/240-volt system conductors shall be color coded as follows: Line 1 - Black, Line 2 - Red, and Neutral - White. The 480/277-volt system conductors shall be color coded as follows: Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs. Color coding tape shall be used where colored insulation is not available. Colored identification tape may be used on conductors between the local disconnect and the load, where permitted by the NEC. Any phase changes necessary for proper rotation shall be made at the driven equipment where colored insulation is used. Phase changes may be made on the load side of the local disconnect, where phase colors are identified using tape.

c. General purpose AC control cable shall be red. General purpose DC control cable shall be blue.

d. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

e. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.3 FIELD QUALITY CONTROL

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01 33 00 – Contractor Submittals, prior to shipment of cable. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests) shall be the minimum requirements:

1. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.

2. Field testing shall be done after cable is installed in the raceways.

3. Field megger testing may be performed by the CONTRACTOR or a NETA-certified test organization. When tested by the CONTRACTOR, submit test equipment calibration sheets prior to performing any field testing. Test results shall be submitted to the ENGINEER for review and acceptance.

4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cable in service.

END OF SECTION

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SECTION 26 05 26 – GROUNDING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide the electrical grounding system, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 ACTION SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals and Section 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Shop Drawings

1. Submit manufacturer's product information for connectors, clamps, and all grounding system components, showing compliance with the requirements of this Section.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

B. Grounding System

1. Grounding loop conductors shall be bare annealed, tin-plated copper conductors.

2. Conductors shall be No. 4/0 unless indicated otherwise.

3. Ground Rods

   a. Unless indicated otherwise, provide ground rods minimum of 3/4 inch in diameter, 10 feet long, and with a uniform covering of electrolytic copper metallically bonded to a rigid steel core.

   b. Provide corrosion-resistant copper-to-steel bond.

   c. The rods shall conform to UL 467.

   d. The rods shall be of the sectional type, joined by threaded copper alloy couplings.

4. Make buried, concrete-encased, or otherwise inaccessible cable-to-cable and cable-to-ground rod connections using irreversible compression connectors or exothermic welds by **Cadweld, Thermoweld,** or equal.

5. Exposed Connectors

   a. Exposed grounding connectors shall be of the compression type (connector-to-cable), constructed of high-copper alloy, and manufactured specifically for the particular grounding application.

   b. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

6. Use grounding clamps to bond each separately-derived system to the grounding electrode conductors.

7. Equipment Grounding Circuit Conductors

   a. The conductors shall be the same type and insulation as the load circuit conductors.

   b. The minimum size shall be as indicated. Where not indicated, sizes shall conform to Table 250.122 of the National Electrical Code.

   c. Metallic conduit systems shall have an equipment grounding wires as well as being equipment grounding conductors themselves.

8. Grounding Materials Manufacturer, or Equal

   a. Copperweld

   b. Thermoweld

   c. Burndy

   d. Thomas and Betts

   e. OZ Gedney

PART 3 -- EXECUTION

3.1 PREPARATION

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Provide a supplemental ground connection for motor shaft grounding rings, where applicable.

C. Do not use bolts for securing the motor box to the frame or the cover for grounding connectors.

D. Sizes shall be as indicated on the Conduit Schedule and in accordance with NEC Article 250.

E. Route the conductors inside the raceway.

F. Provide a grounding-type bushing for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.

G. Individually bond the raceway to the ground bus in the secondary section.

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

I. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.

J. Provide the duct bank ground system as indicated, including trenching, splices, ground rods, and connections to equipment and structures.

K. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system. Provide additional grounding system testing in accordance with Section 26 01 26 – Electrical Tests.

L. Embedded Ground Connections

1. Underground and grounding connections embedded in concrete shall be UL-listed ground grid connectors.

2. The connection shall be made in accordance with the manufacturer's instructions.

3. Do not conceal or cover ground connections until the ENGINEER or an authorized representative has established that every grounding connection conforms to the requirements of the Contract Documents and has given the CONTRACTOR written confirmation.

M. Ground Ring

1. Furnish trenching and materials as necessary to install the ground ring as indicated.

2. The bonding conductor shall be in direct contact with the earth and of the indicated size.

3. Provide a minimum burial depth of 36 inches or as indicated on the Drawings, whichever is greater.

4. Re-compact disturbed soils to their original density in 6-inch lifts.

N. Duct Bank Ground

1. Embed a grounding conductor in every duct bank as indicated. The ground conductor shall be terminated at the ground grid at each end of the duct bank. Where no ground grid is installed, terminate at a suitable grounding electrode conductor near the end of the duct bank in accordance with the NEC.

O. Ground Rods

1. Provide ground rods at the indicated locations.

2. A single electrode that does not have resistance-to-ground of 5 ohms or less shall be augmented by additional electrodes to obtain this value.

3. Take the resistance-to-ground measurement during dry weather, a minimum of 48 hours after a rainfall.

4. Rods forming an individual ground array shall be equal in length.

P. Instrumentation Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless the approved Shop Drawings indicate that the shield will be grounded at both ends.

2. The grounding point shall be at the control panel or at the receiving end of the signal carried by the cable.

3. The termination of the shield drain wire shall be on its own terminal screw.

4. Jumper together the terminal screws, using manufactured terminal block jumpers or a No. 14 green insulated conductor.

5. Connect the ground bus via a green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 26 05 33 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals, and Section 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

B. Shop Drawings

1. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. As-Built Drawings

a. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

b. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid Aluminum (RAL) Conduits

1. Provide rigid aluminum conduit manufactured from 6063 alloy, temper T-1.

2. Provide rigid aluminum conduit manufactured in accordance with NEMA C80.5 – Electrical Rigid Aluminum Conduit, and UL-6A – Electrical Rigid Metal Conduit - Aluminum, Red Brass and Stainless Steel.

3. Manufacturer, or Equal

   a. **V.A.W. of America**

   b. **Alcoa**

B. Rigid Galvanized Steel (RGS) Conduit

1. Provide rigid steel conduit manufactured from mild steel, hot-dip galvanized inside and out.

2. Provide rigid steel conduit manufactured in accordance with NEMA C80.1 – Electrical Rigid Steel Conduit, and UL-6 – Electrical Rigid Metal Conduit - Steel.

3. Manufacturer, or Equal

   a. **Allied Tube & Conduit**

   b. **Triangle**

   c. **Wheatland Tube**

C. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 or Schedule 80 PVC, as indicated, and sunlight-resistant.

2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.

3. Manufacturer, or Equal

   a. **Carlon**

   b. **Cantex**

D. Rigid PVC-Coated Rigid Aluminum Conduit

1. The conduit shall meet the requirements for rigid aluminum conduit as indicated above.

2. Bond a PVC coating to the outer surface of the aluminum conduit.

3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.

4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.

5. Provide a PVC coating thickness not less than 40 mils.

6. The PVC-coated rigid aluminum conduit shall be manufactured in accordance with the following standards:

   a. UL-6

   b. ANSI C80.5

7. Manufacturer, or Equal

   a. **Robroy Industries**

   b. **O'Kote**

   c. **Thomas & Betts**

E. Rigid PVC-Coated Galvanized Steel (RPGS) Conduit

1. The conduit shall meet the requirements for RGS conduit as indicated above.

2. Bond a PVC coating to the outer surface of the galvanized conduit.

3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.

4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.

5. Provide a PVC coating thickness not less than 40 mils.

6. The PVC-coated RGS conduit shall be manufactured in accordance with the following standards:

   a. UL-6

   b. ANSI C80.1

   c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

7. Manufacturer, or Equal

   a. **Robroy Industries**

   b. **O'Kote**

   c. **Thomas & Betts**

F. Liquid-Tight Flexible Conduit

1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.

2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.

3. Manufacturer, or Equal

   a. **Anaconda, Sealtite**

   b. **Electriflex, Liquatite**

G. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast fittings of the threaded type with 5 full threads.

2. Fittings and Boxes

   a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless steel screws.

   b. Attach covers by means of holes tapped into the body of the fitting.

   c. Covers for fittings attached by means of clips or clamps will not be accepted.

3. Provide boxes larger than standard cast or malleable types manufactured of Type 304 or Type 316 stainless steel, NEMA 4X.

4. Terminations

   a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal.

   b. In other than outdoor areas, provide sealed locknuts and bushings.

B. Cast Aluminum Fittings and Boxes

1. Provide cast aluminum boxes and fittings with less than 0.40 percent copper content, and use with aluminum conduit.

2. Manufacturer, or Equal

   a. **O.Z. Gedney**

   b. **Appleton**

   c. **Crouse-Hinds**

C. Malleable Iron Fittings and Boxes

1. For use with galvanized steel conduit, provide fittings and boxes constructed of malleable iron or gray-iron alloy with zinc plating.

2. Manufacturer, or Equal

   a. **O.Z. Gedney**

   b. **Crouse-Hinds**

   c. **Appleton**

D. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.

2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).

3. Manufacturer, or Equal

   a. **Carlon**

   b. **Crouse-Hinds**

   c. **Hoffman**

4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

E. PVC-Coated Rigid Aluminum Fittings

1. Meet requirements of UL 514B.

2. For use with PVC-coated rigid aluminum conduit, provide PVC-coated fittings that are the products of the same manufacturer as the conduit.

3. Provide male and female threads and internal surfaces with a 2-mil urethane coating. External finish shall be 40-mil PVC coating.

F. PVC-Coated RGS Fittings

1. Meet requirements of UL 514B.

2. For use with PVC-coated RGS conduit, provide PVC-coated fittings that are the products of the same manufacturer as the conduit.

3. Provide male and female threads and internal surfaces with a 2-mil urethane coating. External finish shall be 40-mil PVC coating.

G. Stainless Steel Boxes

1. Provide stainless steel boxes with PVC-coated RGS conduit and where indicated.

2. Provide NEMA 4X stainless steel boxes, constructed of Type 304 stainless steel.

3. Provide stainless steel of a minimum of 14-gauge thickness, with a brushed finish.

4. Door Hinges

   a. Provide doors with full-length stainless steel piano hinges.

   b. Non-hinged boxes will not be accepted.

5. Manufacturer, or Equal

   a. **Hoffman**

   b. **Rohn**

   c. **Hammond**

H. Sheet Steel Boxes

1. Sheet steel boxes shall be galvanized steel outlet and switch boxes.

2. Manufacturer, or Equal

   a. **Raco**

   b. **Steel City**

   c. **Appleton Electric**

PART 3 -- EXECUTION

3.1 GENERAL

A. Run wiring in raceway unless indicated otherwise.

B. Install raceways between equipment as indicated.

C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.

D. Bends and Offsets

1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.

2. Provide factory elbows wherever possible.

E. Combined Raceways

1. Conductors shall not be combined in the same raceway unless indicated on the drawings or with written permission from the ENGINEER.

   a. Raceways other than those containing power conductors may be combined in strict accordance with the NEC.

b. In general, combine only raceways containing the same type (control, signal, and the like) and voltage of conductors/cables, or dedicated conduits from one source to one device/equipment, in accordance with the NEC.

c. Permission from the ENGINEER shall not relieve the CONTRACTOR of responsibility to meet national, state and local requirements.

d. Do not combine wiring for redundant systems into single raceways.

F. Routing

1. Where raceway routings are indicated, follow those routings to the extent possible.

2. Where raceways are indicated but routing is not indicated, such as home runs or on conduit developments and schedules, raceway routing shall be the CONTRACTOR's choice and provided in strict accordance with the NEC as well as customary installation practice.

3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.

4. Adjust routings in order to avoid obstructions.

G. Coordination

1. Coordinate between trades prior to installing the raceways.

2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price.

H. Install exposed raceways parallel or perpendicular to structural beams.

I. Expansion Fittings

1. Install expansion fittings with external bonding jumpers wherever exposed raceways cross building expansion joints.

2. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.

3. Encased Expansion Fittings

a. Install encased expansion fittings wherever encased conduits cross building expansion joints.

b. Deflection type fittings shall not be required for encased conduits crossing an expansion joint within a single structure.

4. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

J. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.

K. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

3.2 CONDUIT

A. Provide exposed conduit manufactured of rigid aluminum, except as follows and unless indicated otherwise:

1. For circuits housing instrumentation cable, provide rigid galvanized steel conduit.

2. For conduit containing only grounding system bonding conductors, provide Schedule 80 PVC conduit.

B. Power and 120VAC discrete control circuit conduit encased in concrete shall be constructed of Schedule 40 PVC.

C. Instrumentation conduit encased in concrete shall be PVC-coated rigid galvanized steel.

D. Concrete Encasement

1. Where PVC or RGS conduit is stubbed up from a concrete encasement or direct-buried application, provide a PVC-coated RGS elbow and riser.

2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.

3. Do not encase conduit in the bottom floor slab below grade.

E. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased and direct-buried conduit of one-inch minimum trade size.

F. Install supports at distances required by the NEC.

G. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.

H. Penetrations

1. Provide conduit passing through walls or floors with plastic sleeves.

2. Perform core drilling in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

3. Conduits passing through a slab, wall, or beam shall not significantly impair the strength of the construction.

I. Conduits embedded within a slab, wall, or beam (other than those merely passing through) shall meet the following requirements:

   1. Conduits with their fittings embedded within a column shall not displace greater than 4 percent of the gross area of cross section;

   2. Conduits shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which it is embedded; and,

   3. Conduits shall not be spaced closer than 3 outside diameters on centers.

J. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.

K. Coat threads with a conductive lubricant before assembly. For field-cut rigid galvanized steel or PVC-coated rigid galvanized steel conduit, apply zinc-rich paint to the threads prior to assembly.

L. Joints

   1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.

   2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.

   3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.

   4. Replace conduit with wrench marks.

   5. Where installed in chemical or fuel containment areas, the conduit shall not have joints or fittings located below the top of the containment area to prevent entry of chemicals or fuel into the conduit system.

M. Slope

   1. Wherever possible, slope the conduit runs to drain at one or both ends of the run.

   2. Wherever conduit enters a substructure below grade, slope the conduit in order to drain water away from the structure.

   3. Take extreme care in order to avoid pockets or depressions in the conduit.

N. Where conduits from duct banks enter building walls below grade, transition to PVC-coated RGS at least 12” outside the wall. Installation of PVC-coated rigid steel conduit though a core-drilled hole in an exterior wall below-grade shall utilize a sealing device as manufactured by **Link Seal**, or equal.

O. Connections

   1. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.

2. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.

P. Duct sealant shall be foam duct sealant such as **Polywater FST or approved equal.** Provide duct sealant at the following locations:

1. Where required by NEC Article 300.7.

Q. Empty Conduits

1. Tag empty conduits at both ends to indicate the final destination.

2. Where it is not possible to tag the conduit, identify the destination by means of a durable marking on an adjacent surface.

3. Install a pull-cord in each empty conduit in floors, panels, manholes, equipment, and the like.

4. Install a removable plug on empty conduits that terminate below grade, in vaults, manholes, handholes, and junction or pullboxes.

R. Identification of Conduits

1. Identify conduits at ends and at pulling points.

2. Identification shall be the unique conduit number assigned in the Contract Documents.

3. Other than 120 VAC panelboard circuits, if a conduit has not been assigned a unique number in the Contract Documents, assign a unique number following the numbering scheme used in the Contract Documents.

4. Assign a unique number to 120 VAC panelboard circuits, similar to the cable numbering scheme used in the Contract Documents.

5. Provide conduit identification by a stamped or engraved non-corroding metal tag attached to the conduit bushing.

6. Provide an engraved phenolic nameplate in accordance with the requirements of Section 26 00 00 – Electrical Work, General, or a computer printed self-adhesive label attached to the equipment or enclosure inside which the conduit terminates.

7. Markings with a pen or paint will not be accepted.

S. Identification of Pullboxes and Junction Boxes

1. Identify pullboxes and junction boxes.

2. Identification shall be the unique tag number assigned in the Contract Documents, or if not assigned a unique number the CONTRACTOR shall assign one following the numbering scheme used in the Contract Documents.

3. Provide box identification by a stamped or engraved non-corroding metal tag or an engraved phenolic nameplate, in accordance with the requirements of Section 26 00 00 – Electrical Work, General, and attached to the box or enclosure.

4. Markings with a pen or paint will not be accepted.

T. Provide conduit for data cables in accordance with the equipment manufacturer's recommendations, especially regarding separation from low- and medium-voltage power raceways.

END OF SECTION

SECTION 26 05 43 - UNDERGROUND RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide underground raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. Pullboxes, and fittings that are dedicated to the underground raceway system shall comply with the requirements of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals, and Section 26 00 00 – Electrical Work, General.

B. Shop Drawings

1. Submit complete catalog cuts of all raceways, fittings, and pullboxes, marked where applicable in order to show proposed materials and finishes.

2. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. As-Built Drawings

1. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

2. Show routings, burial depths, pullbox locations and sizes, and where applicable, connections to drainage systems.

3. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

PART 2 -- PRODUCTS

2.1 PRECAST PULLBOXES

A. Frames and Covers

1. Provide traffic-type covers with an H-20 loading, except as otherwise indicated.

2. Identify pullbox covers as indicated on the plans by providing raised letters cast into the covers.

3. Provide galvanized, spring assisted cover with 180 degree layback hinge system.

4. Cover shall be capable of being bolted down.

5. Factory-prime the frames.

6. Provide provide pick holes.

7. Provide frames with a 1/2-inch drilled and tapped hole and lug in order to accommodate a No. 2 AWG bare stranded copper conductor connected to a ground rod.

B. Equip pullboxes with pulling-in irons, opposite and below each ductway entrance.

C. Provide pullboxes with closed bottoms; open-bottom pullboxes will not be accepted.

D. Precast Pullbox Manufacturer, or Equal

1. **Jensen Precast**

2. **Mack**

3. **Quikset**

4. **U.S. Precast**

2.2 DUCTBANKS

A. Provide underground ducts constructed of Schedule 40 PVC. Instrumentation circuits shall be routed in PVC-coated rigid galvanized steel conduits.

B. Where concrete encasement is specified on the plans, encase ducts in red-dyed concrete with steel reinforcing bars. Provide concrete with a 3,000-psi compressive strength conforming to the requirements of section 03 30 00 – Cast-In-Place Concrete, Reinforcements, and Formwork. Concrete Colorant shall satisfy the following requirements:

1. The concrete shall be dyed red throughout the ducts; surface treatment will not be accepted.

2. Provide colorant consisting of an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

3. The costs, if any, of cleaning coloring pigment from the concrete delivery equipment and other related cleanings shall be considered as part of the WORK.

C. Ductbanks

1. Ductbanks shall contain a No. 2 bare stranded copper ground wire.

2. The ground wire shall be continuous through the ductbank and terminate at pullboxes and the grounding electrode at each end.

D. Identification Tape

1. Provide continuous lengths of underground warning tapes located 12 inches above and parallel to the ductbanks.

2. Provide tape consisting of 6-inch wide polyethylene film, imprinted with "CAUTION - ELECTRIC UTILITIES BELOW."

3. Tape Manufacturer, or Equal: **Brady**

PART 3 -- EXECUTION

3.1 GENERAL

A. Install underground raceways between pullboxes as indicated.

B. Raceway systems shall be electrically and mechanically complete before conductors are installed.

C. Provide bends and offsets that are smooth and symmetrical, and fabricated with tools designed for this purpose.

D. Use factory elbows wherever possible.

E. To the extent possible, follow the raceway routings as indicated on the Drawings.

F. Adjust the indicated routings as necessary in order to avoid obstructions.

G. Coordination with Other Trades

1. Coordinate with other trades prior to installation of raceways.

2. The lack of coordination shall not be justification for extra compensation.

3. Perform removal and re-installation to resolve conflicts as part of the WORK.

3.2 DUCTBANKS

A. Install ductbanks in accordance with the following criteria:

1. Assemble the duct using high-impact, non-metallic spacers and saddles in order to provide conduits with vertical and horizontal separation.

2. Set the plastic spacers every 5 feet.

3. For concrete encased ductbanks, anchor the duct array every 5 feet in order to prevent movement during the placement of concrete.

4. Lay the duct on a grade line of at least 3 inches per 100 feet, sloping towards pullboxes.

5. For concrete encased ducts, install the duct and adjust the pullbox depths such that the top of the concrete envelope is a minimum of 18 inches below grade and a minimum of 24 inches below roadways.

6. Accomplish changes in direction of the duct envelope by more than 10 degrees horizontally or vertically by using bends with a minimum radius 24 times the diameter of the largest duct.

7. Stagger duct couplings a minimum of 6 inches.

8. Provide select backfill or sand for the bottom of the trench.

9. Cleaning

    a. Clean each bore of the completed ductbank by drawing through it a standard flexible mandrel, one foot long and 1/4 inch smaller than the nominal size of the duct.

    b. After passing the mandrel, draw through a wire brush and swab.

10. For spare raceways that are not indicated to contain conductors, provide a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.

B. Assemble sections of pre-fabricated manholes and pullboxes using waterproof mastic, and set on a 12-inch minimum bed of gravel as recommended by the manufacturer or as required by field conditions.

C. Provide watertight ductbank penetrations through walls of manholes, pullboxes, and building walls below grade.

D. Terminate concrete-encased ductbanks at building foundations.

E. Where ducts enter buildings, provide duct sealant in every duct at the building-end of the duct run to prevent water or condensation entry from the duct bank into the building. Duct sealant shall be **Polywater FST, Polywater FST-Mini,** or equal.

F. Sealing

1. Where an underground conduit enters a structure through a concrete roof or a membrane-waterproofed wall or floor, provide a **Link-Seal** or equal sealing device.

2. Use the sealing device with rigid steel conduit.

END OF SECTION

SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall perform equipment evaluation, protective device coordination, and arc flash hazard analyses for the proposed additions to the electrical power system in accordance with the Contract Documents.

B. It is the responsibility of the CONTRACTOR to obtain the information required from the electric utility and existing conditions.

1.2 QUALIFICATIONS

A. The electrical system analyses shall be performed by a manufacturer who has been regularly engaged in electrical systems analysis for a period of at least 5 years.

B. The indicated studies shall be signed by the professional electrical engineer, registered in the State of FL, responsible for the studies.

C. The studies shall utilize computer programs with proven reliability and accuracy for performing 3-phase fault-duty calculations

1.3 CONTRACTOR SUBMITTALS

A. The short circuit current analysis shall be submitted and approved by the ENGINEER prior to final acceptance of the Well Pump Motor Control Panel Shop Drawings and release of equipment for manufacture.

B. The equipment evaluation, protective device coordination, and arc-flash hazard analyses shall be updated prior to Project Substantial Completion utilizing characteristics of as-installed equipment and materials and submitted for review.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. The studies shall include development of single-line and impedance diagrams of the plant power distribution system.

B. The diagrams shall identify components considered in the study and the ratings of power devices, including transformers, circuit breakers, relays, fuses, busses, and cables.

C. The resistances and reactances of cables shall be identified in the impedance diagram.

D. The studies shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

E. The studies shall include every protective device and feeder or modified within the WORK.

F. The first upstream overcurrent device outside the WORK shall be used as a fixed reference.

G. The electrical model shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480-volt distribution system, and shall provide results for all possible source combinations.

3.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

ANSI/IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE 242	Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
ANSI/IEEE C 37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C 37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures

3.3 EQUIPMENT EVALUATION STUDY

A. An Equipment device evaluation study shall be performed in order to determine the adequacy of circuit breakers, molded case switches, and fuses for the available fault current at the applied location.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the attention of the ENGINEER.

C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project.

D. Devices shall be fully rated to withstand available fault currents.

3.4 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed in order to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the ENGINEER's attention.

C. For the purposes of this project, existing protective devices to be included in the coordination study shall be limited to devices upstream of the main disconnect at Well No. 4.

D. Time-current coordination curves:

1. As a minimum, the time/current coordination curves for the power distribution system shall include the following items plotted on 5-cycle log-log graph paper:

2. time/current curves for each protective relay, circuit breaker, or fuse demonstrating graphically that the settings will provide protection and selectivity within industry standards

3. Each curve shall be identified and tap and time dial settings shall be specified.

4. Provide individual curves for each feeder unless identical to others.

5. Selectivity

   a. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing.

   b. Where selectivity cannot be achieved, the ENGINEER shall be notified as to the cause.

   c. Recommendations shall be included for alternate methods that would improve selectivity.

6. time/current curves and points for cable and equipment damage.

7. circuit interrupting device operating and interrupting times

8. Indicate maximum fault values on the graph.

9. sketch of bus and breaker arrangement

10. magnetizing inrush points of transformers

11. thermal limits of dry-type and liquid-insulated transformers (ANSI damage curve)

12. Every restriction of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.5 ARC FLASH STUDY

A. An arc flash study shall be performed with the aid of a digital computer program in order to determine the “Arc Flash Protection Boundary” and “Personal Protective Equipment” (PPE) levels for proposed Pump Motor Control Panel and disconnect switch.

B. The arc flash study shall be in accordance with the latest version of the following Standards:

   1. NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces

   2. IEEE 1584 IEEE guide for performing Arc Flash Hazard Calculations

   3. OSHA (29 CFR PART 1910) Occupational Safety and Health Standards for General Industry

   4. ANSI Z535.4 Product Safety Signs and Labels

C. The recommended values for the “Arc Flash Protection Boundary” and PPE levels, based on the arc flash study results, shall be tabulated for the pump control panel and main disconnect switch in the study.

D. Labeling

1. The digital computer program shall provide the “Arc Flash Protection Boundary” and PPE values in a format that can be directly printed on to labels.

2. The CONTRACTOR shall apply these labels in accordance with Section 26 00 00 – Electrical Work, General. Information shown on these labels shall comply with NFPA 70E requirements.

3.6 FINAL SUMMARY REPORT

A. Summarize the results of the indicated power system studies in a final report.

B. The report shall include the following items:

1. single-line diagram

2. impedance diagram

3. tabulation of all protective devices identified on the single line diagram

4. time/current coordination curves

5. specific recommendations, if any

6. test instrumentation, condition, and connections, as applicable, for each study

7. computerized fault current calculations

8. any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety

9. recommendations to minimize the arc flash energy

C. The report shall include information concerning the computer program used for the study, as well as a general discussion of the procedure, items, and data considered in the preparation of the study.

3.7 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices in accordance with the recommendations in the power system coordination study.

B. Calibrate the MCPs as in accordance with the recommendations in the power system study.

C. Adjustments shall be made prior to energizing any electrical equipment. Any required adjustments shall be limited to new equipment only.

END OF SECTION

SECTION 31 10 00 - SITE PREPARATION

PART 1 -- GENERAL

1.1 SUMMARY

A. In its initial move onto the Site, the CONTRACTOR shall protect existing fences, lighting, asphalt surfaces, landscaping, existing utilities downslope of construction areas from damage due to trees, or other objects dislodged during the construction process and clear, grub, strip; and regrade certain areas, in accordance with the Contract Documents.

1.2 SITE INSPECTION

A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions. The CONTRACTOR shall document existing site conditions in accordance with **Section 02 22 00 Site Conditions Survey**.

B. Refer to **Section 01 55 00 Site Access and Storage** for additional requirements.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 CLEARING, GRUBBING, AND STRIPPING

A. Construction areas shall be cleared of grass and weeds to at least a depth of 6-inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10-feet of the top of cut lines shall be removed from the Site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction.

B. Underground utilities shall be marked and located prior to initiate clearing and grubbing. All existing utilities shall be protected during

C. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, buried logs, and other objectionable material.

D. Objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations. Any material removed from the Site shall be treated as contaminated and disposed of at an approved facility in accordance with all regulatory requirements.

E. All trees shall be protected during construction.

3.2 HANDLING AND DISPOSAL OF ON SITE SOILS

A. Disposal (including hauling) of cleared, grubbed, and unsuitable material and debris shall be the responsibility of the CONTRACTOR.

B. If approved by the OWNER, the material may be incorporated on-Site at a location approved by the OWNER.

END OF SECTION

SECTION 31 30 00 - EARTHWORK

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall perform earthwork as indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Samples

1. The CONTRACTOR shall submit samples of materials proposed for the WORK in conformance with the requirements of Section 01 33 00 – Contractor Submittals.

2. Sample sizes shall be as determined by the testing laboratory.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General

1. Fill, backfill, and embankment materials shall be selected or shall be processed and clean fine earth, rock, gravel, or sand, free from grass, roots, brush, other vegetation and organic matter.

2. Fill and backfill materials that are to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

B. Suitable Materials

1. Materials not defined below as unsuitable will be considered as suitable materials and may be used in fills, backfilling, and embankment construction, subject to the indicated requirements.

2. If acceptable to the ENGINEER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

3. Mixing or blending of materials to obtain a suitable composite is the CONTRACTOR's option but is subject to the approval of the ENGINEER.

4. The CONTRACTOR shall submit certification to the ENGINEER that the chloride concentration in imported materials within the pipe zone does not exceed 100 ppm, when tested in accordance with the requirements of AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.

5. Suitable materials may be obtained from on-site excavations, may be processed on-Site materials, or may be imported.

C. Unsuitable materials

1. ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

2. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

3. Muck, marl or other unstable and unsuitable material occurring within the project limits shall be removed and replaced with material suitable for fill construction.

4. Any material having stumps, large roots, bushes or other deleterious organic matter.

2.2 BEDDING

A. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

2.3 SUBGRADE

A. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch sieve and not more than 10 percent passing a No. 200 sieve. LBR shall be as shown on plans.

2.4 MATERIALS TESTING

A. Samples

1. Soils testing of samples submitted by the CONTRACTOR will be performed by a testing laboratory of the OWNER's choice and at the CONTRACTOR’s expense.

2. The ENGINEER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System

1. References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.

2. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 in the interpretation of soil classifications.

E. Testing for sulfate, resistivity, and pH shall be performed in accordance with the applicable rules and standards in the State of Florida and by the OWNER.

F. Testing for chloride shall be performed in accordance with AASHTO T291-94 – Standard Method of Test for determining Water-Soluble Chloride Ion Content in Soil.

2.5 IDENTIFICATION TAPE

A. Unless otherwise indicated, identification tape shall be placed above buried pipelines that are not comprised of magnetic components at least in part.

PART 3 -- EXECUTION

3.1 EXCAVATION AND BACKFILLING - GENERAL

A. General

1. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions, that would interfere with the proper execution and completion of the WORK.

2. The removal of such materials shall conform to the lines and grades indicated or ordered.

3. Unless otherwise indicated, the entire Site shall be stripped of vegetation and debris and shall be grubbed, and such material shall be removed from the Site prior to performing any excavation or placing any fill.

4. The CONTRACTOR shall furnish, place, and maintain supports and shoring that may be required for the sides of excavations.

5. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

6. The CONTRACTOR shall provide quantity surveys where so required to verify quantities for Unit Price Contracts.

7. Surveys shall be performed prior to beginning WORK and upon completion by a surveyor licensed in the state where the Site is located.

B. Removal and Exclusion of Water

1. The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, and wastewater, from excavations.

2. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation WORK begins at each location.

3. Water shall be removed and excluded until backfilling is complete and field soils testing has been completed.

3.2 OVER-EXCAVATION

A. Indicated

1. Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade indicated.

B. Not Indicated

1. When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade.

C. Neither Indicated nor Ordered

1. Any over-excavation carried below the grade that is neither ordered or nor indicated shall be backfilled and compacted to the required grade with the indicated material as part of the WORK

3.3 EXCAVATION IN LAWN AREAS

A. The CONTRACTOR shall minimize damage to lawn areas adjacent to proposed trench installation. Contractor to provide new sod at these locations.

3.4 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations.

B. No tree roots larger than 2 inches in diameter shall be cut without the express permission of the ENGINEER.

C. Trees shall be supported during excavation by any means previously reviewed and accepted by the ENGINEER.

3.5 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. Unless otherwise indicated, excess excavated material shall be the property of the CONTRACTOR.

B. The CONTRACTOR shall be responsible for the removal and disposal of excess excavated material.

C. Material shall be disposed of at an approved on-Site disposal area or off-Site at a location arranged by the CONTRACTOR in accordance with laws and regulations regarding the disposal of such material.

3.6 BACKFILL

A. General

1. Backfill shall not be dropped directly upon any structure or pipe.

2. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.

3. Backfill around water-retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after water is removed from the excavation and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. Pre-Placement Conditions

1. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have any loose, sloughing, or caving soil and rock materials removed.

2. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

D. Soil Sterilant

1. Apply soil sterilant or a chemical weed control agent under roads and as indicated, in strict compliance with the manufacturer's dosage and application instructions and with applicable laws, ordinances, and regulations governing the use of such chemicals.

E. Layering

1. Backfill materials shall be placed and spread evenly in layers.

2. When compaction is achieved using mechanical equipment, the layers shall be evenly spread such that when compacted each layer shall not exceed 6 inches in thickness.

F. During spreading, each layer shall be thoroughly mixed as necessary in order to promote uniformity of material in each layer.

G. Moisture Content

1. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

2. Where the backfill material moisture content is too high to permit the indicated degree of compaction, the material shall be dried until the moisture content is satisfactory.

3.7 PIPELINE AND UTILITY TRENCH EXCAVATION AND BACKFILL

A. Exploratory Excavations

1. The CONTRACTOR shall excavate and expose buried points of connection to existing utilities as indicated.

2. Excavation shall be performed prior to the preparation of Shop Drawings for connections and before the fabrication of the pipe

3. The data obtained from exploratory excavations shall be used in preparing the Shop Drawings.

4. Data, including dates, locations excavated, and dimensioned sketches, shall be submitted to the ENGINEER within one week of excavation.

5. Damage to utilities from excavation activities shall be repaired by the CONTRACTOR in accordance with the General Conditions.

B. General

1. Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with minimum widths as indicated.

C. Trench Bottom

1. Except where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.

2. Excavations for pipe bells and welding shall be made as required.

3. Where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding.

D. Open Trenches

1. The maximum amount of open trench permitted in any one location shall be 500 feet or the length necessary to accommodate the amount of pipe installed in a single Day, whichever is greater.

2. Trenches shall be fully backfilled at the end of each Day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each Day.

3. These requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure; in such cases, however, barricades and warning lights meeting appropriate safety requirements shall be provided and maintained.

E. Placing and Spreading of Backfill Materials

1. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of achieving the required density in 2 passes and that is acceptable to the ENGINEER.

2. Where such materials are used for pipe zone backfill, vibratory compaction shall be used at vertical intervals of the lesser of:

   a. one-half the diameter of the pipe; or

   b. 24 inches, measured in the uncompacted state.

3. In addition, these materials shall be subjected to vibratory compaction at the springline of the pipe and the top of the pipe zone backfill, regardless of whether that dimension is less than 24 inches or not.

4. Each layer of backfill material with greater than 10 percent passing the No. 4 sieve shall be compacted using mechanical compactors suitable for the WORK.

5. The material shall be placed and compacted under the haunch of the pipe and up each side evenly so as not to move the pipe during the placement of the backfill.

6. The material shall be placed in lifts that will not exceed 6 inches when compacted to the required density.

F. Mechanical Compaction

1. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand-operated vibratory compactors and rollers that do not damage the pipe.

2. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. Pipe And Utility Trench Backfill

1. Pipe Zone Backfill

a. Definitions

1) The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated.

2) The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe.

3) The embedment is defined as that portion of the pipe zone backfill material between the bedding and a level line as indicated.

b. Final Trim

1) After compacting the bedding, the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.

2) Excavation for pipe bells and welding shall be made as required.

c. The pipe zone shall be backfilled with the indicated backfill material.

d. Pipe zone backfill materials shall be manually spread evenly around the pipe, maintaining the same height on both sides of the pipe such that when compacted the pipe zone backfill will provide uniform bearing and side support.

e. The CONTRACTOR shall exercise care in order to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.

2. Trench Zone Backfill

a. After the pipe zone backfill has been placed, backfilling of the trench zone may proceed.

b. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

3. Final Backfill

   a. Final backfill is defined as backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, backfill within 18 inches of the roadway subgrade.

H. Identification Tape

1. Install identification tape as indicated.

2. Terminate the tape in a precast concrete box either adjacent to or part of the valve box, manhole, vault, or other structure into which the non-metallic pipe enters or at the end of the non-metallic pipeline.

3. The termination box shall be covered with a cast iron lid.

4. The box shall be located at grade in paved areas or 6 inches above grade in unpaved areas.

I. Trench Shield

1. If a moveable trench shield is used during backfill operations, the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer.

2. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.

J. Compaction Requirements

1. The following compaction test requirements shall be in accordance with AASHTO T-180 where the material is graded such that 10 percent or more passes a No. 4 sieve.

3.8 FIELD TESTING

A. General:

1. Testing Agency: The CONTRACTOR will engage and pay for a qualified independent geotechnical engineering testing agency to perform field quality-control testing. The CONTRACTOR will be responsible for coordinating all testing as needed with the CONTRACTOR, the OWNER, the ENGINEER or Architect and the testing agency. The CONTRACTOR shall provide test trenches and excavations, including excavation, trench support and groundwater removal for the field soils testing operations.

2. All re-testing costs due to failed tests shall be paid for by the CONTRACTOR at no additional cost to the OWNER.

3. The trenches and excavations shall be provided at the locations and to the depths as required by the Contract Documents.

4. Lawn areas destroyed by test trenching and excavation shall be regraded and re-landscaped with sod and hydroseeding.

5. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

6. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by ENGINEER.

7. The ENGINEER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System

1. References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.

2. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 in the interpretation of soil classifications.

E. Density

1. Field density tests in accordance with ASTM and Florida Method Testing Standards, for each type of material used in backfilling may be required. Failure to meet the specified density will require the CONTRACTOR to re-compact and retest, at his own expense, those areas directed by the OWNER.

2. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557.

3. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with AASHTO T-180

4. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254.

5. Field density in-place tests will be performed in accordance with Florida Test Method FM T-238 Density of Soils In-Place by the Nuclear Method, or by such other means acceptable to the ENGINEER.

F. Remediation

1. In case the test of the fill or backfill shows non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance.

2. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and paid by the CONTRACTOR.

G. CONTRACTOR's Responsibilities

1. The CONTRACTOR shall provide test trenches and excavations, including excavation, trench support and groundwater removal for the OWNER's field soils testing operations.

2. The trenches and excavations shall be provided at the locations and to the depths as required by the OWNER.

3. Lawn areas destroyed by test trenching and excavation shall be regraded and relandscaped with sod.

END OF SECTION

SECTION 31 35 26 - EROSION CONTROL BARRIER

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall provide erosion control barriers, complete and in place, in accordance with the Contract Documents. The CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities that may cause erosion until barriers are in place.

B. The CONTRACTOR shall conduct and schedule operations to avoid pollution by siltation.

C. The CONTRACTOR shall comply with all erosion control and dewatering permit requirements during the execution of the work.

1.2 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with **Section 01 33 00 - Contractor Submittals**.

B. Product Data: Manufacturer's catalog sheets on geotextile fabrics.

PART 2 -- PRODUCTS

2.1 FABRIC

A. Fabric may be woven or non-woven, made from polypropylene, polyethylene, or polyamid, and shall contain sufficient UV inhibitors so that it will last for 2 years in outdoor exposure.

B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D 4632	100 lb
Burst strength	ASTM D 3786	200 psi
Apparent opening size	ASTM D 4751	Between 200 and 70 sieve size

C. Fabric Manufacturer, or equal

1. **Mirafi**

2.2 POSTS

A. Posts shall be wood, at least 2-inches by 2-inches, at least 6-feet long.

2.3 FENCING

A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6-inches, maximum 14-gauge, at least 30-inches tall.

2.4 FASTENERS

A. Fasteners to wood posts shall be steel, at least 1-1/2 inches long.

2.5 PREPARATION

A. Provide erosion control barriers at the indicated locations and as required to prevent erosion and silt loss from the Site.

B. CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities which may cause erosion until barriers are in place.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Handle, store, and install in accordance with manufacturer recommendations.

B. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.

C. Attach the woven wire fencing to the posts that are spaced a maximum of 6 feet apart and embedded a minimum of 12-inches. Install posts at a slight angle toward the source of the anticipated runoff.

D. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.

E. Securely fasten the fabric materials to the woven wire fencing with tie wires.

F. Reinforced fabric barrier shall have a height of 18-inches.

3.2 Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.3 MAINTENANCE

A. Regularly inspect and repair or replace damaged components of the barrier.

B. During periods of heavy rain (1” or greater as reported by the National Weather Service), the CONTRACTOR shall monitor the temporary erosion control measures to ensure that they are not causing localized flooding.

C. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.

D. Remove sediment deposits when silt reaches a depth of 6-inches or 1/2 the height of the barrier, whichever is less. Dispose of sediments on the Site, if a location is indicated on the Drawings, or at a site arranged by the CONTRACTOR which is not in or adjacent to a stream or floodplain.

END OF SECTION

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SECTION 32 31 13 – CHAIN LINK FENCING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide chain link fencing and gates and appurtenant WORK, complete and operable, all in accordance with the requirements of the Contract Documents.

B. Single Manufacturer: Chain link fencing, gates, accessories, fittings, and fastenings shall be products of a single manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. General: Furnish submittals prior to the fabricationtypical fence and fence corner post construction in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Manufacturer's technical data, product specifications, standard details, certified product test results, installation instructions and general recommendations.

2. Scale layout of fencing, gates, and accessories. Drawings shall show fence height, post layout, including sizes and sections; post setting and bracing configuration, details of gates and corner construction, and other accessories which may be necessary.

3. Color charts accurately illustrating the full range of standard colors available from the manufacturer.

C. Samples: Samples of proposed fence components, at least 12-inches long, to illustrate the selected color and finish.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Fencing shall be eight feet (8') high unless otherwise shown. All fencing materials, including gates, shall be galvanized steel. All materials and components shall be new, first quality items specifically manufactured for the intended application. Dimensions indicated herein for roll-formed pipe and H-sections are outside dimensions, excluding coatings.

B. Fence fabric shall be No. 9 gage galvanized steel wire, 2-inch mesh. The fabric shall have a twisted finish on the top edge and a twisted and barbed finish on the bottom edge. Galvanized wire shall be black vinyl coated unless specified otherwise on the drawings.

C. Fabric ties shall be No. 9 steel wire, spaced 14 inches apart on posts and 24 inches apart on rails. Aluminum ties will not be permitted. A continuous No. 7 gage galvanized steel wire shall be interlaced with the fabric or attached to the fabric with clips along the extreme bottom of the fence.

2.2 STEEL FABRIC

A. Fence fabric shall be No. 9 gauge steel wire, 2-inch mesh, with top selvages knuckled and bottom selvages twisted and barbed.

B. Fabric Finish: Fabric shall be galvanized in conformance with ASTM A 392 - Zinc-Coated Steel Chain Link Fence Fabric, Class II, with not less than 2.0 ounces zinc per square foot of coated surface.

2.3 FRAMING AND ACCESSORIES

A. Steel Framework, General: Unless otherwise indicated, framework components shall be fabricated of galvanized steel conforming to ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, or ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, with not less than 1.8 ounces zinc per square feet of coated surface.

   1. Fittings and accessories shall be galvanized in accordance with ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware, with zinc weights per Table I of that standard, except that no coating shall be less than 1.8-ounce zinc per square foot of coated surface.

B. All posts shall be one-piece without circumferential welds, and shall be as follows:

C. End, Corner and Pull Posts: Posts shall be one-piece without circumferential welds, 3-inch schedule 40 pipe, 5.79 pounds per linear foot.

D. Line Posts: Line posts shall be spaced no more than 10-feet on center and shall be 2-1/4 inch “H” column section, 4.1-pounds per linear foot, or schedule 40, 2-1/2 inch pipe, 3.65-pounds per linear foot.

E. Gate Posts: Gate posts shall be 4-inch schedule 40 pipe, 9.1-pounds per linear foot.

F. Gate posts shall be provided with concrete foundation. Posts shall be centered in 15-inch concrete encasement extending a minimum of 40-inches into thr ground.

G. Top Rail: Top railing shall be provided in manufacturer’s longest lengths, with expansion type couplings, approximately 6-inches long, for each joint. Fence design shall provide positive, secure attachment of top rail to each gate post, corner post, pull post and end post. Top rail and braces shall be 1-5/8 inch schedule 40 pipe, 2.27-pounds per linear foot, or 1-1/2 inch “H” column section, 2.00-pounds per linear foot.

H. Tension Wire: Tension wire shall be located at the bottom of the fabric and shall consist of No. 7 gauge coated coil spring wire of metal and finish to match fabric. Tension wire shall be interlaced with the fabric or attached to the fabric along the extreme bottom of the fence. Tension wire attachment shall be with fabric tie wires at a spacing of no more than 24-inches apart.

I. Fabric Tie Wires: Fabric tie wires shall be No. 9 gauge galvanized steel wire of the same finish as the fabric. Aluminum ties shall not be used. Ties shall be spaced 14-inches apart on posts and 24-inches apart on rails.

J. Post Brace Assembly: Post brace assembly shall be manufacturer's standard adjustable brace assembly provided at each end post, gate post and at both sides of each corner post and intermediate brace post. Material used for brace shall be same as top rail. Truss bracing between line posts shall be achieved with 0.375-inch diameter rod and adjustable tensioner.

K. Post Tops: Post tops shall be weather-tight closure caps, designed for containment of top rail and positive permanent attachment to post. One cap shall be provided for each post.

L. Caps: Malleable iron, black vinyl coated; sized to post diameter, stainless steel set screw retainer.

M. Stretcher Bars: Stretcher bars shall be one-piece lengths equal to the full height of the fabric, with minimum cross-section of 3/16-inch by 3-1/2 inch. One stretcher bar shall be provided for each gate and end post, and 2 for each corner and intermediate brace post.

N. Stretcher Bar Bands: Stretcher bar bands shall be one-piece fabrications designed to secure stretcher bars to end, corner, intermediate brace, and gate posts. Bands shall have a minimum cross-section of 1/8-inch by 3/4-inch. Stretcher bar bands shall be spaced no more than 15-inches on center.

2.4 GATES

A. Fabrication: Perimeter frames of gates shall be fabricated from same metal and finish as fence framework. Gate frames shall be assembled by welding or with fittings and rivets for rigid, secure connections. Welds shall be ground smooth. Gate frames and any ungalvanized hardware, shall be hot-dip galvanized after fabrication. Horizontal and vertical members shall be provided to ensure proper gate operation and attachment of fabric, hardware and shall be hot-dip galvanized after fabrication.

1. Fabric for gates shall match fence fabric, unless otherwise indicated. Fabric shall be installed with stretcher bars at all perimeter edges. Stretcher bars shall be attached to gate frame with stretcher bar bands spaced no more than 15-inches on center.

2. Each gate shall be diagonally cross-braced with a 3/8-inch diameter adjustable length truss rod to ensure frame rigidity without sag or twist.

B. Swing Gates: Perimeter frames of swing gates shall be constructed of the same pipe or "H" column members as the top rails and shall be fabricated by welding. Welds shall be ground smooth prior to hot-dip galvanizing and black vinyl coating. Each gate or pair of gates shall be provided with a heavy drop rod latch assembly with a locking device for a padlock.

1. Hardware and accessories shall be provided for each gate, galvanized in conformance with ASTM A 153, and in accordance with the following:

a. Hinges: Hinges shall be of size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Three hinges shall be provided for each leaf 6-feet or more in height.

b. Latch: Latch shall be forked type or plunger-bar type, permitting operation from either side of the gate, with padlock eye as an integral part of the latch.

c. Keeper: Keeper shall be provided which automatically engages the gate leaf and holds it in the open position until it is manually released.

2.5 RELATED ITEMS

A. Concrete: Concrete shall be provided according to Section 03 31 00 - Cast-In-Place Concrete.

B. Nuts, bolts and screws shall be steel, minimum size 3/8-inch diameter, hot-dip galvanized after fabrication.

2.6 MANUFACTURERS

A. Manufacturer's Qualifications: Chain link fencing and gates shall be products of a single manufacturer which has been successfully engaged in the production of such items for a period of at least 5 years.

B. Installer's Qualifications: Installation of the chain link fence shall be by the manufacturer or by a firm accepted and licensed by the manufacturer.

C. Manufacturers, or equal

1. **American Fence Corp.**

2. **Anchor Fence, Inc.**

3. **United States Steel**

PART 3 -- EXECUTION

3.1 INSPECTION

A. Prior to commencing installation, require Installer to inspect all areas and conditions within which WORK of this Section will be performed. Dimensions and clearances shall be verified. Final grading shall be completed and all earth, brush, or other obstructions which interfere with the proper alignment and construction of fencing shall be removed at the expense to the CONTRACTOR.

3.2 INSTALLATION

A. General: Unless otherwise indicated, all posts shall be set in concrete. Gate and related posts, corner posts, and other critical elements shall be provided with concrete foundations which are designed by an engineer to safely accommodate the loads to which they will be subjected. The soils report is appended to the Contract Documents and contains information regarding soil properties in the vicinity of the Site.

B. Excavation: Holes for posts shall be drilled or hand excavated to the diameters and spacings indicated, in firm, undisturbed or compacted soil. Post foundations which are not designed by an engineer shall comply with the following:

1. Holes shall be excavated to a diameter not less than 12-inches or not less than 5 times the largest dimension of the item being anchored, whichever is larger.

2. Depth for holes shall be not less than 40-inches; excavated approximately 4-inches lower than the post bottom, with bottom of posts set not less than 36-inches below finish grade surface.

C. Setting Posts: Line posts shall be spaced at not more than 8-foot intervals, measured from center to center of the posts, and generally parallel to the ground slope. Posts shall be set plumb and shall be centered in 12-inch diameter concrete encasement , 4-inches above the bottom of the excavation, with posts extending not less than 36-inches below finish grade surface.

1. Corner posts shall be installed where changes in the fence lines equal or exceed 15 degrees, measured horizontally.

2. Bracing shall be provided at all end, gate, and corner posts, the latter in both directions. Horizontal brace rails shall be set midway between top rail and ground running from the corner, end, or gate post to first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

3. Each post shall be properly aligned vertically and its top aligned parallel to the ground slope. Posts shall be maintained in proper position during placement and finishing operations.

D. Concrete

1. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing concrete, the earth around the hole shall be thoroughly moistened. The concrete shall completely fill the hole and top surfaces of the concrete encasement shall be sloped outward to shed water and shall have a neat appearance.

2. Encasement concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating.

3. Concrete footings shall have a neat appearance and shall be extended 2-inches above grade and troweled to a crown to shed water.

4. A minimum of 7 days shall elapse after placing the concrete footings before the fence fabric or barbed wire is fastened to the posts.

5. Concrete shall have a minimum compressive strength of 3,000 psi at 28 days.

E. Bracing

1. Bracing shall be provided at all ends, corners, gates, and intermediate brace posts. Corner posts and intermediate brace posts shall be braced in both directions. Horizontal brace rails shall be set midway between the top rail and the ground, running from the corner, end, intermediate brace or gate post to the first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

2. Braces shall be so installed that posts remain plumb when diagonal rod is under proper tension.

F. Top Rails: Top rails shall be run continuously through post caps, bending to radius for curved runs. Expansion couplings shall be provided as recommended by the fencing manufacturer.

G. Tension Wire: Continuous bottom tension wire shall be stretched tight with turnbuckles at end, gate, intermediate, and corner posts. Tension wire shall be installed on a straight grade between posts, with approximately 2-inches of space between finish grade and bottom selvage, unless otherwise indicated. Tension wire shall be tied to each post with not less than 6 gauge galvanized wire.

H. Fabric

1. Chain-link fabric shall be fastened on the secured side of the posts.

2. The chain-link fabric on the side of the posts as shown or as designated by the ENGINEER. The fabric shall be stretched and securely fastened to the posts and between the posts, top and bottom edges of the fabric shall be fastened to the top rail and bottom rail wire, respectively.

3. The fabric shall be fastened to the end, corner, and gate posts with stretcher bars and stretcher bar bands spaced at approximately 14 inches on line posts and at approximately 18 inches on tension wires.

4. Fabric shall be stretched and anchored in such a manner that it remains in tension after the pulling force is released.

I. Tie Wires: Tie wire shall be bent to conform to the diameter of the pipe to which it is attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Ends of wire shall be bent back to minimize hazard to persons or clothing.

1. Fabric shall be tied to line posts with tie wires spaced at 12-inches on center.

2. Fabric shall be tied to rails and braces with tie wires spaced at 24-inches on center.

3. Fabric shall be tied to tension wires, with hog rings spaced 24-inches on center.

J. Stretcher Bars: Fabric shall be fastened to end, corner, intermediate brace, and gate posts with stretcher bars. Bars shall be threaded through or clamped to fabric at 4-inches on center and secured to posts with stretcher bar bands spaced no more than 14-inches on center.

K. Stretcher bars shall be 1/4-inch by 3/4-inch steel bars and steel bands for fastening stretcher bars to the posts shall be 1/8-inch by 3/4-inch.

L. Truss Rod: Truss Rod shall be 3/8-inch diameter black vinyl coated steel rod and equipped with adjustable turnbuckles. Attach to posts with clamps and brackets designed for this purpose.

M. Fasteners: Nuts for tension bands and hardware bolts shall be installed on the side of fence opposite the fabric side. Ends of bolts shall be peened or the threads scored to prevent removal of nuts.

N. Any galvanized coating damaged during construction of the fencing shall be repaired by application of Galvo-Weld; Galvinox; or equal.

3.3 GROUNDING

A. A ground must be installed for all fences**.** The ground rod is to consist of an aluminum or galvanized rod, with connection of similar metal if required, or of other appropriate material, eight feet in length and at least 5/8 inch in diameter. Drive the rod vertically until the tip of the rod is approximately six inches below the ground surface. Use a No. 6 conductor to connect the rod and all fence elements. Connect the conductor to each fen he ground rod by means of electrical type clamps, which will prevent corrosion. After installation, the total resistance of fence to ground shall not be greater than 25 ohms.

END OF SECTION

SECTION 32 92 00 - SODDING

PART 1 -- GENERAL

1.1 THE SUMMARY

a. The CONTRACTOR shall apply sodding, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals for approval.

B. Materials List: A list of all materials to be used in the sodding.

1.3 CLEANUP

A. Upon completion of all sodding operations, the portion of the Site used for a work or storage area by the CONTRACTOR shall be cleaned of all debris, superfluous materials, equipment, and garbage.

B. Walks and pavement shall be swept or washed clean upon completion of the WORK of this Section.

1.4 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The CONTRACTOR shall be responsible for protecting, watering, fertilizing, and maintaining sod areas until final acceptance of the WORK.

B. At time of acceptance, sod areas shall be totally established with no bare spots, mowed a minimum of 4 times, and the grass shall be at least 1-1/4 to 2 inches in height.

C. Upon completion of sodding, the entire planted area shall be soaked to saturation by a fine spray. The new planting shall be kept watered by the sprinkling system on the Site during dry weather or whenever necessary for proper establishment of the turf. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the CONTRACTOR.

D. Protection: The CONTRACTOR shall provide adequate protection to all newly sodded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the one-year correction period.

E. The CONTRACTOR shall replace any materials or equipment it has damaged or which has been damaged by its employees or subcontractors.

F. Partial utilization of the project shall not relieve the CONTRACTOR of any of the requirements of this Section

G. Mowing of Sod Areas: First mowing of turf areas shall begin as soon as the grass has reached a height of 3 inches and subsequent mowing shall be at least once a week, or as often as necessary to maintain turf areas at a uniform height of 1-1/2 to 2 inches.

H. Maintenance shall include, in addition to the foregoing, cleaning, edging, the repair of erosion, and other maintenance work. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.

1.5 FINAL INSPECTION AND GUARANTEE

A. Inspection of sodded areas will be made at final acceptance.

B. Written notice requesting inspection shall be submitted to the ENGINEER at least 10 days prior to the anticipated inspection date.

C. Any delay in completing the WORK of this Section beyond a single season will be cause for extending the correction of defects period an equal time.

D. The CONTRACTOR shall, without additional expense to the OWNER, replace sodding which develops defects or dies during the correction period.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Materials for soil conditioning and weed abatement shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or furnished with each delivery. Delivery certificates shall be given to the ENGINEER as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the ENGINEER prior to final acceptance.

2.2 SOD GRASS

A. The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 1-inch in any dimension, woody plant roots and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregularly shaped pieces of sod and torn or uneven ends shall be rejected.

B. Sod shall be machine cut to a uniform thickness of 1-1/4 inches within a tolerance of 1/4 inch, excluding top growth and thatch. Measurement for thickness shall exclude top growth and thatch.

C. Sod shall contain at least 85 percent permanent grass suitable to the climate in which it is to be placed; not more than 25 percent nursing grass; not more than 10 percent weed and undesirable grasses, and shall be of good texture, free from obnoxious roots, stones and foreign materials.

D. The sod shall be nursery grown Bahia, or similar to existing, sod. It shall be uniformly cut approximately 3/4-inch or more thick and shall be well rooted, 2-year old growth of permanent and desirable grasses indigenous to this general location. The sod shall be practically free from weeds and undesirable grasses.

PART 3 -- EXECUTION

3.1 SOD PLACEMENT

A. Sodding Period: Sod shall be placed from March 30 to June 1 for spring planting and from September 15 to November 1 for fall planting.

B. Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a minimum depth of 1 inch.

C. Placing Sod: Rows of sod shall be placed parallel to and tightly against each other. joints shall be staggered laterally. The sod strips shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. On long slopes, sod shall be laid at right angles to slopes. In ditches, sod shall be laid at right angles to the flow of water. When required, the sod shall be anchored by placing anchors a minimum distance of 2-feet on center with a minimum of 2 anchors per sod section.

D. Finishing: All air pockets shall be eliminated and a true and even surface shall be provided by tamping or rolling the sod in place. Displacement of the sod shall be assured by knitting of sod to the soil. Frayed edges shall be trimmed and holes or missing corners shall be patched in the sod.

E. Water Sod: Watering shall be started immediately after completing each day of sodding. Water shall be applied at a rate of 1-1/2 inches of water per week and at sufficient intervals to ensure moist soil conditions to a minimum depth of 1-inch. Run-off and puddling shall be prevented

END OF SECTION

SECTION 33 05 05 – PRESSURE PIPE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall test and disinfect potable water pipelines and appurtenant piping, in accordance with the Contract Documents.

B. The Contractor shall be responsible for obtaining permits for discharging excess testing and disinfection water and dechlorination of such water if required to satisfy permit limits.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Definitions

1. Makeup water: The quantity of water that must be supplied into a pipeline section to maintain the specified test pressure during a hydrostatic pressure test.

2. Pigging: Passage of a sufficient number of pigs through a pipeline to achieve the clean conditions required.

3. Testing allowance: The maximum quantity of makeup water that may be added into a pipeline section undergoing hydrostatic pressure testing to maintain the specified test pressure.

4. Visible Leakage: The visible escape (e.g., drip, spray, stream, flow) of test liquid from the test section through components, joints, connections, appurtenances, and the like in the test section.

B. Reference Specifications

01 33 00	Submittal Procedures

C. Reference Standards

American National Standards Institute (ANSI) / American Water Works Association (AWWA)	
ANSI/AWWA B300	Hypochlorites
ANSI/AWWA B301	Liquid Chlorine
ANSI/AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
ANSI/AWWA C604	Installation of Buried Steel Water Pipe - 4 In. (100 mm) and Larger
ANSI/AWWA C651	Disinfecting Water Mains
ANSI/AWWA C655	Field Dechlorination
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA Manual M9	Concrete Pressure Pipe
AWWA Manual M41	Ductile-Iron Pipe and Fittings
AWWA Manual M55	PE Pipe - Design and Installation

ASTM International (ASTM)	
ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Furnish:

1. A testing plan and schedule for flushing and pigging, and hydrostatic testing. This shall include all equipment to be used including but not limited to pump, metering device, pressure gauge, etc., to be used for maintaining test pressure and measuring the amount of water required to maintain test pressure; method of connection of pump to pipeline; sections of pipeline to be tested with length and size of pipe, the exact area being tested, and the valves, plugs, caps, etc., being tested against indicated; and allowable loss calculations.

2. A plan and schedule for disinfection and bacteriological testing. This shall include the form of chlorine to be used; method of chlorination; flushing locations, rates of flushing, and locations of drainage facilities; the number and frequency of samples for bacteriological tests; method of taking samples; and name of the certified bacteriological testing laboratory.

3. Resume of experienced technician shall be submitted if liquid chlorine is proposed. The method of dechlorination shall be included if chlorinated water discharges to the environment are proposed.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Liquid Chlorine Technician: Shall be familiar with the biological, chemical, and physical properties of liquid chlorine and be trained and equipped to handle emergencies that may arise.

PART 2 -- PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the Contractor. No materials shall be used that would be injurious to the WORK.

B. Pressure Monitoring: A pressure gage or sensor accurate to within 2% of full scale, with full scale no be more than twice the test pressure and scale graduations no greater than 2% of the full scale.

C. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

1. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301, and shall be used only when each of the following conditions are satisfied:

a. Appropriate gas flow chlorinators and ejectors are used.

b. An experienced technician directly supervises.

c. Appropriate safety practices are observed to protect working personnel and the public.

2. Sodium hypochlorite (liquid form) and calcium hypochlorite (granular form or tablets) shall be in accordance with ANSI/AWWA B300.

D. Dechlorination agents shall be in accordance with ANSI/AWWA C655.

PART 3 -- EXECUTION

3.01 GENERAL

A. Water for testing and disinfecting water pipelines will be furnished by the Owner; however, the Contractor shall convey the water from the Owner-designated source to the points of use, and secure and pay for the metered water.

B. Hydrostatic pressure testing shall be performed for all pressure pipelines. Potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the Engineer.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the Engineer.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the WORK is accepted by the Owner. Bacteriological testing shall be performed by a certified testing laboratory accepted by the Owner. Results of the bacteriological testing shall be satisfactory with the state Department of Health or other regulatory agency having jurisdiction.

3.02 FLUSHING AND PIGGING

A. Flushing is recommended prior to a pressure test to reduce the probability of foreign material causing valve-seat or hydrant-seat leakage during pressure tests. Flushing should be accomplished by partially opening and closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out. The pipeline flow velocity shall be no less than 3.0 ft/s (0.91 m/s). The duration of the initial flushing procedure shall be continued until the discharge appears clean; however, the minimum duration shall be based sufficient that a minimum of three changes of pipeline volume occurs.

B. For larger mains or where conditions do not permit the required flow to be discharge to waste, pigging shall be required. The Contractor shall clean the system thoroughly by pigging to remove sand, grit, gravel, stones, fluids, construction waste, and all material which would not be found in a properly cleaned pipeline. Pigging shall obtain a smooth interior pipe surface free from any material or fluid not used in cleaning.

1. Provision for pig access and egress points and disposal of water and materials shall be the Contractor's responsibility.

2. Pigs shall be individually marked and their location shall be controlled and monitored so that no pigs remain in the system after cleaning.

3. Pigging may be done in conjunction with initial filling for the hydrostatic test.

C. For 24-in (600-mm) or larger diameter mains, an acceptable alternative to flushing is to carefully broom-sweep the main, carefully removing sweepings prior to filling and chlorinating the main. The Contractor shall address OSHA requirements for confined space prior to entering a pipeline.

3.03 HYDROSTATIC TESTING OF CONCRETE, DUCTILE IRON, PVC, AND WELDED STEEL WATER PIPELINES

A. General Requirements:

1. The Contractor shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline or, where such valves are not present, the Contractor shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero leakage allowance may be tested as a unit.

2. The Contractor shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.

3. The Contractor shall remove or protect pipeline-mounted devices that may be damaged by the test pressure.

4. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 days.

5. Hydrostatic testing shall be conducted in accordance with this Section and requirements of the following:

a. Concrete pressure pipe: AWWA Manual M9.

b. Ductile iron pipe: AWWA Manual M41 and ANSI/AWWA C600.

c. PVC pipe: ANSI/AWWA C900.

d. Welded steel water pipe: ANSI/AWWA C601.

B. Pre-test Procedures:

1. The test section shall be slowly filled with potable water at a rate that allows air to leave the line at the same rate as water entering the line to minimize air entrapment and potential surge pressures. The test section shall be filled from a low point.

2. Air shall be expelled completed from the test section. If permanent air vents are not located at all high points, corporation cocks shall be installed at all high points to expel any air as the line is filled with water. Following the removal of any air, the corporation cocks shall be closed and the test pressure applied.

a. At the conclusion of the pressure test, the corporation cocks shall either be removed and the pipe plugged or be left in place as directed by the Engineer.

3. The main valve of hydrants in the test section shall be closed.

4. Pipe with cement-mortar linings shall be filled for a minimum of 24 hours prior to testing to allow for water absorption into the lining. Concrete pressure pipe shall be filled for a minimum of 48 hours prior to testing to allow concrete lining to be saturated.

5. The specified test pressure shall be applied using a suitable pump connected to the pipeline.

6. The pipeline shall be allowed to stabilize at the test pressure before conducting the hydrostatic pressure. This may require several cycles of pressurizing and bleeding trapped air prior to beginning the test.

C. Hydrostatic Pressure Testing for Acceptance:

1. The hydrostatic test shall be of at least a 2-hr duration.

2. The test pressure in the test section shall be as indicated in the Piping Schedule. The test pressure shall be measured at the lowest point of the test section.

3. The test pressure shall not vary by more than 5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline to return the pressure in the test section to the starting pressure.

4. At the end of the test period, makeup water shall be added through the pressure test pump into the pipeline to return the pressure in the test section to the starting pressure.

5. The section of pipe passes if the total amount of makeup water added during the test period and at the end of the test period does not exceed the applicable testing allowance.

D. Testing Allowance:

The testing allowance for pipelines may be calculated using the equation below from ANSI/AWWA C600:

- In inch-pound units:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where:

L	=	testing allowance (makeup water), gph
S	=	length of pipe tested, ft
D	=	nominal diameter of the pipe, in
P	=	average test pressure during the hydrostatic test, psi (gauge)

1. For test sections up to 2,000 feet of pipe, the testing allowance shall be calculated based on the actual length of pipe. When the test section exceeds 2,000 feet of pipe, the testing allowance shall be that which would be allowed for 2,000 feet of pipe.

2. If pipe with a zero leakage allowance is included in a test section, then length of pipe with a zero leakage allowance shall not be considered when calculating the testing allowance.

3. For distribution and transmission pipelines with rubber-gasketed joints, the testing allowance shall be:

    a. PVC and Ductile Iron Pipe: 10.5 gallons per nominal inch diameter per mile per 24 hours.

4. Pipelines with welded or heat-fusion joints shall have no leakage.

5. Exposed piping shall have no visible leakage and no pressure loss during the test.

3.04 HYDROSTATIC TESTING OF HDPE PIPELINES

A. General Requirements

1. The Contractor shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline or, where such valves are not present, the Contractor shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments.

2. The Contractor shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.

3. The Contractor shall remove or protect pipeline-mounted devices that may be damaged by the test pressure.

B. Pre-test Procedures

1. The test section shall be slowly filled with potable water at a rate that allows air to leave the line at the same rate as water entering the line to minimize air entrapment and potential surge pressures.

2. Air shall be expelled completed from the test section. If permanent air vents are not located at all high points, corporation cocks shall be installed at all high points to expel any air as the line is filled with water. Following the removal of any air, the corporation cocks shall be closed and the test pressure applied.

    a. At the conclusion of the pressure test, the corporation cocks shall either be removed and the pipe plugged or be left in place as directed by the Engineer.

3. The main valve of hydrants in the test section shall be closed.

C. Hydrostatic Pressure Testing for Acceptance

1. Pressurize the test section by gradually adding water using a suitable pump connected to the pipeline. Initially advance the pressure to 50 psi (345 kPa). Then the pressure shall be advanced in gradual additional until the test pressure is achieved. The test pressure shall be maintained for 3 hours to allow for pipe expansion, adding water as necessary.

2. Immediately after the 3-hour expansion period, the test pressure shall be reduced by 10 psi (69 kPa) and the addition of water stopped. Monitor for 1 hour. If the pressure drops by less than 5 percent, then the test section of HPDE pipeline passes.

3.05 REPAIR AND RETESTING AFTER FAILING TESTS

A. In the case of pipelines that fail to pass the leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

3.06 DISINFECTING PIPELINES

A. General: Potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the “Continuous-Feed Method” as modified herein. Where not practical (e.g., for large-diameter mains where the volume of water makes the continuous-feed method impractical and difficult to achieve for short segments), pipelines shall be disinfected using the “Slug Method” in accordance with ANSI/AWWA C651.

B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/L. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. Retention Period: Chlorinated water shall be retained in the pipeline for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/L. If testing does not demonstrate a residual of 25 mg/L or greater, the disinfection procedure above shall be repeated.

D. Chlorinating Valves: During the process of chlorinating the pipelines, valves and other appurtenances shall be operated from closed to full open to closed while the pipeline is filled with the heavily-chlorinated water.

E. Sampling Taps: The Contractor shall provide sampling taps as shown in ANSI/AWWA C651 or as approved by the Engineer. Taps may be made at manways and air valves to help facilitate the spacing requirement.

F. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. Any release of chlorinated water into the environment shall comply with applicable federal, state, and local regulations and the permit requirements for the project. Dechlorination of chlorinated water being discharged to the environment shall be performed in accordance with ANSI/AWWA C655.

G. Bacteriological Testing: After disinfection and final flushing such that typical system chlorin residuals are present, if the system operates with a residual, bacteriological testing for total coliform analysis shall be performed in accordance with ANSI/AWWA C651 and the applicable requirements of the state Department of Health or other agency having jurisdiction. The pipe shall be filled with fresh potable water and left for a period of 24 hours before any sample is collected. An initial set of samples shall be taken and then second set up samples shall be taken after a minimum of 16 hours. Each set of samples shall include a sample taken every 1,200 feet (370 meters) of new potable water main, plus one sample at the end of the line and at least one from each branch greater than one pipe length.

H. Redisinfection: If the initial disinfection treatment fails to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

3.07 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a minimum one percent free chlorine solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

SECTION 33 21 00 - WATER SUPPLY WELL

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Water Supply Well

1. The CONTRACTOR shall provide all labor, materials, transportation, tools, supplies, services, equipment, and appurtenances, unless specifically excepted hereinafter, required to complete the wellhead work for a water supply well (Well No. 4), at the Seminole Tribe of Florida (STOF) Immokalee Water Treatment Plant.

2. General well construction information for Well No. 4 is provided in **Table 1**.

Table 1: Summary of Well Construction Details

Well ID	Diameter (inches)	Cased Depth (ft-bls)	Screened Interval (ft-bls)	Approximate Pump Capacity (gpm)
No. 4	12	120	120-205	400-500

3. The total depth of Well No. 4 is approximately 205 feet below land surface (bls).

4. Drilling of the water supply well was completed under a previous contract.

5. If the CONTRACTOR requires a dumpster, the CONTRACTOR shall use the OWNERS waste hauler.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).

   a. ASTM A 53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

   b. ASTM A 139, Specification for Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over)

   c. ASTM C 150, Specification for Portland Cement

   d. ASTM C 494, Specification for Chemical Admixtures for Concrete

   e. ASTM C 618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

   f. ASTM D 1785 - 06 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

2. American Welding Society, (AWS)

3. American Water Works Association, (AWWA)

    a. AWWA A100 Standard for Water Wells (Latest version at time of Bid)

4. U.S. Environmental Protection Agency, (EPA).

    a. Manual of Water Well Construction Practices EPA Document #EPA-570/9-75-001

    b. Manual of Water Well Construction Practices EPA Document #EPA-570/9-75-001

5. South Florida Water Management District (SFWMD)

    a. Chapter 40-3, Regulation of Wells

6. Florida Department of Environmental Protection (FDEP)

    a. Chapter 62-532, Water Well Permitting and Construction Requirements

7. American National Standards Institute (ANSI)

    a. ANSI B 36.10

1.3 CODES AND STANDARDS

A. Latest editions with current revisions and amendments of the following codes and standards are considered minimum requirements for materials, workmanship, and safety where not covered elsewhere in these Specifications.

1. Florida Building Code 8th Edition (2023)

2. CISPI – Cast iron Soil Pipe Institute

3. PDI – Plumbing Drainage Institute

4. U.L. – Underwriters' Laboratories Listed

5. NSF – National Sanitation Foundation

6. NEMA – National Electrical Manufacture's Association

7. ANSI – American National Standards Institute

8. NFPA No. 101 – Life Safety Code

9. NFPA No. 70 – Electrical

10. ADA – Americans with Disabilities Act

11. F.M. – Factory Mutual Research Corporation Approved

12. NAIMA – North American Insulation Manufacturers' Association

1.4 QUALITY ASSURANCE

A. The ENGINEER will perform part-time observation during construction activities of the water supply wellhead. The CONTRACTOR shall cooperate with the ENGINEER in performing this observation, which shall include, but not be limited to, well development, testing, and water quality sampling.

B. Products used in the WORK specified under this Section shall be produced by manufacturers regularly engaged in the production of such items that have a successful history of product acceptability, as interpreted by the ENGINEER. Equipment of less quality or of inferior design to that specified will not be accepted.

C. The CONTRACTOR shall provide a Project Superintendent and a dedicated Project Manager specific to this project as a supervisor to oversee proper performance of the WORK. The Project Manager shall attend all meetings and have the authority to make decisions on behalf of the CONTRACTOR. The Project Manager shall be in attendance at the site at a minimum of once a day to evaluate the construction and to prepare a daily job report. The Project Manager shall be responsible for all coordination, document handling, submittal review and processing, quality control, and project scheduling. The Project Manager, once approved by the OWNER and the ENGINEER shall not be replaced without prior consent by the OWNER and ENGINEER.

1. The Project Superintendent shall be a direct employee of the Prime CONTRACTOR.

2. The Project Superintendent and Project Manager shall fluently speak, read, and write in English.

1.5 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with **Section 01 33 00** approval prior to starting well construction at the water supply well.

B. Submit the following prior to receipt of the Notice to Commencement:

1. Shop Drawings:

a. Well development plan

b. List of permits

c. Permit applications

d. Records of permit approval/denial

e. Certificates of compliance with warranties

f. Record of permits (closeout)

C. Informational Submittals

1. A Daily Contractor's Report shall be kept available at the Site for review by the ENGINEER and at the conclusion of the water supply wellhead construction, two (2) neat, legible copies of these reports shall be submitted to the ENGINEER. The daily reports shall be submitted to the ENGINEER at the end of each week

WORK is completed. These reports shall contain, but not be limited to, the following information for each day's activity:

a. Number of crew on the Site and name of superintendent for each shift

b. Number of hours on the job

c. Number of hours of shutdown

d. WORK completed each day

e. Amount of water used each day

f. Material used each day

2. If the CONTRACTOR requires any changes to these Specifications, as outlined herein, the CONTRACTOR shall submit, in writing, the changes to the ENGINEER a minimum of 24 hours prior to commencement of the change. Change shall require approval of the ENGINEER prior to their implementation.

3. The CONTRACTOR shall develop a health and safety plan and submit it to the ENGINEER and the OWNER prior to the start of the WORK. The CONTRACTOR health and safety plan shall have a subsection which details site specific hazards.

1.6 SITE CONDITIONS

A. The water supply well is located just east of the STOF Immokalee WTP adjacent to the John Jimmie Memorial Arena as shown on the Drawings.

B. The CONTRACTOR shall coordinate with the STOF Staff during execution of the Work.

1. The CONTRACTOR shall coordinate with WTP personnel to review the securing of the Work area and make any adjustments requested by STOF personnel to ensure the Work area is secure for the safety of personnel and public.

2. The CONTRACTOR shall provide personnel access to the Work area when requested for any operations or maintenance activities.

3. The CONTRACTOR shall obtain permission from the STOF prior to conducting any Work on the area outside of the secured Work zone. This shall include discharge of well development water.

4. The CONTRACTOR shall restore and immediately repair irrigation systems damaged by the CONTRACTOR equipment. Any damage to the irrigation system shall be reported to the ENGINEER and the STOF immediately.

C. The CONTRACTOR can use the OWNER’s water hydrants for a source of water. Refer to **Section 01 51 00 Temporary Utilities**.

PART 2 -- PRODUCTS - (NOT USED)

PART 3 -- EXECUTION

3.1 COMPLETION OF WATER SUPPLY WEL

A. Disposal of Discharge Water

1. The CONTRACTOR is responsible for capturing and disposing of all discharge water as shown.

   a. Prior to any discharge, the CONTRACTOR shall sample discharge water and have it analyzed for arsenic. The results shall be provided to the OWNER to demonstrate arsenic levels are below the maximum contaminant level. The CONTRACTOR shall begin dispose of discharge water only with OWNER approval. The CONTRACTOR shall sample and analyze disposal water for arsenic during disposal operations.

   b. All discharged water shall be directed into a settling tank prior to being discharged. The discharge water turbidity level must be reduced to within 29 NTU of receiving water background levels before being sent to the ponds or as directed in the discharge permit. The CONTRACTOR is responsible for collection of turbidity readings.

2. During well development and testing, the CONTRACTOR shall provide all equipment and appurtenances necessary for disposal of discharge water into the OWNER's ponds and canals as indicated. These shall include, but not be limited to sedimentation tank (with air break), clean water tank, check valves, air release valves, backflow preventers, transfer pumps, isolation valves, piping, and restraints etc. The CONTRACTOR shall be responsible at all times for preventing releases of discharge water onto the ground. The CONTRACTOR shall be responsible for selecting the appropriate transfer pumps for discharging the development and test water into the ponds or canals.

3. The discharge line shall not exceed 8-inches in diameter, shall be a combination of rigid and lay-flat lines, and shall be secured to prevent movement. Above ground cart path crossings will be permitted if approved by the OWNER and ENGINEER.

4. The CONTRACTOR is responsible for armoring the discharge point so that erosion of the pond or canal bank and bottom does not occur. The CONTRACTOR is responsible for all restoration efforts needed to restore the pond at the discharge point to original condition.

5. The CONTRACTOR shall utilize floating turbidity curtains to further reduce silt entering the ponds and canals.

6. The CONTRACTOR shall collect all water quality data associated with discharge and dewatering permit requirements.

B. Well Development

1. Development shall be by a combination of mechanical surging, airlifting, and pumping. The CONTRACTOR will submit a Well Development Plan that outlines this operation including equipment Specifications. The development will begin at the bottom of the well and proceed upward.

2. The CONTRACTOR shall be responsible for maintaining turbidity levels of the development discharge water to the nearby water ways. If turbidity levels are exceeded, the CONTRACTOR shall capture and dispose of all development water until turbidity levels meet the requirements stated in Section A Disposal of Discharge Water.

3. Sand, silt, or other foreign material shall be removed from the interior of the well by the time development is complete.

4. Initial development shall be by a combination of mechanical surging and air lifting.

5. The CONTRACTOR shall furnish, install, operate, and remove a temporary pump for further developing the well after mechanical surging and air lifting is complete. The CONTRACTOR shall furnish and install discharge piping for the pumping unit in accordance with Section A, Disposal of Discharge Water and of appropriate length to conduct water to a holding container for disposal at a location designated by the ENGINEER. The CONTRACTOR shall also furnish, install, and operate acceptable orifices, meters, or other approved devices, which will accurately measure the flow rate. A sounding tube shall be installed to a depth designated by the ENGINEER to allow water levels to be easily measured by the CONTRACTOR.

6. The initial pumping rate shall be restricted and as the water clears shall be gradually increased until the maximum rate is reached. The maximum rate will be determined by the ENGINEER after consideration of the well's drawdown and discharge characteristics but is generally considered to be approximately 250 gpm greater than the rated capacity of the well. At proper intervals the pump shall be stopped and the water in the pump column shall be allowed to flow back (surge) through the pump bowls and open area.

7. The CONTRACTOR shall repeat the cycle of pumping and surging until, in the opinion of the ENGINEER, the following conditions have been properly met:

   a. Sand production shall be less than one (1) parts per million (ppm) within 20 minutes after commencement of pumping at the production rate selected by the ENGINEER. Average sand production shall not exceed five (5) ppm for a two-hour cycle at that production rate. Sand production shall be measured by a Rossum Sand Tester, which shall be supplied and properly installed by the CONTRACTOR.

   b. The discharged water is clear of sand, silt, and mud.

   c. There is no increase in specific capacity during at least four (4) hours of continuous pumping and surging.

C. Well Closeout

1. Upon completion of water production testing and removal of the test pump, the CONTRACTOR shall run a color video survey log of the entire well depth. The video equipment introduced into the water supply well shall be thoroughly washed and disinfected in a manner approved by the ENGINEER, prior to inserting into the well. The CONTRACTOR shall make available Four (4) total DVD copies. Two (2) copies of the video survey to the OWNER and the ENGINEER.

2. If the video log indicates material in the bottom of the well related to construction activities, the CONTRACTOR shall be responsible for removing it. All oil, soil, and other materials which could harbor and protect bacteria from disinfectants, shall be removed from the well.

3.2 WELL DISINFECTION

A. The CONTRACTOR shall provide for disinfection of the well immediately after field adjustment services have been completed.

B. Well Disinfection:

1. Disinfection of the well shall be performed in accordance with the requirements of with Sections 1 through 4 and Section 5.2 of American Water Works Association (AWWA) Standard C654, as incorporated into Rule 62-555.330, Florida Administrative Code (F.A.C.).

2. The CONTRACTOR shall utilize either sodium hypochlorite or calcium hypochlorite that meets NSF/ANSI 60 standard for chemicals used in drinking water systems for sanitization.

3. The water in the well casing shall be treated with the chlorine to provide a minimum chlorine residual concentration of 50 mg/L. The quantity of chlorine compounds required to produce a chlorine residual of 50 mg/L may be calculated by multiplying the appropriate quantity shown in ANSI/AWWA C654, Appendix A, Table A.1 by the appropriate factor.

4. After a minimum of eight (8) hours contact time, the CONTRACTOR shall flush the well and piping to remove all chlorinated water until zero chlorine residual is achieved. All water pumped from the well must be properly collected in a tank and dechlorinated using sodium bisulfite before disposal to a pre-approved discharge area. Field testing shall be conducted to ensure a chlorine residual of zero prior to disposal.

5. The CONTRACTOR shall perform post-disinfection sampling necessary to obtain a release from the Health Department to place the well into service.

a. The CONTRACTOR shall meet with the ENGINEER and OWNER to discuss bacteriological sampling procedures and requirements prior to scheduling.

b. The CONTRACTOR shall collect samples on consecutive days with a minimum of twelve (12) hours between sample times. Two samples shall be collected each day and submitted for bacteriological testing.

c. The well shall be purged for a minimum of 15 minutes prior to sampling. At the end of 15 minutes, the water shall be tested for chlorine residual to ensure zero chlorine residual. If the residual chlorine is zero, two samples shall be taken for bacteriological testing. Immediately following sampling, the two samples shall be submitted to the OWNER's laboratory for bacteriological testing.

d. The CONTRACTOR shall coordinate with the OWNER's laboratory for all bacteriological sampling, including scheduling, sampling containers and volumes, and procedures. The CONTRACTOR shall provide a minimum of 48 hours notice in advance of all sampling.

e. If either of the samples are positive for Total Coliform, the well must be re-sampled until two consecutive samples show the absence of coliform.

f. If any test fails, the CONTRACTOR shall be responsible for all retesting by contracting with an NELAC-certified lab to collect samples and conduct bacteriological testing. The CONTRACTOR will be responsible for all resampling at no additional cost to the OWNER.

g. The CONTRACTOR shall be responsible for all labor and materials required to complete sampling and re-testing until clearance of the well is obtained, including any additional samples required and/or re-disinfection of the well, if deemed necessary.

3.3 RESTORATION

A. The CONTRACTOR shall repair any damage caused by the well construction or testing WORK.

B. The CONTRACTOR shall remove all debris, excess materials, ensure final grading, repl sod as needed, and return of site to its original condition.

C. The CONTRACTOR shall restore the area in coordination with installation of the surface facilities included as part of the WORK.

END OF SECTION

33 95 50 PVC PRESSURE PIPING (AWWA C900, MODIFIED)

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide polyvinyl chloride (PVC) pressure pipe, complete in place, as indicated in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

AWWA C104/A21.5	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution
ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
AWWA C651-14	Disinfection Water Mains MAINS

PPI Technical Report TR 3/4 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials

AWWA Manual M23 PVC Pipe - Design and Installation

1.3 CONTRACTOR SUBMITTALS

A. Shop Drawings

1. Submit drawings of pipe, fittings, and appurtenances.

2. Submit design calculations in order to demonstrate compliance of pipe and fittings with the requirements of this Section.

3. Furnish manufacturer's literature for metallic locating tape.

1.4 QUALITY ASSURANCE

A. Testing

1. Test the materials used in the manufacture of the pipe in accordance with the requirements of this Section and the referenced standards, as applicable.

2. The ENGINEER shall have the right to witness testing, provided that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.

3. Additional Samples

   a. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the OWNER.

   b. Furnish the additional samples as a part of the WORK.

PART 2 -- **PRODUCTS**

2.1 GENERAL

A. Provide PVC pressure pipe (4-inch through 12-inch) conforming to the applicable requirements of AWWA C900, and the requirements indicated in this Section.

B. PVC pipe shall have the following minimum thickness:

Pipe Nominal Diameter	Minimum DR
4” to 6”	DR 14
8” to 12”	DR 18

2.2 PIPE DESIGN CRITERIA

A. General

1. Design PVC pressure pipe wall thickness for internal pressure in accordance with the requirements of AWWA M23, as applicable, and the requirements indicated in this Section.

B. Deflection Control

1. The deflection of the pipe after installation, as determined from the Modified Iowa Formula outlined in AWWA M23, shall not exceed 0.03 times the outside diameter.

2. If the calculated deflection exceeds 0.03 times the outside diameter, increase the pipe class or improve the quality of the pipe zone backfill in order to achieve a higher modulus of soil reaction, E'.

3. For purposes of calculation, values of E' shall be 1100 psi at 90 percent Standard Proctor; 1500 psi at 95 percent Standard Proctor; and 2500 psi at 100 percent Standard Proctor, and the deflection lag factor shall be 1.5.

2.3 PIPE

A. Provide pipe of the indicated diameter and pressure class, complete with rubber gaskets.

B. Provide specials and fittings as indicated.

C. Raw water PVC pipe shall be solid wall blue pipe with Olive Green Marking and label "RAW WATER".

D. Pipe shall be continuously and permanently marked with the manufacturer's name, pipe, size, and DR rating or pressure rating.

E. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.s shall conform to the requirements of AWWA C900.

F. Dimension Ratio (DR):

Minimum dimension ration series shall be as follows:

Nominal Diameter	**Service**	**Minimum Dimension Ratio**
4", 6"	Water/Sewer	14
8", 10", 12"	Water/Sewer	18

G. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.s shall conform to the requirements of AWWA C900 and C905.

H. Additives and Fillers

1. Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin).

2. If requested by the ENGINEER, determine the additive and filler content using the pyrolysis method as specified in ASTM D 2584.

I. The hall be marked with the extrusion or manufacturing code on the pipe. This coding shall be done in conjunction with records to be held by the manufacturer for 2 years, which indicates the date of manufacture, quality control tests, raw material batch number and other information deemed necessary by the manufacturer.

J. Joints

1. Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint.

2. Provide the bell and coupling of the same thickness as of the pipe barrel, or greater thickness.

3. Provide the sealing ring groove in the coupling of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

4. Where indicated, provide ductile iron restrained joint pipe.

5. No restrained joint PVC pipe will be accepted.

K. Joint Deflection

1. Deflection at the joint shall not exceed 75% of the maximum deflection recommended by the manufacturer.

2. No deflection of the joint will be accepted for joints that are over-belled or not belled to the stop mark.

L. Restrained joints for PVC pipe shall properly fit the pipe being installed and shall be manufactured by:

1. EBAA Iron, Inc., Series 2000PV

2. Romac Industries, Grip Ring

3. Ford, Uni-Flange

4. Stargrip series 4000

5. Sigma One Lok SLC Series

M. Bell restrained harnesses shall be used where in-line PVC restrained joints is required. Bell restrained harnesses for PVC pipe shall be manufactured by:

1. EBBA Iron, Inc., Series 1600

2. Stargrip Series 1100C

3. Sigma PVP Series

4. Ford, Uni-Flange series 1390

N. PVC Pipe Manufacturers or Equal:

1. J-M Pipe, Model Blue Brute for water service and Model Ring-tite for sewer/force main service.

2. Diamond Plastic Corporation

3. Certain Teed

2.4 FITTINGS

A. Provide ductile iron fittings conforming to the requirements of AWWA C110, Class 350.

B. PVC pipe fittings shall be mechanical joint.

C. Fittings shall be cement lined and seal coated per ANSI/AWWA C104 in accordance with the requirements of Specification 09 96 00 – Protective Coating.

D. Clearly label each fitting in order to identify its size and pressure class.

2.5 IDENTIFICATION AND LOCATING DEVICES

A. All PVC pipes shall be provided with “early warning” protection tape, 3-inches wide installed continuously along the pipeline alignment. Tape shall be installed during backfilling 12-inches to 18-inches directly above the centerline of the pipe.

1. Tape shall be color coded and marked based on the type of service as follows:

Service	**Color**	**Marking**
Potable / Raw Water	Blue / Olive Green	"Caution – Water Line Buried Below"

2. The tape shall be as manufactured by Terra Tape, Pro-Line Safety Products or approved equal.

B. Markers shall be installed at all fittings (horizontal and vertical) and valves, as detailed in the Drawings.

PART 3 -- **EXECUTION**

3.1 GENERAL

A. Perform laying, jointing, and testing for defects and leakage in the presence of the ENGINEER and obtain the ENGINEER's approval before acceptance.

B. Material found to have defects will be rejected, and the CONTRACTOR shall promptly remove such defective materials from the Site.

C. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements indicated herein.

D. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 HANDLING AND STORAGE

A. Handling

1. Carefully inspect pipe, fittings, and accessories before and after installation, and reject those found to be defective.

2. Pipe and fittings shall be free from fins and burrs.

3. Before being placed in position, clean the pipe, fittings, and accessories and maintain them in a clean condition.

4. Provide proper facilities for lowering sections of pipe into trenches.

5. Under no circumstances drop or dump pipe, fittings, or any other material into trenches.

B. Storage

1. Store pipe, if possible, at the Site in unit packages provided by the manufacturer.

2. Exercise caution to avoid compression damage or deformation to bell ends of the pipe.

3. Store pipe in such a way as to prevent sagging or bending and protect pipe from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe.

4. Store gaskets in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Specification 31 30 00 – Earthwork.

3.4 INSTALLATION

A. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying.

B. Grade the pipe in straight lines, taking care to avoid the formation of any dips or low points.

C. Do not lay pipe when the conditions of trench or weather are unsuitable.

D. At the end of each day's WORK, temporarily close the open ends of pipe with wood blocks or bulkheads.

E. Supports

1. Support pipe at its proper elevation and grade, taking care to provide firm and uniform support.

2. Wood support blocking will not be accepted.

3. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with a recessed excavation in order to accommodate bells, joints, and couplings.

4. Provide anchors and supports where indicated and where necessary for fastening WORK into place.

5. Independently support fittings.

F. Use short lengths of pipe in and out of each rigid joint or rigid structure.

G. Replace piping that does not allow sufficient space for proper installation of jointing material with piping of proper dimensions.

H. Blocking or wedging between bells and spigots will not be accepted.

I. Install joints in accordance with the manufacturer's recommendations.

J. Keep trenches free of water until joints have been properly made.

K. The maximum combined deflection at couplings shall be in accordance with the manufacturer's recommendations.

L. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with a lubricant recommended by the pipe manufacturer shall be placed in the bell groove. The spigot end of the pipe shall be carefully cleaned and lubricated with the same lubricant. The

spigot end of the pipe shall then be inserted into the bell of the previously laid joint and pushed into its proper position. The spigot and bell end of rubber gasketed joints shall not be forced together by the use of excessive mechanical force. Tilting of the pipe to insert the spigot into the bell will not be permitted.

M. Cutting

1. Cut the pipe by means of saws, power-driven abrasive wheels, or pipe cutters, which will produce a square cut.

2. Cuts by wedge-type roller cutters will not be accepted.

3. After cutting, bevel the end of the pipe using a beveling tool, portable type sander, or abrasive disc.

3.5 INSTALLATION OF TRACER WIRE

A. Provide polyvinyl chloride pipelines with 14-gauge multi strand copper wire, laid along the top of the pipe and held in place with ties or hitches of the same kind of wire and spaced not more than 13 feet apart.

B. Tracer wire shall be brought up to grade and a minimum of four (4) feet of excess wire shall be coiled at each valve. A blue wire shall be used for water mains.

C. Furnish manufacturer's literature, completely describing the tape proposed to be furnished.

D. No tape shall be used prior to receipt of written approval of the ENGINEER.

3.6 SERVICE CONNECTIONS

A. PVC Pipe Service Connections: No direct tapping or threading of PVC will be permitted. Double strap ductile iron service saddles anchored by a minimum of four (4) bolts shall be used for all service connections. Service saddles shall be sized exactly to the pipe outside diameter and shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. Sealing gaskets shall be BUNA-N rubber and straps shall be corrosion resistant alloy steel. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. Single fluted shell cutters, twist drills, or hole saws are not acceptable. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service clamps or saddles is 2 inches.

B. Tapping sleeves and valves for full body fittings shall be used for all outlet sizes greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer’s recommendations.

C. Use double-strap bronze service clamps for service connections.

D. Provide service clamps with a bearing area of sufficient width along the axis of the pipe such that the pipe will not be distorted when the saddle is made tight.

E. Cutting

1. Use an internal shell cutter to drill through the corporation stop in order to minimize PVC shavings, retain the coupon, and reduce stress.

2. Cuts by single-fluted shell cutters or twist drills will not be accepted.

3. Lubricate the cutting and tapping edges of the tool with cutting lubricant.

4. Make the cuts slowly, use the follower very lightly, and do not force the cutter through pipe wall.

5. Provide the shell cutter with sufficient throat depth to handle the heavy-wall PVC pipe.

3.7 INSTALLATION OF PIPE APPURTENANCES

A. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation.

B. Valves shall be installed so that the valve stems are plumb and, in the location, indicated.

3.8 CONNECTIONS TO EXISTING WATERLINES

A. Locate underground improvements and install the pipelines to the indicated depths.

B. Where the new WORK is to be connected to existing pipelines, the CONTRACTOR shall verify size, material, location, depth, and type of joints/connections prior to ordering any materials. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, plug the cut ends solid with concrete to a depth of not less than one pipe diameter.

C. The CONTRACTOR shall make arrangements with the ENGINEER and OWNER a minimum of one week in advance of making connections to existing pipelines. The CONTRACTOR shall schedule and expedite the WORK to minimize outages to users and shutdown time of existing facility. The maximum duration of outage to users shall be four (4) hours. The WORK may need to be scheduled at night when WTP flows are minimal.

D. The CONTRACTOR shall comply with all OWNER requirements when making connections to existing pipelines.

3.9 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection of water mains shall conform to the requirements of Specification 33 05 50 – Pressure Pipe Testing and Disinfection.

END OF SECTION

SECTION 40 05 00 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings.

C. The Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. The CONTRACTOR shall prepare pipe spooling and fabrication drawings and shall submit them to the ENGINEER for review.

D. Where pipe layout details are not indicated on the Drawings, it is the CONTRACTOR's responsibility to develop the details necessary to design and construct piping systems to accommodate the specific equipment provided, and to provide spacers, adapters, and connectors for a complete and functional system.

1.2 DEFINITIONS

A. Pipe, piping, pipe work, pipe system, piping system, or similar words, singular or plural shall mean and include, any type of pipes, tubes, fittings, valves, piping specialties, appurtenances, supports, restraints, anchors, coatings and linings and items related to piping.

B. Submerged piping, underwater piping or similar words, shall include any piping located two feet above water surface in basins or tanks

C. Potable water or similar words, shall mean and include any type of potable water or process water that be deemed potable after treatment processes.

D. Corrosive service shall mean and include in locations listed below:

a. Buried locations

b. Submerged locations or submerged piping.

c. Inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump.

d. Chemical handling areas

e. Inside trenches, containment walls, and curbed areas

f. Locations indicated or designated in the contract documents.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Pipe spooling and fabrication drawings shall indicate spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Welding Qualifications and Procedures

3. Pipe Supports: Submit pipe support fabrication drawings including calculations in accordance with Section 40 05 07 - Pipe Supports.

4. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation, and restraint system if applicable.

5. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

6. Seals and Seating Materials: Submit elastomer material and manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

7. Modular Seals for Pipe: Manufacturer's catalog sheet showing materials and installation procedures.

8. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings

9. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Samples

1. Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.

D. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

2. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricator’s or a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

1.4 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Extent of Work

1. Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. Materials in contact with potable water or process water that be deemed potable after treatment processes shall be listed as compliant with NSF Standard 61.

B. Piping Supports

1. Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 05 07 – Pipe Supports, and as indicated.

C. Lining

1. Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated.

D. Coating

1. Application, thickness, and curing of coating on buried pipe shall be in accordance with the applicable Sections of Division 33 and Section 09 96 00 - Protective Coating, unless otherwise indicated.

2. Pipes above ground or in structures shall be coated in accordance with Section 09 96 00 – Protective Coating.

E. Pressure Rating

1. Piping systems shall be designed for the pressure as defined in respective pipe sections.

F. Inspection

1. Pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture, the ENGINEER shall be given access to areas where manufacturing is in progress and shall be permitted to make inspections necessary to confirm compliance with requirements.

G. Tests

1. Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards.

2. Welds shall be tested as indicated.

3. The CONTRACTOR shall be responsible for performing material tests.

H. Welding Requirements

1. Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of AWS D1.1 - Structural Welding Code or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

I. Welder Qualifications

1. Welding shall be performed by skilled welders and welding operators who have adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

3. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

4. Qualification testing of welders and materials used during testing is part of the WORK.

2.2 PIPE FLANGES

A. General

1. Flanges shall be provided with flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated.

2. Flange faces shall be perpendicular to the axis of the adjoining pipe.

3. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for those pipes.

B. Pressure Ratings

1. 150 psig or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2. 150 psig to 275 psig: Flanges shall conform to either AWWA C207 Class E or Class F, or ASME B16.5, Class 150.

3. 275 psig to 700 psig: Flanges shall conform to ASME B16.5, Class 300.

4. Selection Based on Test Pressure

a. Do not expose AWWA flanges to test pressures greater than 125 percent of rated capacity.

b. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. Blind Flanges

1. Provide blind flanges in accordance with AWWA C207, or as indicated for miscellaneous small pipes.

2. Blind flanges for pipe diameters 12 inches and greater shall be provided with lifting eyes in the form of welded or threaded eye bolts.

D. Flange Coating

1. Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

E. Flange Fasteners

1. Unless otherwise shown on the drawings, or indicated in the applicable Sections of Divisions 33 and 40, Bolts and nuts shall conform to the following requirements;

   a. Threads shall be in accordance with ANSI/ASME B1.1, Class 2, UNC for bolt diameters 1” and smaller and UN8 for bolt diameters greater than 1”.

   b. Bolts shall have heavy hexagon heads and heavy hexagon nuts. Length of studs shall provide a projection of not less than 0.25 inch and no more than 0.5 inch through the nut when it is drawn tight.

   c. Thread studs on flange connections are not permitted except where space restrictions preclude the use of standard bolts and where approved by the ENGINEER.

   d. Through bolt holes shall be drilled in accordance with the applicable flange standard.

   e. All bolts fastening metallic flanges shall be provided with plain washers installed under the nut. Washer materials shall be of the same material as the bolt. If the through bolt holes are drilled larger than the applicable standard by 1/8 inch in diameter or more, bolts shall be also installed with a plain washer under the bolt head as well.

   f. All bolts fastening non-metallic flanges shall be provided with plain washers installed under both the bolt head and nut.

   g. Washer materials shall be of the same material as the bolt.

   h. Anti-seize compound shall be used on carbon steel fasteners, and shall be Husk-ITT, Husky 2000; or equal.

   i. Anti-galling compound used for stainless steel fasteners in LOX, nitrogen injection, oxygen, ozone process/off-gas/vent and ozone contactor maintenance air service shall be DuPont “Krytox”; or equal.

   j. Anti-galling compound used for stainless steel fasteners for other services shall be certified for potable water use and shall be Husk-ITT, Lube O’seal; Hercules, Real-Tuff; La Co, Slic-Tite; or equal.

2. Fastener Material Group Numbering System

   a. Flange fasteners shall conform to the following material standards and shall be categorized within the Fastener Material Schedule Groups as indicated:

      1) Material Group S1 (316 SS): ASTM A193, Grade B8M bolts, ASTM A194 Grade 8M nuts with Type 316 SS plain washers.

2) Material Group S2 (304 SS): ASTM A193, Grade B8 bolts, ASTM A194 Grade 8F nuts with Type 304 SS plain washers.

3. Fastener Material Group Numbers used in Non-Corrosive Service Applications

   a. AWWA C115 ductile iron flanges - Material Group C1

   b. AWWA C207 steel flanges - Material Group C2

   c. ASME B31 group piping flanges – Material Group C2

   d. Non-metallic pipe flanges - Material Group S1

   e. Stainless steel pipe flanges and all others not listed above - Material Group S1

   f. Where mating flanges are of different flange material standards and the specified Fastener Material Groups are in conflict, then fasteners of the higher grade shall be utilized unless otherwise indicated. For the purpose of this requirement, the Material Groups in order of decreasing grade shall be S1, C2, C1. Provide insulating flange sets for dissimilar metal flanged piping to electrically isolate the dissimilar piping.

   g. Where gaskets of Teflon or Viton-A are required, fasteners of Material Group C2 shall be utilized for all C1 flange standards.

4. Fastener Material Group Numbers used in Corrosive Service Applications

   a. All Flange fasteners shall be of Material Group S1 unless S2 and S3 are otherwise indicated on the drawings.

F. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full faced type in accordance with AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to 11, and pressures to 1000 psig.

2. Blind flanges shall be provided with gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange.

3. Ring gaskets will not be accepted unless otherwise indicated.

4. Unless otherwise indicated, flange gaskets up to 150 psi shall be EPDM sheet material, NSF 61 approved, **Garlock, Style 98206-U (unbranded), or similar products from John Crane, or equal**.

5. Unless otherwise indicated, flange gaskets up to 500 psi shall be aramid fiber with rubber binder material, NSF 61 approved, **Garlock, Style 3760-U (unbranded), or similar products from John Crane, or equal**.

6. Gaskets for flanged joints in PVC and CPVC piping used in general water and wastewater service shall be NSF 61 approved, full-faced, 1/8-inch thick, and made of fluoroelastomer having a durometer hardness of 50 to 70. Gaskets for pipe sizes up to 24-inch and 150 psi shall be Garlock Style XP or similar products from John Crane, or equal.

7. When the mating flange has a raised face, provide stainless steel flat ring gasket filler between the PVC flange and gasket and the adjacent flange.

2.3 PIPE THREADS

A. Pipe threads shall be in conformance with ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

B. Unless otherwise indicated, use metal FNPT and plastic MNPT for threaded pipe connections between metal and plastic pipes.

2.4 THREADED INSULATING CONNECTIONS

A. General

1. Threaded insulating bushings, unions, or couplings, as appropriate, shall be furnished for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials

1. Threaded insulating connections shall be constructed of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.5 MODULAR MECHANICAL SEALS FOR PIPING PENETRATIONS

A. Where indicated and where required in order to prevent flow of water or air, the passages of piping through cored openings shall be sealed with modular interlocking link mechanical closures.

B. Individual links shall be constructed of EPDM rubber, be suitable for temperatures between minus 40 and plus 250 degrees F, and be shaped to fill the annular space between the outside of the pipe and the inside of the wall sleeve or cored opening.

C. Assemble the links using Type 316 stainless steel bolts and nuts to form a continuous rubber belt around the pipe.

D. Pressure plates under each bolt and nut shall be fabricated of a corrosion-resistant composite material.

E. After the seal assembly is positioned in the sleeve, tighten the bolts against the pressure plates to expand the rubber links and form the watertight seal.

F. Sizing and installation of sleeves and assemblies shall be in accordance with the manufacturer's recommendations.

G. Modular Mechanical Seals Manufacturer, or Equal

1. **EnPro Industries Company (GPT), Link-Seal**

2. **Proco Products, Inc., Pen-Seal**

H. Application

1. Cast or ductile iron pipes and fittings shall be bored or machined smooth in order to remove voids or protrusions.

2. Steel pipe shall be seamless pipe, with internal fitting welds ground smooth, slag holes ground out, re-welded, and ground smooth.

3. Interior surfaces shall be grit-blasted to white metal, and lining shall be fused onto chemically clean metal at above 1400 degrees F.

4. Welded flanges shall be factory-installed before lining.

5. Threaded flanges or cast and ductile iron pipes shall be installed after lining.

6. Pieces shall be sealed and tested prior to shipment.

7. Finish shall be subject to the ENGINEER'S approval.

I. Manufacturer, or Equal

1. **Pfaudler, Inc.**

2. **A.O. Smith Corp.**

3. **U.S. Pipe**

PART 3 -- EXECUTION

3.1 GENERAL

A. This section specifies the general installation requirements for piping, valves, and related items and shall be installed in accordance with the manufacturer's technical data and printed instructions. Specific piping materials, systems, appurtenances, and related installation and testing requirements are specified in related sections of Divisions 01, 33, and 40, and as noted on the Drawings, Pipe and Valve Schedules.

B. Piping shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.

C. CONTRACTOR shall obtain the assistance of the pipe manufacturer to instruct the pipe fitters in the correct installation and support of the piping system. Valves and flanges attached to the pipe shall be provided with adequate supports.

3.2 INSTALLATION

A. Installation shall be free from defects. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true straight. Ends of threaded pipes shall be reamed and filed smooth. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove. Fittings shall be equally cleaned before assembly.

B. Supports and Anchors: Piping supports and thrust shall be provided where shown on the Drawing or where determined to be required in according to Section 40 05 07 - Pipe

Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Pipe shall be firmly supported with fabricated or commercial hangers or supports.

C. Piping Joints: Pipe joints requirements shall conform to the applicable piping sections of Division 33 and Division 40.

1. Threaded Joints: Pipe threads shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.

2. Welded Joints: Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders. Pipe surface residues, oxides, and heat stains are to be removed from a field weld and the affected areas adjacent by the use of stainless steel wire brushes. For alloy and stainless steel pipe, the post welding surfaces shall be cleaned with a pickle agent such as nitric/hydrofluoric acid solutions or pickle paste or equal, then complete removal of the agent by wash the surface thoroughly with clean water.

3. Flange Joints: Flanged joints shall be made with gaskets with bolts and nuts as specified. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

4. Fusion-Welded Joints: Fusion-welded joints shall be made with the manufacturer's recommended equipment on clean, dry pipe ends. The joints shall be made up at the recommended ambient temperatures, to the pipe manufacturer's written recommendations. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by fusion welded of pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe. Socket fusion, extrusion welding and hot gas welding shall not be used for field connections.

5. Brazed and Soldered Joints: Brazed and soldered joints shall conform to the manufacturer’s recommendations and to the specifications and recommendations of ASME B 31.1 - Power Piping. Brazing shall be done by skilled and qualified welders. Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned

6. Grooved Joints: Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conform to AWWA C 606 – Joints, Grooved and Shouldered Type. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

7. Push On Joints: Push on joints and gasket installation shall be in accordance with the manufacturer's recommendations and lubricants. Pipe ends shall be beveled to facilitate assembly. Lubricants shall be suitable for potable water service and shall be kept clean in closed containers.

8. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. PVC socket connections shall be joined with PVC cement conforming to ASTM D2564

Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC). CPVC socket connections shall be joined with CPVC solvent cement conforming to ASTM F493. For chemical service applications, solvent cement shall be formulated and labeled for use on that chemical.

9. Adhesive Joints: Adhesive joints shall be made with freshly-mixed 2-part epoxy on clean, dry pipe ends per pipe manufacturer recommendations. The joints shall be made up at the recommended ambient temperatures, to the pipe or adhesive manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

D. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

E. Isolation Joints / Dielectric Protection: Provide electrically isolate connections between dissimilar metal piping connections. Electrical checks shall be made to assure no contact is made between dissimilar metal piping elements.

1. Use dielectric couplings specially designed for the prevention of galvanic reaction between dissimilar metals.

2. For flanged connections, use stainless steel bolts with isolation bushings, washers, and full-face flange gaskets.

F. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction in order to avoid damage to embedded raceways and reinforcing bars.

G. Coating: Exposed pipes shall be coated with a finish coat to the pipe manufacturer's standard protective coating, with the manufacturer's recommended prime coat and a finish coat in accordance with Section 09 96 00 - Protective Coating.

H. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected.

3. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

4. Flange Bolts

a. Flange bolts shall be initially hand-tightened with the piping connections properly aligned.

b. Bolts shall be tightened with a torque wrench in a staggered sequence to the recommended torque for the applicable piping material per AWWA or manufacturer's recommendation. Care shall be taken to avoid over-torquing the bolts especially on plastic flanged joints.

c. Harness, thrust restraint, and tie rod bolts used for sleeve couplings, flange coupling adapters, or flexible joints shall be tightened gradually and equally at diametrically opposite sides until snug, in order to prevent misalignment and to insure that all studs carry equal loads.

d. In order to prevent induced stress or misalignment, do not over-torque connections to adjoining pump or equipment. Flanges shall not be deformed nor cracked.

3.3 INSPECTION

A. After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be in a clean and functional condition.

B. Inspection: Finished installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Defective WORK shall be repaired to the satisfaction of the field engineer or plumbing inspector.

3.4 FIELD TESTING FOR PRESSURE PIPING

A. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than two hours without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements, refer to Section 33 05 05 - Pressure Pipe Testing and Disinfection.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

END OF SECTION

SECTION 40 05 02 - PIPING IDENTIFICATION

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide identification for the piping and valves, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASME A13.1 Scheme for the Identification of Piping Systems

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings: Provide a list of the suggested wording for each pipe label and valve tag, prior to fabrication.

C. Samples

1. Sample of each type of identification device.

2. Sample of each proposed color required by the pipe color schedule.

PART 2 -- PRODUCTS

2.1 EXPOSED PIPING OR ABOVE GROUND PIPING IDENTIFICATION

A. Pipe markers, type as indicated below, suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements. Except as indicated below for very short pipe lengths, identify esposed piping larger than 2-inches nominal size for the pipe contantes and direction of flow.

1. Marker Type

a. Snap Around: Vinyl or polyester sheet with UV- resistant ink, preshaped and sized to tightly curl around the pipe and remain in position.

b. Adhesive: Vinyl or polyester sheet with UV- resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

c. Stencil: Lettering painted directly on surface of pipe inside color coded marker area.

2. Marker Area: Sized per pipe size according to ANSI/ASME A13.1 and conforming to the color codes in the Identification Colors table below.

3. Lettering: Sized per pipe size according to ANSI/ASME A13.1 and conforming to the color codes in the Identification Colors table below.

4. Arrows: At least two (2) arrow at each marker area, showing direction of flow.

B. Pipe 1-inch diameter and smaller or pipe not suitable for the marker type(s) listed above shall be identified with aluminum or stainless steel pipe identification tags with stamped-in ¼" high identification lettering.

C. Manufacturer or Equal.

1. **Seton Identification Products**, Opti Code Pipe Markers (adhesive type)

2. **Grainger, Inc.** (adhesive, snap around)

3. **Marking Services, Inc.**(adhesive, snap around)

2.2 BURIED PIPELINE IDENTIFICATION

A. Underground Warning Tape

1. Material:

a. Polyethylene tape or polyolefin film. The material and ink shall be chemically inert and shall not degrade when exposed to acids, alkalis and other destructive substances commonly found in soil.

b. 6" wide tape with a minimum 4 mil thickness.

c. Message: "CAUTION, LINE BURIED BELOW" with the name of the fluid service in black lettering on a colored background.

1) Water: Blue

2) Sewer: Green

3) Raw Water: Olive Green

4) Gas and other services: Yellow

5) Other services: colors as approved by the OWNER.

2. Manufacturer, or Equal

a. **Reef Industries, Inc.**

b. **Seton Identification Products**

c. **T. Christy Enterprises, Inc.**

2.3 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, the CONTRACTOR shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the system indicated herein.

2.4 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Valves and sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to the valves or short pipes.

C. Wording on valve tags shall describe the exact function of each valve (e.g., "HWR-BALANCING," "CLS THROTTLING", "RAS-PUMP SHUT-OFF," etc.) and include the valve number as indicated in the Contract Drawings. Wording on small pipes shall describe the contents of the pipe.

2.5 Pipe Coating:

A. Unless otherwise indicated, pipe coating shall be in conformance with Section 09 66 00 - Protective Coating.

PART 3 -- EXECUTION

3.1 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.2 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

3.3 MARKER LOCATIONS

A. Each pipe shall be marked at:

1. Intervals of 20-feet in straight runs.

2. Within 2 feet of turns, elbows, and valves.

3. On the upstream side of tees, branches, and other distribution points.

3.4 IDENTIFICATION COLORS

1. Conform to the following color codes.

Pipe Contents		**Marker Color**	**Letter Color**	**Pipe Color**
Symbol	**Service**			
RW	Raw water	olive	white	

END OF SECTION

SECTION 40 05 07 - PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing the pipe supports.

C. The provisions of this Section shall apply to piping in Divisions 33 and 40.

1. The CONTRACTOR shall provide supporting devices for supporting and restraining piping as indicated on the Drawings. Where pipe support devices and/or restraining details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to support and restraint the piping for a complete and functional pipe support system.

D. Seismic and Wind Forces

1. Pipe support details indicated in the Contract Drawings are sized for gravity loads only, and not designed to resist seismic and wind forces.

2. The CONTRACTOR shall arrange for the services of a registered professional engineer experienced in pipe support design to design such pipe supports to resist seismic and wind forces.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Drawings of pipe supports, hangers, anchors, and guides.

b. Pipe support schedule or layout indicating where the supports will be installed.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Code Compliance

1. All piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the ENGINEER.

C. Thermal Expansion

1. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.

2. Components shall be structurally suitable to withstand the imposed loads.

D. Heat Transmission

1. Supports, hangers, anchors, and guides shall be designed and insulated such that excessive heat will not be transmitted to the structure or to other equipment.

E. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

F. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

G. Materials of Construction

1. All pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Piping in chemical and corrosive service areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

3. Corrosive service areas are indicated in section 40 05 00 -1.2 Definitions - Corrosive Service.

H. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, FRP, or other pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields for general service and Type 316 stainless steel shields for chemical or corrosive areas.

I. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER for any anchor applications not appearing on the table.

2. Anchor embedment shall be in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Existing Concrete	Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor. Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degree F or higher than the limiting temperature recommended by the manufacturer.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

J. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.

B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.

C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.

D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

F. Steel Pipe

1. Install supports for steel pipe in accordance with the requirements of AWWA: Manual of Practice MOP-11.

2. For steel pipe sizes not indicated, the support spacing shall be designed such that the stress on the pipe does not exceed 5,000 psi.

3. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below.

4. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	Maximum Span, ft (Water Service)
1/2	6
3/4 and 1	8
1-1/4 to 2	10
3	12

4	14
6	16
8 and 10	18
12 and 14	20
16 and 18	22
20 and greater	24

G. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration
All diameters	two supports per pipe length, with one of the two supports located at a joint

H. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	100 °F and below	101 to 120 °F	121 to 140 °F
1	5	3.5	3
1-1/2	5.5	3.5	3.5
2	6	4	3.5
3	7	4.5	4
4	7.5	5	4.5
6	9	6	5
8	9.5	6.5	5.5

10 and larger	10	7	6

I. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.3 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. **Basic PSA, Inc.**

2. **Bergen-Paterson Pipe Supports Group**

3. **Grinnell Corp (Anvil International)**

4. **Power Piping Company**

5. **TOLCO (Eaton B-Line)**

2.4 COATING

A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and shall receive protective coatings in accordance with the requirements of Section 09 96 00 – Protective Coating.

B. Other Coatings – Other than stainless steel or non-ferrous supports, supports shall receive protective coatings in accordance with the requirements of Section 09 96 00 – Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per ASME B31.1 – Power Piping.

2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and without interference with other WORK.

3.2 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

SECTION 40 05 23 - STAINLESS STEEL PIPE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General and Section 40 05 07 – Pipe Supports apply to the WORK of this Section.

1.2 CONTRACTOR SUBMITTALS

A. In addition to the submittals required by Section 01 33 00 – Contractor Submittals and Section 40 05 00 – Piping, General, provide proposed post welding cleaning method (including precleaning, descaling, chemicals to be used) or mechanical descaling method and final cleaning/passivation.

B. Provide written certification that the pipe as supplied are in accordance with ASTM A 409 or ASTM 778, If the pipes are provided, Supplemental testing is not required.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312 - Seamless and Welded Austenitic Stainless Steel Pipe, Type 316L seamless, of the schedules indicated. Stainless steel pipe 12 inches in diameter and larger shall be in accordance with ASTM A 409 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service or ASTM A 778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 316L, of the schedules indicated, with welded or flanged joints. Piping less than 3 inches in nominal diameter shall have a minimum wall thickness not less than the Schedule 40S.

2.2 PIPE JOINTS

A. Stainless steel pipe for sizes 2-1/2 inches and smaller shall have threaded ends with NPT threads made up with Teflon tape. Stainless steel pipe 3 inches and larger and where indicated shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welding flanges. Stainless steel flanges shall have stainless steel bolts and nuts. Where indicated, stainless steel pipe shall have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Where indicated, stainless steel pipe shall have plain ends for sleeve-type couplings.

B. Threaded joints (all sizes) are not allowed for the following fluid services: sodium hydroxide, sulfuric acid, oxygen and other fluid services indicated in pipe schedule.

2.3 FITTINGS

A. Threaded Fittings: Forged stainless steel fittings conforming to ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded, Type 316.

B. Socket-Welding Fittings: Forged stainless steel fittings conforming to ASME B 16.11, Type 316.

C. Butt-Welding Fittings: Wrought stainless steel butt-welding fittings conforming to ASTM A 403 - Wrought Austenitic Stainless Steel Piping Fittings, and ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings, Type 316.

D. Grooved Fittings: Wrought stainless steel grooved fittings conforming to ASTM A 403 and ASME B 16.9, with grooving conforming to AWWA C606 - Grooved and Shouldered Joints, Type 316.

E. Flanged Fittings: Type 316 stainless steel flanged fittings and flanges conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings.

F. Pressure Class: Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, the fittings shall have the same pressure rating as the pipe.

2.4 CLEANING

A. Stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed in accordance with ASTM A 380 – Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems or A 967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

PART 3 -- EXECUTION

3.1 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

SECTION 40 05 64– WAFER VALVES

PART 1 -- GENERAL

1.01 SUMMARY

A. The Contractor shall provide wafer valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Specifications

09 96 00	High-Performance Coatings

B. Reference Standards

American National Standards Institute (ANSI)	
ANSI B 16.1	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
American Petroleum Institute (API)	
API 598	Valve Inspection and Testing
API 609	Butterfly Valves: Double-flanged, Lug- and Wafer-type, and Butt-welding Ends
American Society of Mechanical Engineers (ASME)	
ASME B31.1	Power Piping
ASME B31.3	Process Piping
American Water Works Association (AWWA)	
AWWA C504	Standard for Rubber-Seated Butterfly Valves
AWWA C541	Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
ASTM International (ASTM)	
ASTM A 36	Standard Specification for Carbon Structural Steel
ASTM A 48	Standard Specification for Gray Iron Castings
ASTM A 126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 216	Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service
ASTM A 240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A 351	Steel Castings, Austenitic, for High-Temperature Service
ASTM A 436	Standard Specification for Austenitic Gray Iron Castings
ASTM A 439	Standard Specification for Austenitic Ductile Iron Castings
ASTM A 515	Pressure Vessel Plates, Carbon Steel, for Intermediate-and Higher-Temperature Service

ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM A 564	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless-Steel Bars and Shapes
ASTM A 743	Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion - Resistant for General Application
ASTM UNS S31803 SS	Duplex Stainless Steel

1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings

1. Complete Shop Drawings of wafer valves.

2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.

3. Certified statement of proof-of-design tests from the valve manufacturer. Valve manufacturer shall state that the valves proposed for this project will be manufactured with identical basic type of seat design and materials of construction to the prototype evaluated under the proof of design testing.

4. Manufacturer's certification that the valve complies with applicable provisions of AWWA.

1.04 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 -- PRODUCTS

2.01 RUBBER SEATED WAFER VALVES 25 TO 150 PSI (AWWA)

A. General: Wafer valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for freshwater service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated. Valves subjected to steady state working pressures and steady state differential pressures from 25 to 150 psi in sizes 3-inches through 24-inches shall be rated for Class 150B with actuator sized for Class 150B. Valves 30 inches through 72-inches shall be of the class indicated. Valves larger than 72-inches shall be of the class indicated, designed in accordance with the intent of AWWA C504. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve.

B. Valves shall be of the body type, pressure class, end joint, and actuator indicated.

C. Construction: Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. Seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

Description	**Material Standards**
Valve bodies	Per ASTM C504
End flanges	Same material as valve bodies
Valve shafts	Stainless steel ASTM A 240 or A 276, Type 316
Valve discs	Same material as valve bodies.
Rubber seats	New natural or synthetic rubber
Seat mating surfaces	Stainless steel, ASTM A 240 or A 276, Type 316
Clamps and retaining rings	Type 316 retaining rings and cap screws.
Valve bearings	Self lubricating materials per AWWA C504
Shaft seals	Resilient non-metallic materials suitable for service
Painting and coating	Refer to Section 09 96 00 – High-Performance Coatings

D. Manual Actuators: Unless otherwise indicated, manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.

E. Worm Gear Actuators: Valves 30-inches and larger, as well as submerged and buried valves, shall be equipped with worm-gear actuators, lubricated, and sealed to prevent entry of dirt or water into the housing.

F. Manufacturers, or Equal

1. DeZURIK Water Controls, Corporation

2. Kennedy Valve

3. M & H Valve Company

3. M & H Valve Company
4. Mueller Company
5. Henry Pratt Company

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve.

END OF SECTION

SECTION 40 91 00 - PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

The CONTRACTOR, in coordination with the OWNER, shall provide a Process Control and Instrumentation System (PCIS) complete and operable, in accordance with the Contract Documents. For the purpose of this CONTRACT, PCIS is synonymous and interchangeable with supervisory control and data acquisition (SCADA) and distributed control system (DCS), where applicable. The requirements of this Section apply to every component of the PCIS unless indicated otherwise.

A. Responsibilities

1. The CONTRACTOR, through the use of a System Supplier and electrical and mechanical installers, and with close coordination with the OWNER, shall be responsible to the OWNER for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices. The System Supplier shall be a single firm, corporation, or other entity assuming full responsibility through the CONTRACTOR to perform all engineering and to select, furnish, program, configure, integrate, supervise the installation and connections, test, calibrate, and place into operation all instrumentation, controls, communication hardware and software. The System Supplier shall specialize and have an experienced engineering and technical staff in the design, integration, and supply of systems similar to the one in these Contract Documents. The term "System Supplier" shall mean the same as "SCADA System Supplier" or "PCIS Supplier

2. The OWNER shall provide Well Pump PLC Control Panel software for upload by the CONTRACTOR. SCADA programming and integration with the existing plant SCADA system shall be performed by the CONTRACTOR. Refer to Seminole Tribe of Florida SCADA Master Plan for requirements.

3. The CONTRACTOR shall request the OWNER to demonstrate that all existing equipment that is to be reused or interfaced with in this project works properly for the intended function.

4. As a minimum, the implementation of the PCIS by the CONTRACTOR shall include the following WORK:

   a. Integration of the the PCIS with existing devices and systems provided under this and other Divisions

   b. Prepare the required PCIS submittals

   c. Design and develop control panel drawings

   d. Field verify existing conditions

   e. Prepare factory and field test submittals

f. Prepare training plan

g. Prepare spare parts submittal

h. Procure hardware

i. Bench calibrate instruments and verify calibration after installation

j. Terminate signals inside control and network panels; terminate communication and network devices and nodes

k. Supervise and coordinate installation and termination of field signals, power, and utilities associated with the PCIS. Resolve signal, power, or functional incompatibilities between the PCIS and new and existing interfacing devices.

l. Validate and certify control loops

m. Oversee, document, and certify system commissioning

n. Prepare technical manuals

o. Conduct training classes

p. Prepare PCIS as-built final construction drawings

5. Any Instrumentation Supplier responsibilities in addition to the list above are at the discretion of the CONTRACTOR and the Instrumentation Supplier. Additional requirements in this Section and throughout Division 40 that are stated to be the CONTRACTOR's responsibility may be performed by the Instrumentation Supplier if the CONTRACTOR and Instrumentation Supplier so agree.

B. RELATED WORK AND REQUIREMENTS SPECIFIED ELSEWHERE

1. All electrical work required under this section shall conform to the requirements of this Section and the applicable requirements of the Sections in Division 01 and Division 26.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all WORK specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this Section; provided, that where such documents have been adopted as a code or ordinance by the public agency having jurisdiction, such code or ordinance shall take precedence.

B. The PCIS WORK shall conform to or exceed the applicable regulations, standards, specifications, and codes which are referenced in Section 01 42 19 – Reference Standards, and current as of the date of the final inspection for this Contract, including, but not limited to, those which are established by the following sources:

1. The International Society of Automation (ISA)

2. National Electrical Code (NEC)

3. National Fire Protection Association (NFPA)

4. Institute of Electrical and Electronic Engineers (IEEE)

5. Occupational Safety and Health Administration (OSHA)

6. American National Standards Institute (ANSI)

7. National Electrical Manufacturers Association (NEA)

8. Insulated Cable Engineers Association (ICEA)

9. Local Power and Telephone Companies

10. Local Authorities having jurisdiction over the work

11. Federal Communication Commission (FCC)

12. Underwriter Laboratory (UL)

C. Where the requirements set forth in these Specifications or on the Drawings are greater or more rigid than the mandatory requirements referenced above, the applicable Specifications or Drawings shall govern.

D. In the case of conflict between any mandatory requirements and Specifications or Drawings, the mandatory requirement shall be followed in each case, but only after submitting such proposed changes to the ENGINEER for approval.

E. Nothing contained in these Specifications or shown on the Drawings will be so construed to conflict with any national, state, municipal, or local laws or regulations governing the installation of work specified herein, and all such acts, ordinances, and regulations, including the National Electrical Code, are hereby incorporated and made a part of these Specifications. All such requirements will be satisfied by the CONTRACTOR at no additional expense to the OWNER.

F. The Drawings and Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If a conflict between Drawings and Specifications is discovered, this shall be referred to the ENGINEER as soon as possible for resolution. Should a conflict exist between the Drawings, Specifications, and/or mandatory requirements (i.e., codes, ordinances, etc.), the more stringent shall apply and it will be assumed that the more expensive method has been estimated, unless such alternate has been agreed to prior to submission of bids.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. The CONTRACTOR shall provide submittals in accordance with Section 01 33 00-Contractor Submittals and the additional submittal requirements specified in this Section, in Division 40, and the following:

1. The CONTRACTOR shall coordinate the PCIS part of the WORK so that a complete instrumentation and control system will be provided and will be supported by accurate Shop Drawings and as-built drawings.

2. The submittals and their schedules shall be shall be in accordance with the requirements listed below: Any incomplete submittal will be rejected and returned without comments.

3. Interface between instruments, motor controllers, control valves, flowmeters and other equipment related to the PCIS shall be included in the shop drawing submittal. Interface between existing equipment, instruments and control panels shall also be included.

4. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout Shop Drawings, and similar materials. No other designations, or nomenclature unique to the manufacturer's standard methods shall replace those prescribed above, used herein, or on the Drawings.

B. Shop Drawings Submittal Organization

1. Shop Drawings shall include the letter head or title block of the panel vendor. The title block shall include, as a minimum, the panel vendor’s registered business name and address, project name, drawing name, revision level, and personnel responsible for the content of the drawing.

2. Organization of the Shop Drawing submittals shall be compatible with eventual submittals for later inclusion in the Technical Manual. Submittals not so organized will not be accepted.

3. Drawings that require more than one sheet due to space limitation or continuation in the subject of the drawings (e.g. loop diagrams, etc.) shall be given the same drawing number but with different sheet number.

4. Each submittal shall include a complete index appearing in the front of each bound submittal volume. Drawings and/or system groups shall be separated by labeled tags. The organization of the initial shop drawing submittal required above shall be compatible to eventual inclusion with the Technical Manuals submittal and shall include final alterations reflecting as-built conditions.

C. Field Instrument Submittal

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete field and process instrument submittal within 30 calendar days after the date of Notice to Proceed is given to the CONTRACTOR.

2. Submittal Contents: The submittal shall include a complete index which lists each device by tag number, type, and manufacturer in accordance with the specified data sheets provided in this CONTRACT. A separate manufacturer technical brochure or catalog sheet shall be included with each specified instrument data sheet. If, within a single system or loop, a single instrument is employed more than once, one manufacturer brochure or catalog sheet may cover multiple identical uses of that instrument in that system. Each manufacturer brochure or catalog sheet shall include a list of tag numbers for which it applies. System groups shall be separated by labeled tags. Special options and features which are furnished shall be identified.

D. System Hardware Submittal:

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete system hardware submittal within 45 calendar days after the date of Notice to Proceed is given to the CONTRACTOR.

2. Submittal Contents:

   a. The submittal shall be for the Pump Control Panel and PLC Control Panel shown on the drawings. Submitted drawings shall be based on the Owner's details included in the Electrical drawings and available from the Owner in CAD file format.

   b. The submittal shall include a complete index which lists each device by type, and manufacturer in accordance with the contract documents. A separate manufacturer technical data sheet or brochure shall be included for each hardware component. If, within a single system a single component is employed more than once, one manufacturer technical data sheet or brochure may cover multiple identical uses of that component in that system. Special options and features which are furnished shall be identified.

   c. Spare Parts and Tools List: A list of spare parts and tools shall be submitted, covering items which are specified and furnished under this Contract. The list shall include the name, address, and phone number of manufacturer and manufacturer's local service representative of these parts. The list shall also include recommended spare parts and tools, quantities and prices from which the OWNER will select the "Additional Recommended Spare Parts and Tools".

   d. Hardware submittal drawings may be based on the Owner's standard details (RW-07-1, RW-07-2, RW-08-1, RW-08-2, RW-08-3 and RW-08-4).

3. Hardware submittal shall include a complete set of wiring diagrams. Wiring diagrams shall define and document the contents of each analog and discrete monitoring, alarming, hardware interlock, and control functions associated with equipment provided under Division 40 sections. The wiring diagrams shall also cover equipment provided under sections in other Divisions, existing, and OWNER-furnished equipment. The wiring diagrams shall also include both field and panel wiring diagrams.

   1) Drawings showing definitive diagram for every analog and discrete instrumentation loop system. These diagrams shall show and identify each component in each loop or system using legend and symbols consistent with ISA standards. The wiring diagrams shall be presented on an 11"x17" drawing.

   2) In general, loops shall be grouped and organized by PLC (if used) and the I/O cards within the PLC. The type of card, part number and its slot location shall be identified. Each I/O shall be identified as well as its location on the card and its address. Existing, spare, and future I/Os shall also be shown. Power supply wiring to the card/loops, wire colors, and terminal numbers shall be shown on the wiring diagrams. The I/O cards, the loops and any device in the loop shall be shown together. Each loop shall be complete, including the source/destination within new or existing panels, device(s) in the loop, field connection panels or field junction boxes, field and PLC interface terminal blocks and wire numbers.

3) In addition wiring diagrams shall show the following details

a) Functional name of each loop

b) Reference name, drawing, and loop diagram numbers for any signal continuing off the wiring diagram sheet.

c) MCC panel, circuit, and breaker numbers for power feeds to the loops and instrumentation.

d) Wiring type, size and color

e) Designation, and if applicable, terminal assignments associated with every termination junction box in which wiring is to be located, and panel through which the loop circuits pass.

f) Vendor panel, instrument panel, junction boxes, equipment and SCADA terminations, termination identification wire numbers and colors, power circuits, and ground identifications.

4) Wiring diagrams shall be developed for loops in equipment vendor-supplied packages, equipment provided under Division 40, and OWNER-furnished equipment.

4. Panel Wiring Diagrams: Panel wiring and/or piping diagrams shall be prepared in concert with the PWWD and shall include the following information:

a. Name of panel

b. Power distribution schematic diagrams associated with each panel or system (120VAC, 24VDC and other DC systems, control circuits). The schematic diagram shall show source of power for the panel (circuit breaker panel and breaker) and fuses. All power backup system distribution shall also be shown.

c. Schematic diagrams for control circuits in accordance with ANSI standards. The diagrams shall show complete details on the circuit interrelationship of all devices within and outside each Control Panel. Including primary measurement and control devices.

d. Communication diagram(s) for the equipment inside the panel.

e. Interfaces with existing control and monitoring systems. The CONTRACTOR shall furnish all necessary diagrams that depict any and all modifications made to existing measurement and control circuits, equipment and wiring. It is the responsibility of the System Supplier to ascertain actual field conditions of the existing circuits, equipment and wiring. The CONTRACTOR may request copies of as built drawings and data that the OWNER can provide that show such existing conditions. Lack of such drawings shall not alleviate the contractual responsibility to ascertain and implement interfaces and modifications to existing measurement and control circuits, equipment and wiring.

f. Surge protection and signal and safety grounding circuits

g. Wiring type and piping size and material

h. Terminal block numbers and wire numbers

5. Panel Drawings: Panel drawings, including console, and cabinet layout drawings, shall be prepared and submitted for each panel and shall include the following information: These drawings may be based on Owners Standard Details .

a. Name of Panel.

b. Panel Dimensions; front, side, and plan views and layout to scale.

c. Arrangement of internally and externally mounted instruments and equipment to scale. Note: Control panel layouts shown on the Contract Drawings are diagrammatic.

d. Location of terminal blocks, electrical devices, and conduit entry location(s).

e. Tag number or item number and functional name of items mounted in and on panel, console, or cabinet.

f. Nameplate legend which includes text, letter size, and colors to be used.

g. Complete and detailed Bills of Materials shall include all items within a panel and shall be presented on the panel layout drawing. The bill of material list shall include quantity, description, manufacturer, and part number.

h. Panel mounting information, including conduit entrance location.

i. Assembly and construction drawings. These drawings shall include dimensions, identification of all components, construction material and gauge, surface preparation and finish data, panel door locks and hinge mechanism, nameplates, and the like.

6. System Architecture and Communication Diagrams

a. Submittal Schedule: The CONTRACTOR shall submit for approval system architecture and communication diagrams within 45 calendar days after the date of Notice to Proceed is given to the CONTRACTOR. This submittal shall be submitted together with the System Hardware submittal

b. Submittal Contents: System Architecture and Communication System Diagrams: The CONTRACTOR shall develop system architecture and communication diagram. The submittal shall include a set of drawings that presents the following as applicable:

1) System architecture and network (copper and fiber optic) physical topology schematic.

E. System Software Submittal

1. Submittal Schedule: The CONTRACTOR shall submit for approval a complete system hardware submittal within 45 days after the date of Notice to Proceed.

2. Submittal Contents:

a. The submittal shall be for the OWNER-furnished well pump control software and updates made to existing SCADA system software required for integration of well no. 4. This submittal shall be provided in a singular all inclusive submittal and be made separately from other PCIS submittals.

b. The software submittal shall include but not be limited to:

1) Complete description of the standard (baseline) application Human Machine Interface (HMI) software programs, operating system and utility programs to be furnished, including modifications and explanation of how the specific functional requirement will be met. A cross reference between the specification and the software submittal shall be provided in order to provide the ENGINEER the ability to identify how each specified section or function is being met by the CONTRACTOR.

2) A functional design report of the implemented control functions. The report shall include:

a) Control narratives and their implementation, which describe all monitoring and control functions (e.g., commands, mission, anticipated action, etc.) on a loop by loop or site by site basis in the PLC. It shall also describe special control functions in the server(s), including peer-to-peer communication. These narratives will be used for the operating instructions and inclusion in the Operations and Maintenance Manuals.

b) Control narratives shall enumerate the signal point name, signal description, associated PLC number, associated graphic displays, system functions activated by the signal (i.e., interlocks, alarms, logs, etc.)

c) A complete set of all available software algorithms with annotation of:

1) Individual coil register and variable description

2) Program, group of program, subroutine, and complete rung detail comments

3) Memory, coil, register, and variable usage mapping

d) Description of how the HMI software will be configured.

e) Copies of the configured PLC control software shall be provided in the technical manual together with a flash drive.

1.4 CLOSEOUT SUBMITTALS

A. Technical Manuals Submittal

1. Submittal Schedule:

a. The CONTRACTOR shall submit for approval Technical Manuals for the PCIS: Initial set shall be submitted complete and within 120 days months after the date

of Notice to Proceed is given to the CONTRACTOR. But at least 21 days prior to the starts of the OWNER's training.

b. Each set shall consist of one (1) or more volumes and provided in PDF on a CD.

2. Submittal Contents:

a. Information in the Technical Manual shall be based upon the approved Shop Drawing submittals as modified for conditions encountered in the field during the WORK. The Technical Manuals shall therefore contain the as-built drawings and information.

b. The Technical Manuals shall include installation, connection, operating, calibration, set points (e.g., pressure, pump control, time delays, etc.) adjustment, test, troubleshooting, maintenance, and overhaul instructions in complete detail.

c. The Manuals shall have the following material organized in volumes and divided by subject and tabs The Technical Manual shall have the following organization for each process (the number and the enumeration of the sections shall be project specific):

1) Section A - System Architecture and Communication System Block Diagram(s)

2) Section B - Wiring Diagrams.

3) Section C – Panel Wiring Diagrams

4) Section D – Panel Drawings

5) Section E – Functional design report. It shall include a copy of the site graphic display(s) and description how the site is controlled and any special control strategies specific for each site. Special control functions in the server shall also be included. Calibration, set points (e.g., pressure, pump control, time delays, etc.) shall also be included.

6) Section F - Instrument Data Sheets and corresponding manufacturer's data sheet/catalog cuts/brochure that was used in the hardware submittal

7) Section G – Calibration Documentation.

8) Section H – Precommissiong and commissioning test results

d. Software Manual: This manual shall be devoted exclusively to the control system software and the PLC programming. In addition to the requirements specified in Section entitled Contractor Submittal, this manual shall contain complete documentation of the software programs provided, including listings, database (flash drive), communication protocol(s), annotated PLC programs, and all as necessary to maintain, troubleshoot, modify, or update the all the software systems such as application software and PLCs.

All PLC program and workstation configuration program files stored on labeled flash drives. The PLC program and workstation configuration files

on flash drives shall also be updated as required if any changes or corrections are required in this programming prior to project completion.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. The CONTRACTOR shall provide the specified spare parts and tools.

1.6 QUALITY ASSURANCE

A. Field Tests: The CONTRACTOR's attention is directed to the Article "EXECUTION" of this Section which delineates all the tests that are required to be performed in the field in order to demonstrate compliance with the Contract Documents.

B. Prior to final acceptance of the PCIS System and related equipment, the CONTRACTOR shall propose and present in writing to the OWNER a one-year maintenance contract and quotation which will become effective upon the expiration of the warranty. The maintenance contract is an option that the OWNER may purchase from the CONTRACTOR.

1.7 FIELD SITE CONDITIONS

A. The PCIS shall be designed and constructed for satisfactory operation and long, low maintenance service under the following environmental conditions:

1. Water treatment facility

B. Site Equipment:

1. Ambient temperature range: 0° through 40° C

2. Relative humidity: 95 percent maximum non-condensing

1.8 WARRANTY

A. All parts, material labor, travel, subsistence, or other expenses incurred in providing services and service visits during the warranty period shall be borne by the CONTRACTOR under the guarantee specified in Division 1. Equipment, software, and materials that do not achieve their intended purpose shall be replaced by the CONTRACTOR to attain compliance, at no additional cost to the OWNER.

B. Extended Period for Correction of Defects: The CONTRACTOR shall correct defects in the PCIS upon notification from the OWNER within 2 years from the date of Substantial Completion. Corrections shall be completed within 5 Days after notification.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Standard and Current Technology: All PCIS hardware, materials, and equipment furnished under this contract shall be new, free from defects, and shall be standard products and technology produced by manufacturers regularly engaged in the manufacturer of these products. Meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

The CONTRACTOR shall submit a Substitute Item Request Form in case of discontinued or upgraded product or other cases where changing technology requires changes in equipment or software.

B. Hardware Commonality and Modularity: Instruments which utilize a common measurement principle shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer. All equipment shall be of modular design to facilitate interchangeability of parts to assure ease of servicing and expandability.

C. Loop Isolators and Converters: The CONTRACTOR is responsible to resolve any signal level incompatibilities where required.

D. Signal Levels: Analog measurements and control signals shall be as indicated herein, and unless otherwise indicated, shall vary in direct linear proportion to the measured variable. Electrical signals outside control panels shall be 4 to 20 milliamperes DC except as indicated. Electrical signals shall be electrically or optically isolated from other signals. Alternative Equipment and Methods: Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the ENGINEER through the "or equal" process of Section 01 60 00 - Products, Materials, Equipment, and Substitutions. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational advantage, and maintenance enhancement over the equipment or method indicated, or shall include evidence that an indicated component is not available.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Shipping: After completion of shop assembly and approval, the PCIS equipment, cabinets, panels, and computer hardware shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special Instructions: Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Tagging: A permanent stainless steel or other non-corrosive material tag marked with the instrument or equipment tag number shall be provided on each piece of equipment in the PCIS, except where otherwise noted. Identification shall be prominently displayed on the outside of the package.

D. Storage: It is the CONTRACTOR's responsibility to assure proper handling and on-site storage of instrumentation and control equipment in accordance with the equipment manufacturer’s recommendations. All equipment and materials delivered to the jobsite shall be stored in a location which will not interfere with the operations of other contractors or the OWNER. Equipment shall not be stored outdoors. Storage and handling will be performed in manners which will afford maximum protection to the equipment and materials.

E. Equipment shall be stored in dry shelters, including in-line equipment, and shall be adequately protected against mechanical damage. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through tests as directed by the ENGINEER. If such tests reveal defects, the equipment shall be replaced.

3.2 INSTALLATION

A. General

1. All systems and instrumentation, including instrumentation furnished under other Divisions, shall be installed, connected calibrated, tested, started, and placed into operation in accordance with CONTRACT documents under Division 40 and the manufacturers' instructions. The installation shall be coordinated with the ENGINEER and the OWNER. This shall include final integration in concert with equipment specified and provided by others.

2. The CONTRACTOR shall employ installers who are skilled and experienced in the installation and connection of all PCIS equipment.

3. Equipment Locations: The monitoring and control system configurations indicated in the contract documents are diagrammatic. The locations of equipment are approximate unless dimensioned. The exact locations and routing of wiring and cables shall be governed by structural conditions and physical interferences and by the location of electrical terminations on equipment. Equipment shall be located and installed so that it will be readily accessible for operation and maintenance. Where job conditions require reasonable changes in approximated locations and arrangements, or when the OWNER exercises the right to require changes in location of equipment which do not impact material quantities or cause material rework, the CONTRACTOR shall make such changes without additional cost to the OWNER.

4. The CONTRACTOR shall review the existing 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.

5. The Contract Documents identify conduits and instruments required to make a complete PCIS. The CONTRACTOR shall be responsible for providing any reasonable additional or different type connections as required by parts of the PCIS' specific installation requirements, or as practical.

B. Conduit, Cables, and Field Wiring

1. The CONTRACTOR shall supervise and coordinate installation and termination and identification of field signals, power, and utilities associated with the PCIS. Resolve signal, power, or functional incompatibilities between the PCIS and new and existing interfacing devices.

C. Installation and Connections:

1. Instruments, control panels, and equipment shall be anchored by methods that comply with seismic requirements applicable to the Site. Appropriate mounting stands and bracket materials and workmanship shall be provided and shall comply with requirements of the Contract Documents.

2. Existing Instruments that are to be removed and reinstalled shall be cleaned, reconditioned, and recalibrated by an authorized service facility of the instrument manufacturer. The CONTRACTOR shall provide certification of this WORK prior to reinstallation of each instrument.

3. Field Connection Panels and Interface Terminal Blocks: In cases where field I/O wiring has to be extended to a control panel or from enclosures or devices that are removed, the CONTRACTOR shall provide separate enclosures or junction boxes with interface terminal blocks that will serve as a field connection panel (FCP). The FCP and the terminal block shall be shown on the project-wide wiring diagrams.

4. Signal and low voltage wiring shall be run in separate conduits from power and 120-volt control wiring.

5. Field wiring shall terminate at terminal blocks in the control panel. Field wiring shall not be wired directly to equipment in the control panel except communication and specialty cables that must be wired directly to their respective equipment.

6. Power and signal wires shall be terminated with crimped type lugs.

7. Wires shall be marked clearly with an identification wire number labels that are of a permanent nature.

8. Connectors shall be, as a minimum, water tight.

9. Sensing Lines and Tubing:

   a. Instrument process sensing lines shall be installed in conduit under Section 260000 - Electrical General Provisions and in a manner similar to the conduits. Individual tubes shall run parallel and near the surfaces from which they are supported. Supports shall be used at intervals of not more than 3-feet of rigid tubing.

   b. Bends shall be formed to uniform radii with the proper tool without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square cut and cleaned before being inserted in the fittings. Bulkhead fittings shall be provided at panels requiring pipe or tubing entries.

10. Flexible cables and capillary tubing shall be installed in flexible conduits. The lengths shall be sufficient to withdraw the element for periodic maintenance.

11. Differential pressure elements shall have 3 valve manifolds.

12. The CONTRACTOR shall verify the correctness of each installation, including polarity of electric power and signal connections. The CONTRACTOR shall certify in writing all discrepancies have been corrected for each loop or system checked out. In addition, the CONTRACTOR shall make sure process connections are free of leaks.

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Services

1. The CONTRACTOR shall provide jobsite visits and services of a manufacturer's technical field representative for supervision of the following:

    a. Oversee installation: Supervise installation and connection of instruments, elements, and components, including connection of instrument signals to primary measurement elements and to final control elements such as VFD, smart starters, pumps, valves, engines and chemical feeders

    b. Verify that installed instruments meet manufacturer's recommendations

    c. Certify installation and reconfirm manufacturer's accuracy statement

    d. Training the OWNER's personnel

2. Manufacturer's services shall be furnished for the following equipment:

    a. Flow meters

    b. Process Analyzers

B. General:

1. Devices provided under Division 40 shall be initially calibrated by the manufacturer at the manufacturer's facility prior to shipment. The CONTRACTOR shall field calibrate exiting instruments if it is part of a modified loop.

2. Each instrument shall be field tested, inspected, and adjusted to the indicated performance requirement in accordance its manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirement, or, in the absence of a contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the ENGINEER.

C. Calibration Points: During bench and field calibration each instrument shall be calibrated at least at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and outputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

D. Bench Calibration: Instruments that have been bench-calibrated by the manufacturer shall be verified in the field after installation to determine whether any of the calibrations are in need of adjustment, and shall be recalibrated where required.

E. Field Calibration: Instruments which are not typically bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

F. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

G. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:

1. Project name
2. Loop number and site or process name and number
3. Tag number
4. Manufacturer
5. Model number
6. Serial number
7. Calibration range
8. Calibration data: Input, output, and error at 0 percent, 50 percent, and 100 percent of span
9. Switch setting, contact action, and dead-band for discrete elements
10. Space for comments
11. Space for sign-off by System Supplier and when applicable by the manufacturer and date
12. Test equipment used and associated serial numbers

H. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall furnish signed calibration sheet when calibration is complete. The ENGINEER will sign the calibration sheet when the calibration and testing has been accepted.

I. The CONTRACTOR shall notify the ENGINEER and OWNER of scheduled tests minimum of 21 calendar days prior to the estimated completion date of installation and wiring of the PCIS. .

3.4 PRE-COMMISSIONING

A. General:

1. Refer to Section 01 75 00 – Equipment Testing and Plant Startup for additional details regarding pre-commissioning and commissioning that may not be covered in this Section.

2. Pre-commissioning Procedures and Documentation: Pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the ENGINEER. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER. Completion of system pre-commissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the ENGINEER with a clear and unequivocal statement that system pre-commissioning and test requirements have been satisfied. The result of the testing shall also include a punch list developed by the ENGINEER.

3. The burden of proof of conformance of the system to specified functions and performance is on the CONTRACTOR. Tests that fail to demonstrate the required operation shall be repeated in their entirety or continued after corrective action has been completed at the discretion of the ENGINEER.

4. The CONTRACTOR shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the OWNER, wherever the OWNER or ENGINEER has reasonable doubt or evidence of malfunction or poor performance appears.

5. The CONTRACTOR shall coordinate the scheduling of tests among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

B. Control Valve Tests: Control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to ensure that no changes have occurred since the bench calibration.

C. Interlocks: Hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of variable-speed controllers, and packaged equipment controls shall be checked to the maximum extent possible.

D. Loop Validation:

1. Loop validation Shall be witnessed by the OWNER.

2. Control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the HMI displays associated with the PLC and SCADA. Actual signals shall be used wherever available. Following any necessary corrections, the loops shall be retested.

3. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by contract requirements or by published manufacturer accuracy specifications, whenever contract accuracy requirements are not indicated. Each analog loop shall be tested by applying simulated analog or discrete inputs to the first element of an analog loop. For loops which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75, and 100 percent of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. Analog loop test data, including calculated RMS summation system accuracy tolerance, shall be documented by the CONTRACTOR on the loop validation sheets. The validation sheets shall be included in the O&M Manuals.

E. Loop Validation and Certification Sheets:

1. Loop Validation: The CONTRACTOR shall prepare loop validation sheets for each loop covering each active instrumentation and control device. Loop validation sheets shall form the basis for operational tests and documentation. Each loop validation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the CONTRACTOR and OWNER's witness:

    a. Project name

    b. Loop number

    c. Tag number, description, manufacturer, and model number for each element

    d. Installation bulletin number

    e. Specification sheet number

    f. Loop description number

    g. Adjustment check

    h. Space for comments

    i. Space for loop sign-off by the CONTRACTOR and date

    j. Space for OWNER's witness signature and date

2. Loop Certification**:** A copy of each loop test validation sheet signed by the CONTRACTOR and the OWNER's representative as a witness, with test data entered, shall be submitted to the ENGINEER together with a clear and unequivocal statement that the loops have been tested and the instrumentation in the loop has been successfully calibrated, inspected, and tested.

F. Operational Validation:

1. Where feasible, system pre-commissioning activities shall include the use of the actual process to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, PLCs, control panels, and ancillary equipment shall be tested under startup and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational.

2. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of process controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter

oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

3. Pre-commissioning shall also include the testing of remote sites to verify compliance with all functional requirements and communication specified. The testing shall include manual and automatic control modes, fail-safe and backup control modes, and PLC interlocks and control strategies provided by the OWNER.

G. Loop and Equipment Tuning: Controllers incorporating proportional, integral and/or derivative control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed set point settings shall be compared to measured final control element position/speed values at 0, 25, 50, 75, and 100 percent of span and the results checked against indicated accuracy tolerances.

H. Operational Validation Sheets: Operational validation shall be documented on test forms as follows:

1. The validation form shall include:

a. Project name

b. Loop number

c. Loop and function description

d. Tag number, description, manufacturer, and data sheet number for each component.

e. Pre-Commissioning Certification - A statement certifying that the contract requirements have been met. It shall also include a listing of instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system testing must be provided in writing by the ENGINEER before commissioning commences. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

f. Space for sign-off and date by the CONTRACTOR

g. Space for sign-off and date by the OWNER's witness.

3.5 COMMISSIONING

A. Commissioning is the verification that the complete WORK functions on an extended basis in full conformance with the Contract requirements.

B. The PCIS shall operate continuously without failure during the 7-day demonstration test specified in Section 01 75 00.

C. Commissioning shall be performed in accordance with the approved test procedures.

D. Scheduling of startup shall be coordinated by the CONTRACTOR among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

1. Troubleshooting and Corrections

   a. The Contractor shall participate in all start-up activities. If problems occur, the CONTRACTOR and the OWNER shall jointly participate in the diagnosing wiring, control interface, hardware and software problems and correcting deficiencies. The Contractor shall be responsible and bear all expenses to diagnose and correct all the deficiencies for work and equipment furnished under this CONTRACT.

   b. Existing Instruments, Wiring and Interface: As specified above, prior to start of the WORK the CONTRACTOR shall request the OWNER to demonstrate that all existing equipment and software that is to be reused or interfaced with in this project works properly for the intended function. Consequently, if during the calibration, testing or start up, the CONTRACTOR encounters problems with existing instruments, hardware, wiring, or software that have been demonstrated to work, the CONTRACTOR shall notify the Engineer and the OWNER. In this case, the CONTRACTOR and the OWNER's representative shall jointly participate in the diagnosis of the problem. The course of action how to correct the deficiency shall be determined jointly by the OWNER, the Engineer and the CONTRACTOR. The CONTRACTOR shall be compensated for correcting the deficiencies or replacing the equipment.

   c. If a problem is found to be a result of the CONTRACTOR's workmanship or equipment and work furnished under this CONTRACT, the CONTRACTOR shall be responsible and bear the expenses for correcting the deficiencies.

E. During the 7-day testing period, all system functions shall be exercised, and any system interruption and accompanying component, subsystem, software, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure.

F. In addition to the requirements of Section 01 75 00, the CONTRACTOR shall furnish support staff as required to operate the system and to satisfy the repair or replacement requirements.

G. The entire PCIS shall be tested and shall include, but not be limited to, the field instrumentation, control and PLC panels and PLC programs, application SCADA software, graphics and trends, reports, and the control and monitoring functions. Each system function, e.g., status report-backs, alarms, logs, and displays shall be exercised several times at a minimum, and in a manner which approximates "normal" system operation.

H. Malfunctions During Testing: Malfunction of the system during the testing shall be considered as indicating that part of the PCIS does meet the requirements of the specifications and corrective action shall be required before resuming the acceptance test.Significant malfunctions, as defined in Section 01 75 00 – Equipment Testing and Plant Startup, shall be remedied and the 7-day test shall be restarted.

I. Technician Report: Each time a technician is required to respond to a malfunction in the PCIS he/she must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report shall be required (logged as specified above). Each report shall be submitted within 24 hours to the ENGINEER and the OWNER.

3.6 CLOSEOUT ACTIVITIES

A. Training:

1. The CONTRACTOR shall train the OWNER'S personnel on the maintenance, calibration, and repair of equipment provided under this Contract. The training shall be by qualified instructors. The training courses shall be given on-site to a minimum of four (4) OWNER's personnel. All instruction, tools and training material shall be provided by the CONTRACTOR.

2. These courses shall be designed to provide the operations, maintenance and supervisory personnel with training in routine and preventive maintenance of all the PCIS including instrumentation, communication, PLCs software, and HMI. The training course shall include instruction on the use of all maintenance equipment and special tools provided under the contract.

3. Instructions: The training shall be performed by qualified instructors. The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.

4. Training Manuals and Material: The CONTRACTOR shall use the approved Training syllabus and Training Manuals to develop training material. The training material shall be designed to provide the operations, maintenance and supervisory personnel with training in routine operation procedures, and preventive maintenance and troubleshooting of the PCIS, PLCs and the computer monitoring and control systems.

5. Schedule: Training shall be performed on-site during the calibration, loop and functional testing of the PCIS prior to the 7-day commissioning demonstration test. The training sessions shall be scheduled a minimum of 3 weeks in advance of when the courses are to be initiated. The ENGINEER will review the course outline for suitability and provide comments that shall be incorporated. Due to availability and scheduling of the OWNER's staff, the CONTRACTOR shall coordinate with the OWNER the schedule of the classes. The OWNER reserves the right to videotape the training sessions for later use. Training Subjects, Duration, and Agenda**:** The training shall include operation and maintenance procedures, troubleshooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment. During the course, hands-on experience with the system equipment shall be provided. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the PCIS and the PLCs. Operator classes shall stress operational theory and use of the PCIS and the PLCs.

   a. Field Instruments

      1) Subjects - installation, setup, configuration, maintenance, calibration, and troubleshooting:

         a) Pressure transmitter

         b) Level transmitter

         c) Flow measuring device and transmitter

         d) High Pressure Switch

e) ORP sensor and transmitter

6. PLC: The training of the following subject shall be performed by the CONTRACTOR and the PLC manufacturer as noted: Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the PLC. Operator classes shall stress operational theory and use of the PLCs.

   a. Subjects:

      1) PLC System Hardware and Programming Software - General Familiarity – by the PLC Manufacture.

      2) PLC programming I/O, ladder logic, registers, etc. (process/site specific) – by the CONTRACTOR

      3) Project specific operation and communication – by the CONTRACTOR

      4) Project specific PLC program troubleshooting – by the CONTRACTOR

      5) PLC Hardware- Troubleshooting and Repair of PLCs _by the PLC manufacturer or by the CONTRACTOR if approved by the ENGINEER

3.7 CRITERIA FOR SUBSTANTIAL COMPLETION

A. For the purpose of this Section and all Division 40, the following conditions shall be fulfilled before the WORK is considered substantially complete:

   1. Submittals have been completed and approved.

   2. The PCIS has been calibrated; loop tested, pre-commissioned, commissioned, and the startup completed.

   3. The OWNER's training has been performed.

   4. Spare parts and expendable supplies and test equipment have been delivered to the OWNER.

   5. Major punch-list items have been corrected.

   6. As built drawings have been submitted and accepted.

   7. Revisions to the Technical Manuals that may have resulted from the field tests have been made and reviewed.

   8. Debris associated with installation of instrumentation has been removed.

   9. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

END OF SECTION

SECTION 40 91 02 – IN-LINE LIQUID FLOW MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide in-line liquid flow measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 and 43 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

D. Section 09 96 00 – Protective Coating

PART 2 -- PRODUCTS

2.1 MAGNETIC FLOW MEASURING SYSTEMS

A. Manufacturers: The Magnetic flow meter manufacturer and model flow meters shall be as follows and or equal:

1. Endress+Hauser Promag 400W

2. Rosemount model 8705 Sensor & 8732E Transmitter or 8707 Sensor (High Signal)/8712H Transmitter

B. Description: Magnetic flowmeter systems shall be the low frequency electromagnetic induction type that produces a DC pulsed signal directly proportional to and linear with the liquid flow rate.

C. Performance / Design Criteria: Magnetic flowmeter system shall be suitable for the intended service and shall be based on the conductivity properties and solid content of the process fluid, in accordance with the manufacturer's recommendations.

1. Magnetic flowmeter system shall be capable of measuring fluid velocities in the range of 0.04 and 39 ft. /sec. in both forward and reverse flow in all sensor sizes.

2. Accuracy: The flow metering system shall be installed in accordance with the manufacturer's recommendations to provide at least 0.5 percent of flow rate from 10 to 100 percent full scale for velocities over 3 feet per second.

3. Repeatability: 0.1 percent of reading.

D. Materials / Components: The magnetic flow metering system shall include a metering tube, transmitter, and signal cable and flowmeter grounding rings.

1. Metering Sensor/Tube:

a. The metering sensor shall employ a pulsed DC technique to drive flux-producing coils. Sensors using high pulsed DC signals shall be used in accordance with the manufacturer's recommendations for the required service application.

b. The metering tube sizes shall be available from at least 1-inch to 48-inch line size. It shall be sized in accordance with the installation application and the intended service and as recommended by the manufacturer. If fractional size or larger size meters are required, the manufacturer shall be consulted for availability.

c. Metering Sensor/Tube

1) Flanged Connections: The flanges' size, style, type and construction material shall be in accordance with the required installation and the intended service application and as recommended by the manufacturer. Pressure ratings shall be suitable for the anticipated operating pressure ranges as indicated on the plans. The metering tube body for the wafer (flangeless) type meter shall be constructed of stainless steel wafer type painted with epoxy paint.

2) A minimum of two (2) electrodes shall be provided. The electrodes' material shall be suitable for the required service as recommended by the manufacturer. A reference electrode shall be provided as recommended by the manufacturer for the required installation application.

3) Lining material shall be in accordance with the manufacturer's recommendation for the intended service.

4) Meter housing shall be rated for NEMA 6P (IP68) (limited depth) and shall be able to operate between -20 to 140 Degrees F (-29 to 60 degrees C).

5) Meter tube shall have epoxy protective coating.

6) Grounding rings shall be provided and designed to protect and shield the liner's edge interface from abrasion at the meter end. Grounding rings shall conform to the manufacturer's bore and material recommendation for the intended service Grounding shall conform to the manufacturer's recommendations.

2. Transmitter/Converter

a. The transmitter/converter shall be capable of being mounted integral to the metering tube or remotely where indicated on the plans. Mounting hardware shall be provided.

b. The transmitter/converter shall be rated for NEMA 4X (IP67). Certified ratings for different hazardous locations shall be offered as an option. It shall be able to operate in ambient temperatures of -20 to 140 degrees F (-29 to 60 degrees C).

c. The transmitter shall convert the DC pulse signal from the metering tube to a linear 4 to 20 mA DC signal into a minimum of 700 ohms. The 4-20 mADC signal shall comply with HART protocol. Output signal shall be continuously adjustable over the full scale.

d. Furnish with RJ45 port for Ethernet/IP communications interface with SCADA.

e. The transmitter shall have an LCD displays for flow rate, percent of span, totalization, operator configuration interface, and diagnostic information.

f. The transmitter shall have an adjustable integral low flow cutoff and zero return.

g. The transmitter shall perform self-diagnostics and automatic data checking and activate a switch closure output when a transmitter fault is detected.

3. Cables

a. Remote transmitter configuration shall be provided with the required lengths and types of electrodes and coil drive cables as recommended by the manufacturer for the required installation application. Maximum distance of transmitter from the metering tube shall be as recommended by the manufacturer.

E. Calibration: Each flow metering system shall be hydraulically calibrated at a facility that is traceable to the National Institute of Standards and Technologies. The calibration procedure shall conform to the requirements of ANSI/NCSL Z 540-1 Calibration. A real-time computer generated printout of the actual calibration data shall be submitted to the ENGINEER at least 30 Days prior to shipment to the site.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. In-line liquid flow measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service,

supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 91 06 - LEVEL MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide level measuring systems, complete and operable in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 SUBMERSIBLE TRANSDUCER TYPE LEVEL MEASUREMENT

A. Description: The submersible level measurement system shall be designed for level and depth measurements, such as wells, where small transducer size is required. The level measurement system shall consist of a submersible transducer, electronic transmitter, support cable, and interconnecting cable with cable shield, termination enclosure, and vent tube for atmospheric reference. The installation shall allow easy removal of the transducer and cable assembly for maintenance purposes.

B. Performance / Design Criteria:

1. The transducer shall be the strain gauge type suitable for sensing pressure equivalent to the measured liquid level range. Various pressure ranges shall be available from 1 to 900 psig and shall be provided as indicated in the data sheet.

2. The transducer shall be less than 1-inch in diameter and shall be integral to and suspended by a corrosion resistant cable, as recommended by the manufacturer.

3. The transmitter shall produce a 24 VDC, 4 - 20 mA DC signal linearly proportional to the required level range as indicated in the data sheet. The measurement system shall operate over a temperature range of -5 to 140 degrees F with an accuracy of plus or minus 0.1 percent of full scale. Local indication shall be provided, unless otherwise indicated in the data sheet.

C. Materials / Components:

1. Submersible Transducer/Transmitter:

a. The wetted parts of the transducer/transmitter's body assembly shall be as recommended by the manufacturer. The transducer/transmitter shall be

provided with a lightning surge arrestor. It shall be rated IP68/Type 6. Based on installation location rating, the unit shall be intrinsically safe and rated for Class I Div. II area. Intrinsically safe barriers shall be provided as required.

b. Vent Tube: The vent tube shall be used for atmospheric reference and terminated in a sensor termination enclosure. Vent tube shall be able to support a load of up to 115 lb. and its material shall be compatible with the measured liquid as recommended by the manufacturer for the intended service.

c. Termination Enclosure: The vent tube and the pressure transducer shall be terminated in an enclosure rated for the installation location. The enclosure shall contain a replaceable desiccant module with an integral moisture status indicator, and a replaceable micro filter assembly against ingress of dust. A DIN standard terminal block shall also be included. Mounting hardware shall be included for the required installation requirements.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. Level measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 91 08 - PRESSURE MEASURING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide pressure measuring systems, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

1.3 ACTION SUBMITTALS / INFORMATIVE SUBMITTALS

A. Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation Systems.

PART 2 -- PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturer and model:

1. Ashcroft 1009S

2. Blue Ribbon BR301L

3. Winters PFQ-LF.

B. Gauge Protection: Gauges shall be protected with the appropriate components as indicated in the details.

C. Pressure range: 0 to 100 PSI

D. Materials / Components:

1. Pressure gauges shall be 4-1/2 inches, with white laminated dials and black graduations, and have a shatterproof acrylic window. The gauges' bottom connection size shall be as indicated in the details.

2. Sensing element shall be bourdon tube with welded, stress-relieved joints. Sensing element material shall be 316L stainless steel. Gauges shall have an accuracy of plus and minus 1/2-percent of full scale.

3. Body material shall be 316 stainless steel.

4. Gauge shall be liquid-filled.

2.2 ELECTRONIC GAUGE PRESSURE TRANSMITTERS

A. Manufacturers: Pressure Transmitter Manufacturer shall be, Endress and Hauser PMP series, Rosemount 3051 or approved equal.

B. Description: Gauge pressure transmitters shall measure the in-line process pressure using a sensor with sealed fill fluid and isolation/sensing diaphragm. The sensor shall convert the process pressure variations to a linear 4-to-20 mA DC output signal at 24 VDC, 2-wire type, proportional to the pressure variation, with an allowable loop load of not less than 600 ohms. A temperature compensation unit shall also be part of the sensing module.

C. Digital readout: None.

D. Performance / Design Criteria:

1. Continuously (external) adjustable span, zero and dampening (internal) adjustment.

2. Accuracy shall be at least plus minus 0.14 percent of span.

3. Ambient operating range of minus 40 degree F to plus 250 degrees F.

4. Pressure range: -14.2 to 300 PSI

5. Provide vent, drain, block and bleed valve plugs.

6. Transmitter output shall be compatible with HART protocol.

7. Sensor or transmitter failure alarm - High or low failure mode - shall be provided and shall be user selectable.

E. Materials / Components

1. Sensor fill fluid shall be silicon.

2. Process wetted parts and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the details.

3. As a minimum, housing material shall be 316 stainless steel unless otherwise noted on the details. Housing shall be rated NEMA 4X.

4. Non-wetted parts shall be as recommended by the manufacturer for the intended service.

5. Process connection style shall be ½-inch NPT or flange. Connection style and flange size rating and material shall be as recommended by the for the intended service and installation application, and as shown on the details.

6. Provide mounting hardware suitable for the intended service and installation application (e.g. surface mounting, 2-inch pipe, etc.)

2.3 DIAPHRAGM SEALS FOR PRESSURE MEASURING SYSTEMS

A. Manufacturers: As shown on owner's standard details.

B. Description: Operating Principles The diaphragm seal shall attach to the inlet connection of a pressure instrument in order to isolate its measuring element from the process fluid due to incompatibility and/or high process fluid temperature. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

C. Materials / Components:

1. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

2. The bottom housing shall be removable in order to permit servicing. Bottom housing material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the details.

3. As a minimum, top housing and bolts shall be 316 stainless steel, or as recommended by the manufacturer for the intended service and installation application and as details.

4. Diaphragm capsule material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the details.

5. The diaphragm seal shall be factory-assemble to the corresponding pressure instrument and factory-filled. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid as recommended by the manufacturer for the intended service and installation application and as indicated in the details.

6. Material of exposed surfaces, housings, and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the details.

7. The seal shall be provided with a ring, flushing port connection, and fill/bleed connection.

8. The diaphragm seal shall be shipped a tag reading "Do not disassemble for installation.

PART 3 -- EXECUTION

3.1 FIELD QUALITY CONTROL

A. Pressure measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer’s service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 91 09 - PRESSURE DETECTION

PART 1 -- GENERAL

1.1 THE SUMMARY

A. **General** The CONTRACTOR shall provide pressure detection switches, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 - PROCESS CONTROL AND INSTRUMENTATION apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 91 00 PROCESS CONTROL AND INSTRUMENTATION and Section 01 33 00 – CONTRACTOR SUBMITTALS.

PART 2 -- PRODUCTS

2.1 ADJUSTABLE PRESSURE SWITCH

A. Adjustable pressure switches shall be diaphragm-actuated, dual adjustment pressure switches with SPDT contacts rated for a minimum of 5 Amps at 120 VAC. The dead band shall be adjustable up to 60 percent of full scale. Set points shall fall between 20 and 80 percent of the adjustable range. The diaphragm shall be Buna-N, and the lower housing shall be brass with a 1/4-inch bottom sensing connection, unless otherwise indicated

B. Manufacturer shall be **Ashcroft Series L/Series B**.

2.2 DIAPHRAGM SEALS FOR PRESSURE DETECTION SWITCHES

A. Manufacturers: As shown on owner's standard details.

B. Description: Operating Principles The diaphragm seal shall attach to the inlet connection of a pressure instrument in order to isolate its measuring element from the process fluid due to incompatibility and/or high process fluid temperature. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch, or other pressure instrument.

C. Materials / Components:

1. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing.

2. The bottom housing shall be removable in order to permit servicing. Bottom housing material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the details.

3. As a minimum, top housing and bolts shall be 316 stainless steel, or as recommended by the manufacturer for the intended service and installation application and as details.

4. Diaphragm capsule material shall be compatible with the process liquid as recommended by the manufacturer and as indicated in the details.

5. The diaphragm seal shall be factory-assembled to the corresponding pressure instrument and factory-filled. The space between the diaphragm and the pressure element shall be completely filled with a suitable liquid as recommended by the manufacturer for the intended service and installation application and as indicated in the details.

6. Material of exposed surfaces, housings, and diaphragm shall be as recommended by the manufacturer for the intended service and installation application and as indicated in the details.

7. The seal shall be provided with a ring, flushing port connection, and fill/bleed connection.

8. The diaphragm seal shall be shipped a tag reading "Do not disassemble for installation.

PART 3 -- EXECUTION

3.1 GENERAL

A. Pressure-measuring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested according to Section 40 91 00. The CONTRACTOR shall furnish the manufacturer’s service, supervision, and training indicated by Section 40 91 00.

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SECTION 40 91 12 - PROCESS MONITORING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. General: The CONTRACTOR shall provide all process monitoring systems, complete and operable, in accordance with the Contract Documents.

1.2 RELATED WORK AND REQUIREMENTS SPECIFIED ELSEWHERE

A. Section 40 91 00 - Process Control and Instrumentation Systems.

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems.

C. Division 26 – Electrical.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Power Requirements: Power Input to the analyzer or controller shall be as indicated in the data sheet.

B. Ambient Conditions: Analyzers shall be suitable for continuous automatic on-line analysis of the parameter specified for each analyzer under the conditions indicated herein and/or in the data sheet.

1. The analyzer shall operate satisfactorily in ambient temperatures between -20 and 120 °F, or shall be provided with an isothermal enclosure so that the specified accuracy is not impaired. Relative humidity shall be from 5 to 95 percent, non-condensing.

2. Process fluid temperatures will range between 40 and 100 °F, unless otherwise noted in the data sheet.

C. Process fluid temperatures and pressure range shall be as recommended by the manufacturer and as indicated in the data sheet for each analyzer application.

D. Sample condition such as pressure, temperature, pH level, flow rate range and optimum flow setting, shall be as recommended by the manufacturer for the intended service application and as indicated in the data sheet.

E. Reagents, Electrolyte and Buffer Solutions: Unless otherwise specified, each analyzer shall be reagent-less, which means that the analyzer measuring system shall not introduce a reagent solution, electrolyte or buffer solution into the sample or the process.

F. Local Indication: Each analyzer shall be provided with an integral local indication scaled in process units.

G. The interconnecting cable between the sensor and the analyzer/controller/transmitter shall be either integral with the sensor or furnished by the instrument manufacturer and shall be of sufficient length to allow proper installation of the analyzer.

H. The analyzers and sensors shall be provided with all the necessary mounting and connation hardware suitable for the intended installation application.

I. Single manufacturer: All components of analyzers measuring the same parameter shall be products of a single manufacturer.

2.2 ORP (REDOX) MEASURING SYSTEMS

A. The ORP (Oxidation Reduction Potential or REDOX Potential) sensor shall be suitable for the determination of ORP (REDOX Potential) in continuous process liquid streams. The ORP measurement system shall consist of a sensor probe and an amplifier/transmitter with an indicator.

B. Sensor:

1. The ORP sensor shall be non-selective and shall respond to the sum of oxidation-reduction reaction in the sample. This means that REDOX potential is a composite parameter of all ions and molecules taking part in the REDOX reaction.

2. The sensor shall use a double chamber reference system with potassium nitrate bridge electrolyte, PTFE-diaphragm, and platinum electrode.

3. The electrodes shall be enclosed in chemical-resistant electrode housing. The electrode material shall be suitable for the intended service application as recommended by the manufacturer.

4. The sensor shall be a flow-through type and shall have automatic temperature compensation. Flow-through type sensors shall be suitable for a working pressure of 15 to 145 psig at 176°F. Process connection shall be as indicated in the details. Device shall be suitable for installation in the orientation shown on the details.

5. The measuring range of the ORP sensor shall be -1,500 to +1,500 mV.

6. The ORP sensor shall be able to operate in temperatures range of 32 Deg. F to 170 deg. F.

C. Analyzer Controller/Transmitter

1. The analyzer system shall be provided with a controller/transmitter unit that shall accept and process the input from one (1) or more analog or digital sensors to produce the required output(s). The controller shall accommodate the number of analyzers/sensors as indicated on the plans.

2. The controller shall use a menu-driven operation system and an auto-ranging digital LCD display.

3. Analyzer system enclosure shall be wall mounted, or as indicated in the details and shall be NEMA 4X.

4. Controller Output:

1. For each analyzer/sensor the controller shall generate an isolated 4-20 mA DC capable of driving 600 ohms load.

2. Furnish with RJ45 port for Ethernet/IP communications.

3. A minimum of one SPDT relay output shall be provided for user-configurable. Contact rating shall be 5 amps.

D. ORP measuring system manufacturer:

1. Endress and Hauser CPF28E with model CM442 Analyzer/Controller. No substitutes accepted.

PART 3 -- EXECUTION

3.1 GENERAL

A. Process monitoring systems shall be handled, installed, calibrated, loop-tested, pre-commissioned, and performance tested in accordance with Section 40 91 00 Process Control and Instrumentation Systems. Manufacturer's service, supervision, and training shall also be in accordance with Section 40 91 00 Process Control and Instrumentation Systems.

END OF SECTION

SECTION 40 95 13 – CONTROL PANELS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR provide control panels, complete and operable, in accordance with the Contract Documents.

B. The CONTRACTOR shall be responsible for selecting, sizing, and providing the correct and necessary type and quantity of the panels for each process control application. The necessary hardware and responsibilities shall include but not limited to:

1. Mounting the panel
2. Locating and mounting interior and exterior instruments, hardware and equipment in the panel
3. Field interface terminal blocks
4. Terminating panel internal wiring and signals
5. Terminating communication and network cabling and wiring

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Section 40 91 00 - Process Control and Instrumentation

B. Applicable Sections in Division 40 – Instrumentation and Control for Process Systems

C. Division 26 – Electrical

D. The provisions of this Section apply to local panels provided in equipment systems specified in other sections unless indicated otherwise in those sections.

E. All panels shall conform to the specifications; codes and standards requirements specified Section 40 91 00 - Process Control and Instrumentation System.

F. Each control panel, including panels for service entrance equipment, shall meet all UL listing and labeling requirements including UL Standard 508 and UL Standard 508A and shall be UL labeled accordingly. Contractor shall arrange components and wiring to meet UL requirements stated above.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. The Submittals shall be provided in accordance with the requirements specified in Section 40 91 00 – Process Control and Instrumentation System.

1.4 QUALITY ASSURANCE

A. Factory and field tests shall be performed in accordance with Section 40 91 00 – Process Control and Instrumentation System.

1.5 WARRANTY

A. Guarantee and Special corrections of defects and software upgrade requirements and warranty shall be in accordance with Section 40 91 00 - Process Control and Instrumentation System.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All PCIS control panel assemblies, such as new PLCs, remote I/Os, analyzer systems, communication systems, etc. shall be mounted inside a new outdoor or indoor NEMA-rated type enclosure, suitable and designed for the application for which it was intended, as specified or as shown on the drawings. If required, PCIS panel assemblies shall be mounted in existing enclosures. Control panels shall be either freestanding, pedestal-mounted or equipment skid-mounted.

B. The enclosure and back panel shall be sized to contain the equipment required to make the installation complete and suitable for its intended purpose. Where shown on the plans, enclosure furnished shall match dimensions shown on the plans. Field conditions and the guidelines provided in the specifications and/or the drawings shall be followed. Accessibility for ease of maintenance, future expansion and good installation and industry practices shall be considered when sizing an enclosure. Spare space shall be kept clear of wiring, etc., to give contiguous clear space for future additions.

C. Environmental Suitability and NEMA Rating

1. Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Enclosures shall be suitable for the environment that they are installed.

2. Control panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.

2.2 CONSTRUCTION

A. Material and Fabrication

1. Wall mounted type enclosure shall be constructed of a minimum of 14-gauge or 12-gauge steel, 316 stainless steel as noted or otherwise required to suit the application, environment, and the project requirements.

2. Seams shall be continuously welded and ground smooth. Corners shall be welded and ground smooth.

3. Each enclosure shall have a heavy gauge, continuous piano hinge pin which shall support each door.

4. Door and body stiffeners shall be provided where required. The stiffeners shall be welded to the inside of enclosures to prevent deformation due to the weight of face-mounted instruments.

5. Doors shall be sealed with a closed cell neoprene gasket.

6. The interior rear and sides of each enclosure shall have steel mounting channels for supporting mounting panels.

7. Enclosures shall be provided with external mounting feet where shown, as well as door clamps, hasp and staple for padlocking, data pocket, and closed-cell oil-resistant gasket. Removable lifting lugs to facilitate handling shall be provided on large enclosures.

B. Back and Side Panels: Each enclosure shall be provided with a removable back panel.

C. Finish: Non-stainless steel enclosures shall have an ANSI 61 gray polyester urethane powder coating electrostatically applied to inside and outside surfaces. Enclosure interior, and back and side panels shall be white.

D. Ventilation, Louvers, Vents, and Filters: In enclosures where excessive internal heat or internal moisture is a problem, the enclosure shall be equipped with louvers with filters and a cooling fan. The perimeters of the louver plate shall be sealed with a gasket. Louver shall be of the same material and finish as the enclosure. The louver shall be sized for effective heat rejection.

E. Accessories: The CONTRACTOR shall provide additional panel accessories to meet the specifications, such as floor stand and mounting kits, door handle and lock kits (common key shall be provided for all doors), 3-point latch, etc

F. Instruments Mounting

1. Equipment mounted at the rear of enclosure shall be installed to allow for commissioning adjustments, operation and servicing requirements. The CONTRACTOR shall arrange components and wiring to meet UL requirements and to meet layouts shown on the plans.

2. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.

3. For front mounted hardware, cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth. Mounting the instruments shall not degrade the NEMA rating of the enclosure.

4. DIN rail mounted equipment shall be used as much as possible.

5. Each enclosure shall be provided with interior nameplates to identify equipment tags and functions.

G. Enclosures shall be Hoffman, Hubbel-Wiegmann, or equal.

2.3 ELECTRICAL REQUIREMENTS

A. The main power supply to the control panel controls shall be as shown on the plans. provide the main power supply from an external source. The CONTRACTOR shall provide a step down transformer as required to power the panel.

B. The CONTRACTOR shall provide wireways, wire, and electrical fittings and components for 120V and 24VDC circuits to instruments and other electrical devices in the panel for a complete and operable installation. Wiring methods and materials for all panels shall be in accordance with the NEC and UL requirements.

C. The circuits for 24VDC shall run in separate wireways from the 120 VAC circuits.

D. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks. Each control panel shall be provided with identified terminal strips for the connection of all external foreign voltage.

E. If required by the contract documents, the control panel shall be the source of power for any 120 VAC solenoid valves interconnected with the control panel.

F. Terminal Blocks

1. The control panel shall be provided with sufficient terminal blocks for the connection of external field conductors, signals, and power and for use inside the panel for power distribution and for future expansion. In order to facilitate easy and safe loop maintenance, each analog input loop shall have a disconnect with test plugs built into its field terminal block.

2. Spare Terminal Blocks for Signals: The CONTRACTOR shall provide a minimum of 20% spare terminals for each type of I/O used, unless otherwise shown on the plans. Implemented spare signals shall be wired to terminal blocks

3. Terminal blocks for all wiring shall be modular terminals, DIN rail mounted type rated at 15 amperes at 600 VAC and have a minimum width of 8-mm suitable for No. 12 A.W.G. stranded wire. Terminals shall be the solderless box lug type with pressure plates in actual contact with the wire to minimize wire breakage. Each terminal shall have a light colored strip for marking the terminal number or circuit designation. Double high terminal blocks are not accepted.

4. External connections to and from enclosures shall terminate on terminal blocks, except approved communication and data cables. Circuit isolating switches and fuse terminals shall include non-conducting pullers which can be removed with finger alone, without tools. Additionally, the panel shall be provided with identified terminal strips for the connection of external/field conductors.

5. Terminals shall be as manufactured by Square D Class 9080 Type M, Allen-Bradley Bulletin 1492 Type H or J, by Entrelec, or equal.

G. Electrical Hardware Accessories: The control panel shall be equipped with the following:

1. A duplex 15 amp, 120 VAC GCFI type receptacles for service and maintenance use. The receptacle shall be 2-pole, 3-wire grounding, and heavy duty industrial grade by Hubbell, Leviton, or equal.

2. An internal manually activated fluorescent light with integrally mounted toggle switch mounted on the top of the enclosure interior. Control panels that are longer than 72-inches, two lamps shall be provided. Hoffman X-LF16M18 or equal.

3. A ¼-inch by one (1)-inch copper grounding bus bar with multiple connecting terminals. The grounding bus shall be complete with solderless connector for one 4 AWG bare stranded copper cable and with tapped holes to accommodate ground connections from various devices in the enclosure. Provide ground connections for different AWG wires and shield connection clamps by Phoenix Contact, or equal. Provide separate ground buses for analog and discrete/digital signals. The copper cable shall be provided by the CONTRACTOR and be connected to a system grounding electrode.

4. Where shown on plans, furnish with 120 VAC Heater and thermostat. Heater by Pfannenberg and thermostat by Stego model KTO-011, or equal.

5. Where shown on plans, furnish with ventilation fan and filter kit by Cooltron FA and FAA series, or equal.

H. Circuit Breakers, Fuses, and Disconnects

1. Circuit breakers, fuses and disconnects shall be installed in the control panel to protect, against fault current, the 120 VAC and 24 VDC branch circuits and the instruments and the electrical components that these circuits power. Circuit breakers shall be installed as disconnects of external power feeds for control circuits from outside the enclosure and branch circuits within the enclosure.

2. The circuit breakers, fuses and disconnects shall also allow disconnecting the power from these instruments in a safe manner. Individual plug and cord set power supply connections, such as for a UPS, may be used without switches. Each circuit breaker and fuse shall be identified by a service nametag.

3. The fuses shall be mounted in a DIN mounted fuse holder terminal block and shall have a blown fuse indicator light. The fuse holders for 120 VAC applications shall have a neon light indicator and shall Entrelec part number 0115-661.21, or equal. The holders for 24 VDC applications shall have an LED indicator light and shall be Entrelec part number 0115-663.23, or equal.

4. The number of power distribution circuits depends on the type of electrical devices they power. Circuit breakers and fuses shall be applied as noted on the plans. The 120 VAC breakers shall by Allen-Bradley,1489 Series or equal.

I. Uninterruptible Power Supply: As shown on plans. Substitutions not accepted.

J. Control Panel 24 VDC Power Supply: As shown on plans. Substitutions not accepted.

K. Control Panel Signal, Control and Power Wiring: Power, controls and signal wiring insulation type and color, and conductor sizes shall be as shown on the plans.

L. Wire Identification: As shown on plans.

M. Phase Monitor: As shown on plans. Substitutions not accepted.

N. Mains Level Surge Protection Devices: As shown on plans. Substitutions not accepted.

O. Device-Level Surge Protection Devices: Surge protection devices (SPD) shall be installed on process control loops, instruments, and networks (e.g. Modbus, Profibus, Device Net, etc.) for protection against induced current surge and transient surge sources (e.g. lightning, power switching, static discharge, etc.). The SPD shall divert the resulting surges safely to earth and limit voltages to acceptable levels.

1. Each end of analog input and analog output loops shall be protected by a SPD - at the control panel side and at the field device. SPD application for analog signals on the control panel side shall be as shown on the plans. SPD application for discrete input signals on the control panel side and at field devices shall be as specified hereinunder.

2. Technical Data and Design:

a. The SPD shall be of the fast acting type, capable of limiting the surge destructive high voltage transients, and shall feature accurate voltage control. It shall be maintenance-free and fully automatic self-resetting, once the over-voltage has ceased.

b. The SPD shall be of a multi stage hybrid circuit design, incorporating gas-filled discharge tubes (for high surge current diversion) with zener diodes for fast operation.

c. Type A2 SPD:

1) Application: Protection of two-wire, 24VDC, 4-20mA analog field devices.

2) Maximum discharge current: At least 20kA (8/20µs).

3) Nominal Discharge current: At least 3kA (8/20µs).

4) Lightning impulse current: At least 2.5kA (10/350µs)

5) Nominal Voltage: 35VDC.

6) Ambient temperature limits: -40°C to +85°C.

7) Housing: Stainless steel conduit nipple with 1/2" NPT threaded connection and NEMA 4X rating.

8) MTL TP48 series or equal.

d. Type B4 SPD:

1) Application: Protection of signal and power circuits for four-wire, 24VDC, 4-20mA analog field devices operating on a 120VAC supply.

2) AC Power protection:

a) Maximum discharge current: At least 36kA (8/20µs).

b) Nominal Voltage: 120VAC.

c) Maximum Operating Current: 15A.

d) Overcurrent protection: 15A fuse

3) Signal Line Protection

a) Maximum discharge current: At least 10kA (8/20µs).

b) Operating Voltage: 0 – 36VDC.

c) Maximum operating current: 150mA.

4) Housing: Polycarbonate case with NEMA 4X rating.

5) Edco SLAC Series.

e. Modular SPD

1) Application: Inside control panels for protection of incoming discrete input signals from field devices. Refer to panel wiring diagrams for additional information.

a) Maximum discharge current: At least 20kA (8/20µs).

b) Nominal Discharge current: At least 3kA (8/20µs).

c) Lightning impulse current: At least 1 kA (10/350µs)

d) Nominal Voltage: 150 VDC/120 VAC.

e) Nominal Current: 3A

f) Ambient temperature limits: -40°C to +85°C.

g) Housing: Stainless steel conduit nipple with 1/2" NPT threaded connection and NEMA 4X rating.

h) MTL SD150X or equal.

2.4 ETHERNET DATA NETWORK SURGE SUPPRESSOR

A. Each Ethernet connection between control panel and field devices shall be protected by a SPD - at the control panel side and at the field device.

B. Technical Data and Design:

1. Fully shielded adapter design with RJ45 sockets.

2. Maximum continuous operating voltage: 48VDC.

3. Maximum continuous operating voltage, pair-to-pair 57VDC.

4. Nominal current: 1A.

5. Nominal discharge current (8/20µs) line-to-line: 150A.

6. Total nominal discharge current (8/20µs) line-to-PG: 10kA.

7. Voltage protection level line-to-line for 1kV/µs: <= 180V

8. Voltage protection level line-to-ground for 1kV/µs: <= 500V.

9. Capacitance line-line: <= 30pf.

10. Capacitance line-to-ground: <= 25pf.

11. Suitable for DIN-rail mounting.

12. Operating temperature range: -40 degrees C to 80 degrees C.

2.5 PLC HARDWARE

A. Programmable logic controllers and associated I/O cards, communications modules, network switches, shall be as shown on the Electrical Drawings. No substitutions accepted.

2.6 ELECTRICAL COMPONENTS

A. General Purpose Relays

1. General purpose relays in the control panel(s) shall be compact plug-in type with contacts rated 10 amperes at 120-volts ac; or 24 VDC. Quantity and form of contacts shall be as required by the application. However, the relay shall have a minimum of two (2)-form C contacts (double pole-double throw), except when used as interpose relay for the PLC's DO modules, where they shall have a minimum of one (1)-form A (single pole single throw) contact. Each relay shall be provided with a neon light to indicate energized state.

2. The relay socket and mounting shall be a standard DIN rail mount with pullover wire spring ("horseshoe clip").

3. Relays shall be IDEC compact relays type RHXB-UL with SHXB-05 sockets where X indicates the number of form C contact, or equal.

B. Slave and Interpose Relays: Additional slave relays shall be provided when the number or type of contacts required exceed the contact capacity and/or rating of the specified relays and timers. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment. The slave and interpose relays shall be as the general purpose relays specified above.

C. Time Delay Relays - Electronic Type: Time delay relays shall be plug-in electronic type with on-delay or off-delay actuation as required. Output contacts shall be DPDT rated 10-amperes at 120-volts ac minimum. Each unit shall include an adjustable time delay with a time range scale. Operating temperature range of the units shall be -20 to +120 degrees-F minimum and each device shall be rated for 10,000,000 mechanical operations and 500,000 electrical operations. Time delay relays shall be Idec RTE series, Schneider Electric, Agastat Series SCC, Omron, or equal.

D. Indicating Pilot Lights

1. Indicating lights shall be push-to-test LED and shall be heavy-duty, oil-tight construction. Operators shall be nickel or chrome plated. Each light shall have a screwed-on prismatic lens approximately 1-inch in diameter. Miniature style devices are not acceptable.

2. Lens colors shall be as shown on the plans.

3. Indicating lights shall be Square D Company, Class 9001 Type K, General Electric Company Type CR104P, or equal. Each light shall have a factory-engraved legend plate, as shown on the Contract Documents.

E. Selector and Pushbutton Switches: Selector and pushbutton switches shall be rated 10-amperes at 600 volts; shall be heavy-duty, oil-tight construction; and shall have the number of positions and poles required. Miniature style devices are not acceptable. Operators shall be nickel or chrome plated. Switches shall be Square D Company,

Class 9001 Type K, General Electric Company Type CR104P, or equal. Each switch shall have a factory-engraved legend plate as shown on the Contract Documents.

F. Signal Isolators, Conditioners and Converters

1. Signal isolators conditioners and converters shall be provided as required to resolve any signal level incompatibilities, to ensure adjacent component impedance match where feedback paths may be generated, or to maintain loop integrity during the removal of a loop component.

2. Signal isolators, integrators and converters shall be 24 VDC or 120 VAC powered as applicable, and shall DIN rail mounted. Isolators shall be by Phoenix Contact, Acromag, or equal.

G. Magnetic starters shall be:

1. NEMA rated, Size 1 minimum. IEC or dual NEMA/IEC rated type are not accepted.

2. FVNR type unless indicated otherwise.

3. Combination starters with magnetic only instantaneous trip circuit breakers such as Eaton Electrical HMCP, General Electric Mag-Break, or equal.

4. Control transformers shall be provided with primary and secondary fuses, 120 V maximum control voltage. VA rating of transformer shall be based on devices on the control schematic.

H. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by General Electric, Eaton Electrical, or equal.

I. Nameplates: Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front or the inside of the control panel. A nameplate shall be provided for each instrument and device. The nameplates shall be descriptive to define the function and system of such device in accordance with the CONTRACT DOCUMENTS or the approved shop drawings. Adhesives shall be acceptable for attaching nameplates, but stainless steel nameplates shall be fastened with screws. Unless otherwise indicated, nameplates shall be fabricated from white-face, black-center, laminated engraving plastic.

PART 3 -- EXECUTION

3.1 EXAMINATION

A. Preparation for Shipment and Shipping

1. Control panels shall be crated for shipment using a heavy framework and skids as required and cushioned to protect the finish and the instruments during shipment. Shipments shall be by air-ride vehicle. Suitable cushioning material shall be used to protect interior hardware that could be damaged due to mechanical shock.

2. Depending on panel size, each separate panel unit shall be provided with removable lifting lugs to facilitate handling.

3. Control panels shall be installed in accordance with Section 40 91 00 - Process Control and Instrumentation System.

3.2 INSTALLATION

A. CONTROL PANEL SIGNAL AND CONTROL CIRCUIT WIRING

1. Wiring Installation

   a. Wiring methods and materials for panels shall be in accordance with the NEC requirements and industry practices.

   b. Wires shall be run in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, and (3) wiring from components on a swing out panel to components on a part of the fixed structure.

   c. Wire shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals. Wiring run from components on a swing out panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at the terminals.

   d. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

   e. Splicing of shall be kept to a minimum and only if the wire cannot be replaced. Splicing shall be either soldered or pressure crimped type. Data and communication wires/cables shall not be spliced.

2. Wiring Termination

   a. All field wiring shall terminate at a terminal block in the enclosure. Field wiring shall be terminated first at the field interface terminal block and then wired to the devices/instrument or PLC inside the panel. Except for antenna cable, Cat 5e cables and other specialty cables, such as thermocouples and data cables, field wiring shall not be wired directly to the panel mounted device.

   b. Terminals and fuses for each conductor and shield drain wire of a twisted shielded pair or triad cable shall be mounted consecutively next to each other.

   c. Terminal blocks shall be grouped based on their function and voltage. Each group of terminal blocks shall be located in the panel to provide easy access, safety, practicality, and minimization of internal wiring.

   d. Terminal blocks for 24 VDC signals shall be grouped separate from the power and other 120 VAC terminals.

   e. Terminal blocks for 24 VDC signals shall be grouped separate from the 24VDC power as well. Likewise, terminal blocks for 120 VAC power and distribution shall be grouped separate from the 120 VAC terminals for control signals.

   f. Each terminal and wire connection shall be tagged in accordance with the approved shop drawings or OWNER's standard tagging/numbering, if available.

3.3 FIELD QUALITY CONTROL

A. General: Calibration, testing, and instruction shall be performed in accordance with Section 40 91 00 - Process Control and Instrumentation System.

END OF SECTION

SECTION 40 95 33 - FIBER OPTIC COMMUNICATION SYSTEM

PART 1 – GENERAL

1.01 REFERENCED STANDARDS

A. The cable and installation shall meet all requirements stated in this specification as well as the latest edition of the following:
   1. Insulated Cables Engineers Association (ICEA); S-87-640 Standard for Fiber Optic Outside Plant Communication Cable
   2. United States Department of Agriculture Rural Development Utilities Program (RDUP); PE-90
   3. ISO/IEC:
      a. 24702 Information technology -- Generic cabling -- Industrial premises OS2 Single-mode fiber type 0.4db/km attenuation
      b. 11801 Information technology — Generic cabling for customer premises OM1 Multimode fiber type 62.5 µm core; minimum modal bandwidth of 200 MHz*km at 850 nm
   4. International Electrotechnical Commission (IEC):
      a. 60793-2-50 Type B1.3 Product specifications - Sectional specification for class B single-mode fibres
      b. 60793-2-10 Type A1b Product specifications - Sectional specification for category A1 multimode fibres
   5. International Telecommunication Union (ITU); T G.652.D Characteristics of a Single Mode Optical Fibre and Cable
   6. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) Standards:
      a. 455-78-B Measurements Methods and Test Procedures-Attenuation
      b. 492 CAAB Detail Specification for Class IVa Dispersion-Unshifted Single Mode Optical Fibers with low water peak
      c. 492 AAAA-A Detail Specification for 62.5 micrometer Core Diameter/125 micrometer cladding diameter Class IVa Graded-Index Multimode
      d. 568-C.3 Optical Fiber Cabling Component Standard
      e. 598-B Optical Fiber Cable Color Coding
   7. Restriction of Hazardous Substance (RoHS) Compliant
   8. Telcordia; GR-20-CORE

1.02 QUALITY ASSURANCE

A. Manufacturer: The cable manufacturer shall be ISO 9001 or Quality Management System TL 9000 registered.

B. Installer
   1. The fiber optic cable installer shall be certified by the cable manufacturer and adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning the Project
   2. The Contractor directly responsible for this work shall be a Premise

Distribution contractor who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years.

3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and have personnel who are adequately trained in the use of such tools and equipment.

1.03 SUBMITTALS

A. In accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.

B. SHOP DRAWINGS shall include:
1. Cable schedule showing cable identification, fiber counts for each cable and identification of used fiber pairs.
2. Component Data:
   a. Manufacturers and model number
   b. Data sheets
3. System Block Diagram
4. Detailed Test Procedure to be implemented including all tests to be conducted and list of equipment to be used.

C. OPERATION and MAINTENANCE submittal shall include:
1. All shop drawing data revised for as built conditions
2. Manufacturers user manuals and installation instructions
3. Fiber Optic Cable Test Results

1.04 SYSTEM DESCRIPTION

A. Furnish and install complete with all accessories a TIA/EIA fiber optic, Cabling System (FOCS). The FOCS system shall serve as a vehicle for transport of data signals connecting designated demarcation points and other locations as indicated on the contract drawings and described herein.

B. The system shall utilize a network of fiber optic cabling. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings. All cables, and terminations shall be identified at all locations. All terminations shall comply with, and be tested to TIA/EIA and Gigabit Ethernet fiber optic standards.

C. Major work items include but are not limited to:
1. Fiber optic cable and patch cords
2. Fusion splicing
3. Splice enclosures
4. Fiber Optic Patch Panels
5. Installation of fiber optic cable
6. Fiber optic terminations
7. Testing of the fiber optic cable including:
   a. OTDR testing on installed fiber optic cable.

D. Electrical Contractor to furnish and install conduit and pull boxes for fiber optic cable. Coordinate fiber optic cable and conduit requirements with electrical contractor.

E. Provide fiber optic cable for installation based on lengths provided by the electrical contractor.

F. Environmental Specifications:
   1. Outside Plant Fiber Optic Cable operation and storage -40 degrees C to +70 degrees C.
   2. Equipment Outside above ground -40 degrees C to +80 degrees C.

PART 2 – PRODUCTS

2.01 GENERAL

A. Fiber optic cabling shall be provided as designated on the contract drawings. Cables placed below grade shall be certified by the manufacturer for that environment. Cables installed in vertical risers between floors shall be U.L. listed riser type cable. Cables installed in plenum spaces shall be listed for that environment.

2.02 SINGLE MODE FIBER OPTIC CABLE

1. Cable Type: All dielectric outdoor plant stranded loose-tube, gel-filled fiber optic cable, **Corning Altos 024RW4-14101A20** or **Lucent Lightpack 7D1X-024-BXD**.

2. Number of fibers: 24 fibers.

3. Buffer Tubes

   a. Optical fibers shall be grouped inside a loose buffer tube. Tubes shall be color coded and arranged symmetrically around the central member.

   b. The fibers shall not adhere to the inside walls of the loose buffer tube. Buffer tubes shall be kink resistant within the specified minimum bend radius.

   c. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

   d. Buffer tubes shall be stranded around a central member using the reverse oscillation, or "S-Z", stranding process.

   e. Binders shall be applied with sufficient tension to secure the buffer tubes to the member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

4. Each fiber shall be numbered and color-coded. The colors of the individual fibers shall be stable across the indicated storage and operating temperature range and not be

subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

5. Cable Core

   a. Filler may be included in the cable core composition to lend symmetry to the cable cross section where needed.

   b. A central anti-buckling member shall be included in the cable. The anti-buckling member shall be composed of a glass reinforced plastic rod.

   c. The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional nontoxic solvents.

   d. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

6. The all dielectric cable shall be sheathed with medium density polyethylene (MDPE). The minimum nominal jacket thickness shall be 1.4-mm. Jacketing material shall be applied directly over the tensile strength members and water blocking material. The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metallic elements and shall be of a consistent thickness.

7. The cable shall contain at least one ripcord under the sheath for easy sheath removal.

B. Fan-Out Termination for Loose Tube Cables

1. Individual fibers within the loose tube cable require handling protection inside the termination cabinets. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Fan-out tubes or furcation kits shall not be used. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall protect all splices. A wall-mountable splice center shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure.

C. Fan-Out Pigtail Cable Specifications: Single mode fiber (**Corning SMF-28,** or equal) shall be used in the pigtails. Optical characteristics shall comply with the optical fiber performance specifications.

Buffer material	Thermoplastic
Buffer OD	900 um
Strength Member	Kevlar
Jacket Material	PVC

Jacket OD	3.0-mm
Temperature Range	-20 to + 70 degrees C

2.03 FIBER OPTIC CONNECTORS

A. Fiber optic waterproof termination shall be LC (snap-lock design) or ST (twist-lock design) all polymer type – as required to suit application and as noted - with ceramic zirconia ferrule. Connector shall be constructed of nickel plated zinc alloy with thermoplastic rubber strain relief boot. Termination fiber must be bonded within the connector ferrule utilizing two part anaerobic bonding compound. Crimp type connectors and/or epoxy heat cure connectors that require ovens shall be deemed unacceptable. Connectors shall adhere to the following standards: ISO/IEC 11801, TIA 568A and CENELEC.

B. Connectors shall be rated for operation in temperatures ranging from -40°C to 80°C. Boot strain relief shall accommodate up to 100N. Insertion loss and repeatability shall be less than 0.3dB.

C. Manufacturers: Optokon Corp (Methode Electronics, Inc.) or equal.

2.04 UNSPECIFIED EQUIPMENT AND MATERIAL

A. Any item of equipment or material not specifically addressed on the contract drawings or in this document and required to provide a complete and functional SCS installation shall be provided in a level of quality consistent with other specified items.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Fiber Optic Cable
1. Install cable in accordance with cable manufacturer recommendations for bend radius and pulling tension. Do not exceed limits specified by the manufacturer.
2. Utilize break away swivel set at 600lbs for straight pulls greater than 100' and all pulls which are not in a straight line.
3. Identify cable on both ends, in pull boxes and at all terminations.
4. Terminate all fibers in each cable to a connector.
5. Provide slack fiber coiled neatly in cable management at all fiber termination centers, converters and switches.
6. Terminate cables using manufacturer supplied break-out kits.
7. Fan out fiber to allow direct connection with connectors. Provide strain relief with fan out collar.

3.02 TESTING

A. General: The CONTRACTOR shall perform pre-installation and post-installation FOC tests. The CONSTRUCTION MANAGER shall be notified a minimum of 10 Days in advance so that these tests are witnessed. All test equipment shall be traceable to LIST standards.

B. Test equipment: The CONTRACTOR shall use the following to perform pre-installation and post-installation FOC tests:

1. **Optical Time Domain Reflectometer (OTDR):** The OTDR shall be laser precision, **ALT Inc MODEL 5200 LRFL**, or equal.

C. Pre-Installation Tests

1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation and manufacturing processes.

2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the CONTRACTOR using an OTDR. The OTDR tests shall consist of end-to-end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the contractor and manufacturer In all cases, all fibers must meet the optical attenuation specifications prior to cable installation.

4. The CONTRACTOR shall perform tests on all reels of cable. The CONSTRUCTION MANAGER shall be notified a minimum of 15 Days prior to any test.

5. The CONTRACTOR shall document each test and submit the report to the CONSTRUCTION MANAGER for review. Documentation shall consist of both hard copy and 32-inch electronic disk complete with all application software.

6. Cable shall not be installed until the CONSTRUCTION MANAGER has reviewed the test report.

7. Maximum allowable attenuation is 0.5 dB/km at 1310 and 1550 nm. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.

D. Post-Installation Tests: After FOC has been installed the following tests shall be performed:

1. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with a 1310

nm and 1550 nm light source for the single mode fiber (SMF). The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30-feet or more to display the required cable section.

2. The maximum permissible end-to-end loss shall be 0.5 dB/km. The CONTRACTOR shall replace any cable in which any fiber does not meet this requirement.

3. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

4. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.

5. Hard and electronic copy of test documentation shall be submitted to the CONSTRUCTION MANAGER. The documentation shall include the trace plot, index, dB/km loss, cable length, date and time of test, wavelength, pulse width, the test site, cable ID, fiber number and type, and operator's initials. The CONTRACTOR shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the CONSTRUCTION MANAGER shall be notified in writing by the CONTRACTOR, and the cable shall be removed and replaced at no additional cost to the OWNER.

6. Upon completion of the previous tests all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Required OTDR Trace Information

1. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km) as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace: away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length of the fiber under test.

2. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the 5 point splice loss measurement technique.

3. The OTDR trace shall also include the following information:

a. The date and time of the test

b. The cable ID number

c. The cable segment ID number

d. The fiber color or sub-cable number

e. Launch point connector number

f. The optical wavelength used for the test

g. The refractive index setting of the OTDR

h. The pulse width setting of the OTDR

i. The averaging interval of the test

END OF SECTION

SECTION 43 20 00 - PUMPS, GENERAL

PART 1 - GENERAL

1.1 THE SUMMARY

A. Provide pumps and pumping appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to pumps and pumping equipment throughout the Contract Documents, except where otherwise indicated.

C. The requirements of Section 01 60 00 – Product, Material, Equipments and Substitutions.

D. Unit Responsibility

1. The pump manufacturer shall be made responsible for furnishing the WORK and for the coordination of design, assembly, testing, and installation of the WORK of each specific pump Section.

2. The CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each specific pump Section.

E. Single Manufacturer

1. Where 2 or more pump systems of the same type or size are required, provide pumps produced by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit pump name, identification number, and specification Section number.

2. Performance Information

a. Submit performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pumps. Submit efficiency curves of motors and VFDs (if used).

b. Require the equipment manufacturer to indicate the head, capacity, required horsepower, pump efficiency and NPSH. Indicate on the pump curve the Allowable Operating Region (AOR), Preferred Operation Region (POR), and minimum submergence required at maximum flow for vertical and submersible pumps.

c. Submit performance curves at intervals no greater than 100 RPM from the specified minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive.

3. Operating Range

   a. Require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration.

4. Submit assembly and installation drawings, including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Where lead containing materials are used for drinking water service pumps submit a calculation to demonstrate that the weighted average of lead content of wetted components do not exceed 0.25% to meet the requirement of the Reduction of Lead in Drinking Water Act.

6. Submit data, in accordance with the requirements of Section 26 05 10 – Electric Motors, for the electric motor proposed for each pump.

7. Submit an elevation drawing of the proposed local control panel, showing panel-mounted devices, details of enclosure type, a single-line diagram of power distribution, current draw of the panel, and a list of terminals required to receive inputs or to transmit outputs from the local control panel.

8. Submit a wiring diagram of field connections, with identification of terminations between local control panels, junction terminal boxes, and equipment items.

9. Submit a complete electrical schematic diagram.

C. Technical Manual

1. Submit a Technical Manual containing the required information indicated in Section 01 33 00 – Contractor Submittals and each specific pump Section.

D. Spare Parts List

1. Submit a spare parts list containing the required information indicated in Section 01 33 00 – Contractor Submittals and each specific pump Section.

E. Factory Test Data

1. Submit signed, dated, and certified factory test data for each pump system which requires factory testing.

2. Submit these data before shipment of equipment.

F. Certifications

1. Submit the manufacturer's certification of proper installation.

2. Submit the CONTRACTOR's certification of satisfactory field testing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Compliance with the requirements of the specific pump Sections may necessitate modifications to the manufacturer's standard equipment.

B. Performance Curves

1. Provide centrifugal pumps with a continuously rising pump curve, or with a pump curve that does not cross the system curve at two different capacities or within the pump curve's "dip region."

2. Unless otherwise indicated, the required shaft horsepower for the entire pump assembly at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

C. Compatibility

1. Provide entirely compatible components of each pump system provided under the specific pump Sections.

2. In each unit of pumping equipment, incorporate basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

2.2 MATERIALS

A. Provide materials suitable for the intended application.

B. For materials not indicated, provide high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and conforming to the following requirements:

1. For drinking water service, use materials with weighted average of lead content of wetted components not to exceed 0.25% to meet the requirement of the Reduction of Lead in Drinking Water Act.

2. Bowls and Casings

a. Provide cast iron pump casings and bowls constructed of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal. Unless otherwise indicated on the specific pump sections, cast iron-fitted pumps shall be epoxy lined and coated for better efficiency.

3. Impellers

a. Where individual pump sections indicate stainless steel impellers, such impellers shall be constructed of Type 316 stainless steel.

4. Provide pump shafts constructed of Type 416 or 316 stainless steel.

5. Provide anti-friction bearings or zero-lead bronze bearings. Bronze bearings shall be Bismuth Tin Bronze ASTM B 584 C89835, or equal.

6. All elastomeric materials such as gaskets, seals, O-rings in contact with water with chloramine and ozone shall be Teflon, Viton-A or other materials compatible with the fluid service. Test certificate from a material testing laboratory to provide proof of test shall be made available to the ENGINEER if requested.

7. Miscellaneous stainless steel parts shall be of Type 316.

8. Provide anchor bolts, washers, and nuts in standard service (non-corrosive application) of galvanized steel in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

9. Provide anchor bolts, washers, and nuts in corrosive service of stainless steel in accordance with Section 05 50 00 – Miscellaneous Metalwork.

C. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Test certificate from a material testing laboratory to provide proof of test shall be made available to the ENGINEER if requested

2.3 PUMP COMPONENTS - GENERAL

A. Flanges and Bolts

1. Provide suction and discharge flanges conforming to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800 or ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions. Pressure class shall be suitable for the application or as otherwise recommended by the pump manufacturer. Bolts will be in accordance with the drawings.

2. Provide flange bolts in accordance with the requirements of Section 40 05 00 – Piping, General.

3. Flange gaskets shall be in accordance with Section 40 05 00 - Piping, General

B. Lubrication

1. Vertical pump shafts for clean water pumps shall be product water-lubricated, unless otherwise indicated.

2. Provide deep-well pumps with external flushing water- or oil-lubricated bearings and seals, and enclosed line shafts.

C. Hand holes

1. Provide hand holes on pump casings shaped to follow the contours of the casing in order to avoid any obstructions in the water passage.

D. Drains

1. Provide and connect pipe gland seals, air valves, and water drainsto the nearest floor sink or drain, using galvanized steel pipe or copper tube that is properly supported with brackets.

E. Grease Lubrication

1. For vertical propeller, mixed-flow and turbine pumps that are not operating continuously, other than deep well pumps of bowl sizes 10-inch and larger, provide a stainless steel tube attached to the column for grease lubrication of the bottom bearing.

F. Stuffing Boxes

1. Where stuffing boxes are indicated for the pump seal, provide stuffing boxes of the best quality, using the manufacturer's suggested materials best suited for the specific application.

2. For sewage, sludge, drainage, and liquids containing sediments, provide fresh-water-flushed seals, using lantern rings.

3. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co., Lakos (Claude Laval Corp.),** or equal.

4. Conventional Packing Gland Type Seal

a. Unless otherwise indicated, provide packing material of Teflon braiding, containing 50 percent ultrafine graphite impregnation in order to satisfy the requirements listed in the table below.

b. Acceptable ring materials are asbestos-free die-molded packing rings of braided graphite material free of PTFE, **Chesterton 1400R** or equal, for non-potable water service, and braided PTFE material, **Chesterton 1725** or equal, that is listed under NSF Standard 61 for potable water service.

Shaft speeds	up to 2500 fpm
Temperature	up to 500 deg F
pH range	0 - 14

5. Mechanical Seals (Conventional Non-Split Type)

a. Provide mechanical seals of the fresh water-flushed-type, unless otherwise indicated in which case use product water cleaned by a solids separator as indicated above.

b. Provide conventional, non-split-type mechanical seals as manufactured by the following, or equal:

Water Pumps (hot and cold)	Single seals	**John Crane Type 5610Q, Flowserve Type ISCPX, Chesterton Type UV, GSS,** or **155**

2.4 PUMP APPURTENANCES

A. Nameplates

1. Equip each pump with a stainless steel nameplate indicating serial number(s), rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

B. Gauges

1. Provide gauges as indicated.

2. Located gauges in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

3. Where subject to shock or vibrations, wall-mount the gauges or attach the gauges to galvanized channel floor stands and connect by means of flexible connectors.

2.5 FACTORY TESTING

A. Conduct the following tests on each indicated pump system:

1. Motors

a. Test electric motors in accordance with the requirements of Section 26 05 10 – Electric Motors.

b. Furnish test results to the pump manufacturer prior to the pump test.

2. Certified Factory Non-witnessed Test

a. For pumps with motors smaller than 100 hp, the manufacturer’s certified test motor will be accepted.

b. Testing of prototype models will not be accepted.

c. Conduct the following minimum tests and submit the test results. For pumps with drives 15 hp and larger shall meet hydraulic acceptance criteria Grade "1U" unless otherwise indicated. Such tests shall, at a minimum, consist of the following:

1) Hydrostatic test;

2) Performance Test:

a) Conduct performance testing at maximum speed, obtain a minimum of 5 hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, and record on data sheets as defined by the Hydraulic Institute Standards;

b) For variable speed driven pumps, test each pump between maximum and minimum speed at intervals no greater than 100 RPM;

c) Submit pump curves showing head, flow, bhp, NPSH and efficiency results. The manufacturer’s certification shall be visible on each submitted curve;

3) Mechanical testing

4) NPSH

a) Perform a net positive suction head required test (NPSH), if required by the specific pump Section.

b) Acceptance criteria shall be in accordance with ANSI/HI 14.6

c) If not required by the specific pump Section, submit the published manufacturer-calculated NPSH curve.

5) Additional tests as indicated in the specific pump specification sections.

d. Perform tests using the completely assembled project pump, motor, and VFD system (if equipped with variable speed drive). Calibrated factory motor may be used in lieu of project motor subject to approval of the ENGINEER.

e. Testing of prototype models will not be accepted.

f. Submit certification signed by a senior official of the pump manufacturer that the required pump shaft horsepower did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

g. No equipment shall be shipped until the test data have been approved by the ENGINEER.

3. Acceptance

a. In the event of failure of any pump to meet any of the requirements, make necessary modifications, repairs, or replacements in order to conform to the requirements of the Contract Documents, and re-test the pump until found satisfactory.

PART 3 - EXECUTION

3.1 MANUFACTURER'S SERVICES

A. Inspection, Startup, and Field Adjustment

1. Where required by the specific pump Section, furnish an authorized service representative of the manufacturer at the Site continuously to supervise the following items and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

a. installation of the equipment;

b. inspection, checking, and adjusting the equipment;

c. startup and field testing for proper operation; and

d. Performance of field adjustments to ensure that the equipment installation and operation comply with the indicated requirements.

B. Instruction of OWNER's Personnel

1. Where required by the individual pump Section, furnish an authorized training representative of the manufacturer at the Site for the number of Days indicated in the specific pump Section, to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.

2. Furnish instruction specific to the model of equipment provided.

3. Qualifications

   a. Furnish a representative with at least 2 years' experience in training.

   b. Submit a resume for the representative.

4. Schedule the training a minimum of 3 weeks in advance of the first session.

5. Lesson Plan Review

   a. Submit the proposed training material and a detailed outline of each lesson for review.

   b. Incorporate review comments into the material.

6. The trainees will keep the training materials.

7. The OWNER may record the training for later use with the OWNER's personnel.

3.2 INSTALLATION

A. General

1. Install pumping equipment in accordance with the manufacturer's written recommendations.

B. Alignment

1. Field-test the equipment in order to verify proper alignment and freedom from binding, scraping, shaft run out, or other defects.

2. Measure the pump drive shafts just prior to assembly in order to ensure correct alignment without forcing.

3. Ensure that the equipment is secure in position and neat in appearance.

C. Lubricants

1. Provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

A. Coat materials and equipment in accordance with the requirements of Section 09 96 00 – Protective Coating.

3.4 FIELD TESTS

A. Field-test each pump system after installation simulating all of the operational scenarios as specified in order to demonstrate:

1. satisfactory operation without excessive noise and vibration;

2. no material loss caused by cavitation;

3. no overheating of bearings; and,

4. Meet indicated head, flow, and efficiency at the design point.

B. Conduct the following field testing:

1. Startup, check, and operate the pump system over its entire speed range.

2. If the pump is driven by a variable speed drive, test the pump and motor at 100-RPM increments.

3. If the pump is driven by constant speed, test the pump and motor at the maximum RPM.

4. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute standards at a minimum of 4 pumping conditions defined by the ENGINEER.

5. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least 4 pumping conditions at each pump rotational speed, at 100-RPM increments if equipped with a variable speed drive or at maximum RPM if equipped with a constant speed drive.

6. Check each power lead to the motor for proper current balance.

7. Bearing Temperatures

   a. Determine bearing temperatures by a contact-type thermometer.

   b. Precede this test with a run time sufficient to stabilize bearing temperatures, unless an insufficient liquid volume is available to furnish such a run time.

8. Ensure that electrical and instrumentation tests conform to the requirements of the Section under which that equipment is specified.

C. Witnessing

1. Field testing will be witnessed by the ENGINEER.

2. Furnish 3 Days advance notice of field testing.

D. If the pumping system fails to meet the indicated requirements, modify or replace the pump and re-test as indicated above until it satisfies the indicated requirements.

E. Certification

1. After each pumping system has satisfied the requirements, certify in writing that it has been satisfactorily tested and that final adjustments have been performed.

2. Certification shall include the date of the field tests, a listing of persons present during the tests, and the test data.

F. The CONTRACTOR shall be responsible for costs of field tests, including related services of the manufacturer's representative, except for power and water, which the OWNER will bear.

G. If available, the OWNER'S operating personnel will provide assistance in field testing.

END OF SECTION

SECTION 43 24 05 – DEEP WELL VERTICAL TURBINE PUMPS

PART 1 -- GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall provide deep well turbine pumps, electric motor and appurtenant, complete and operable, in accordance with the Contract Documents.

B. Pumps shall be deep well vertical turbine pumps designed to be installed in a drilled and cased well. The pumping element shall consist of a multistage bowl assembly with the first-stage impeller located below the lowest liquid level. The pumps shall be product-lubricated open line-shaft pumps. The column pipe shall be supported at the surface by the discharge head. The discharge head shall direct the water from vertical to horizontal flow and also support a driver. The driver shall be a vertical electric motor of the hollow shaft design.

C. The requirements of Section 43 20 00 – Pumps, General, apply to this Section.

D. The Supplier shall examine the Site conditions, intended application, and operation of the pump system, and recommend the pump that will best satisfy the indicated requirements.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals and Section 43 20 00 – Pumps, General.

B. Additional Submittals:

1. Submit welding procedures and welder qualifications requirements associated with discharge head assemblies.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Equipment manufacturer's shop welds and welding procedures and personnel shall be qualified and certified per AWS D1.1/D1.1M or the ASME Boiler and Pressure Vessel Code, Sections VIII and IX.

PART 2 -- PRODUCTS

2.1 GENERAL DESCRIPTION FOR WELL PUMP

A. Design Standard: Vertical turbine pumps shall conform to the applicable requirements of ANSI/AWWA E103-21 – Horizontal Centrifugal and Vertical Line-Shaft Pumps, except as modified herein.

B. Pumps shall be of cast 316 stainless steel construction. Pumps shall have a stainless steel adapter to Certa–Lok pump column. CONTRACTOR shall provide serial number of pump to OWNER.

C. Pump safety cable shall be type 316 stainless aircraft cable at least ¼-inch diameter with a minimum breaking strength of 3,500 lbs. Safety cable will be attached using stainless

steel clamps and hardware. CONTRACTOR shall coordinates with OWNER for safety cable inspection prior to installation in well.

D. Pump cable shall be a flat #4, 3-conductor with insulated ground, milprene rubber insulated and jacket. Cable shall be continuous without splices. Cable must be Centerline Water well cable, Hilo,4/3 jacketed with motor to OWNER.

E. Pump column shall be Certa-Lok of diameter and length as indicated on the drawings.

F. Operating Conditions:

1. Fluid Service:
   a. Fluid Type: Raw groundwater
   b. Fluid Temperature:
      i. Minimum: 72°F
      ii. Maximum: 83°F
      iii. Average: 77°F
   c. Specific Gravity: 1.00±
   d. pH: 7.4 to 7.9
   e. Solids: 0.0 to 0.8 ppm

2. Operating Environment:
   a. Installation Location: Outdoors.
   b. Ambient Temperature:
      i. Minimum: 30°F
      ii. Maximum: 105°F
      iii. Average: 75°F
   c. Atmospheric Pressure (Absolute):
      i. Minimum: 28.0 inches of Hg
      ii. Maximum: 30.3 inches of Hg
      iii. Average: 30.0 inches of Hg

G. Deep Well Data:

The Work of this Section shall be suitable for installation within a deep well with properties listed below and as shown on the Drawings.

1. Existing Well Casing: 12-inch diameter (nominal) DR 17 Certa Lok PVC.
2. Existing Well Casing Inside Diameter: 11.16 inches and Outside Diameter 12.75 inches
3. Bottom of Existing Well Casing Elevation: The well casing will extend to a depth of approximately 120 feet below land surface.
4. Bottom of Well Elevation: An open borehole will extend to a depth approximately 205 feet below the depth of the well casing.
5. Well Head Elevation and Water Level Data:

WELL ID	EXISTING LAND SURFACE ELEVATION	TOP OF WELL HEAD FLANGE ADAPTER	PUMPING WATER LEVEL	
	(ft NAVD88)	(ft NAVD88)	(ft BLS)	(ft NAVD88)
4	28.7	32.5	36[4]	-14[4]
			75[5]	-53[5]

Notes

1. ALS = Above Land Surface
2. BLS = Below Land Surface
3. Water level was derived based on data from Radise Geotechnical Report (2022)
4. Normal Drawdown Levels
5. Maximum Drawdown Levels

2.2 PUMP REQUIREMENTS

A. The pump shall satisfy the following flow, head and efficiency requirements.

Well No.	Design Pump Rate (gpm)	Min. (HEAD, ft)	Max. (HEAD, ft)	HP	Min. EFF.
	300	120	155		78%
4	**400**	125	160	**30**	**80%**
	500	150	182		68%

B. Construction: Construction of deep well turbine pumps shall conform to the following requirements:

Bowls	Type 316 stainless steel
Impeller (multi-stage vertical turbine)	Stainless steel, Type 316 statically and dynamically balanced
Impeller seal ring	stainless steel
Impeller shaft method of connection	Type 316 stainless steel impeller lock collet
Wear rings	Stainless steel, hard-faced replaceable
Bowl shaft	Stainless steel, Type 410, 416, or 316
Suction case and strainer, and lineshaft	Stainless steel strainer, Type 316 Type 316 stainless steel shaft in max 10-ft lengths, turned, ground, and polished with min 8-mils thick hard chrome journals.
Column	Stainless Steel Column coupling. Column Coupling OD shall fit inside 12” PVC Well

	Casing and accommodate a 2” water level tubing. Threaded fittings (no flanges).
Suction case bearing	Stainless steel
Bowl bearing	Rubber with stainless steel
Discharge Head	Ductile Iron, epoxy-lined with flange, base plate, and fittings to connect sounding tube, power cables and other connections as indicated on drawings constructed to support 150% of the weight of all items in the well. Tapping for electrical wire, instrumentation, water level tube and venting shall be provided. A screened vent cap shall be included. The discharge head shall have lifting eyes. The discharge head shall rest on a sole plate welded to the well casing. A .25-inch neoprene gasket and stainless steel bolts with nuts shall seal the discharge head to the sole plate. If the well casing below the discharge head is to be encased in concrete the sole plate shall have tapped bolt holes. The discharge outlet shall be as indicated.

C. Drive

1. Motor Design

a. As specified in Section 26 05 10 – Electric Motors.

b. Furnish with totally enclosed, fan-cooled housing.

c. Furnish with winding thermostats.

2.3 FACTORY TESTING AND SHIPMENT

A. In addition to the factory tests in Section 43 20 00, perform the following procedures with the factory test prior to shipment:

1. Verify the pump characteristic curves by testing at shutoff head, 25, 50, 75, 100, and 125 percent of the indicated design flow, and at maximum "run-out" flow, and recording the measured head and motor current for each flow.

2. Verify cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation.

3. Properly lubricate and protect parts such that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.

4. Properly protect unpainted finished ferrous surfaces in order to prevent rust and corrosion.

5. Protect the finished surfaces of exposed flanges by strong wooden blind flanges.

6. Properly crate each pump to protect against damage during shipment.

2.4 PUMP CONTROLS

A. Contractor shall furnish a pump control panel in accordance with the Pump Control Panel details shown on the electrical plans and as specified in Section 40 95 13 – Control Panels.

2.5 SPARE PARTS

A. The Contractor shall furnish the following spare parts. Provide two for each size and type.

1. Suction Case Bearing Assembly.
2. Set of Bowl and Discharge Case Bearings.
3. Set of Impellers.
4. Set of Wear Rings.
5. Set of Pump Shaft Bearings.

2.6 MANUFACTURERS, OR EQUAL

A. **Goulds Pumps, Inc.**

B. **Peerless Pumps**

C. **Afton Pumps**

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. The installation shall be in accordance with the manufacturers written recommendations and supervised by a representative of the pump manufacturer.

B. Instruction of Owner's Personnel: The training representative of the manufacturer shall be present at the Site for no less than two (2) days for each type of pump to instruct the Owner's personnel in accordance with Section 43 20 00 – Pumps, General.

C. Prior to OWNER acceptance and formal pump start-up, equipment shall be inspected for proper alignment, correct pump rotation, quiet operation, proper connection, and satisfactory performance by means of a trial operation and field performance function test. A start-up report showing function testing, motor voltages, running amperages and well water levels shall be providing to the ENGINEER after pump start-up. Function testing should include hydraulic performance verification testing by operating the pump and recording flow, pressure, well water levels, motor voltage

and running amperage. The discharge valve shall be throttled so that the pump operates at the following points on the pump curve:

1. Shutoff head
2. One point between shutoff head to best efficiency point
3. Best efficiency point
4. Maximum flow point

D. The ENGINEER may require that the inspection, startup, and field adjustment services, above, be furnished in 3 separate trips.

E. The well shall be operated continuously 24 hours per day for seven days. This test shall demonstrate constant operation of the point system without failure.

F. After successful continuous operational test, the CONTRACTOR shall submit to the OWNER a certificate of the successful installation and operation.

END OF SECTION

SECTION 43 30 00 - VALVES, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide valves, actuators, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 01 60 00 – Products, Materials, Equipment and Substitutions, apply to the WORK of this Section.

C. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated.

D. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls, as indicated.

E. Support

1. Where a valve is to be supported by means other than the piping to which it is attached, obtain from the valve manufacturer a design for its support and foundation that satisfies the 01 60 00 – Products, Materials, Equipment and Substitutions

2. Submit the support design, including drawings and calculations sealed by an engineer, with the Shop Drawings.

3. Provide the support after the design has been approved.

F. Unit Responsibility

1. The CONTRACTOR shall assign a single manufacturer to be responsible for the supply, coordination of design, assembly, testing, and furnishing of each valve; however, the CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve Section.

G. Single Manufacturer

1. Where 2 or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Furnish the following information on Shop Drawings:

1. valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number;

2. complete information on the valve actuator, hydraulic power units (HPU), pneumatic air supply system including size, manufacturer, model number, limit switches, and mounting;

3. cavitation limits for control valves;

4. assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, hand wheels, position indicators, limit switches, integral control systems, needle valves, and control systems;

5. complete wiring diagrams and control system schematics; and,

6. A valve-labeling schedule, listing the valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

C. Furnish a technical manual containing the required information for each valve, as indicated.

D. Furnish a spare parts list, containing the required information for each valve assembly, as indicated.

E. Factory Test Data

1. Where indicated, submit signed, dated, and certified factory test data for each valve requiring certification, before shipping the valve.

2. Furnish a certification of quality and test results for factory-applied coatings.

PART 2 -- PRODUCTS

2.1 PRODUCTS

A. General

1. Provide valves and gates of new and current manufacture.

2. Provide valves 6-inch and larger with actuators with position indicators.

3. Provide gate valves 10 -inch and larger, or where chain wheel is required, with spur gear and hand wheel.

4. Provide buried valves with valve boxes and covers containing position indicators and valve extensions.

B. Protective Coating

1. Coat the exterior surfaces of valves and the wet interior surfaces of ferrous valves of sizes 2-inch and larger in accordance with the requirements of Section 09 96 00 – Protective Coating.

2. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with the indicated requirements.

3. Do not coat the machined flange faces of valves except where such flanges are not adjoining a mating flange as shown in the Contract Documents. Apply rust inhibitor coating on machined surfaces of the flange prior to shipment.

C. Valve Labeling

1. Valve boxes set in sodded areas shall be provided with a concrete collar. A 2" diameter brass identification tag shall be provided on the concrete collar.

2. Except when such requirement is waived by the ENGINEER in writing, provide a label on shut-off valves and control valves except for hose bibbs and chlorine cylinder valves.

3. Furnish a label composed of 1/16-inch plastic or stainless steel, a minimum of 2 inches by 4 inches in size, as indicated in Section 40 05 02 – Piping Identification Systems, and permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.

D. Valve Testing

1. As a minimum, unless otherwise indicated or recommended by the reference standards, test valves 3 inches in diameter and smaller in accordance with the manufacturer's standard procedure.

2. Factory-test valves 4 inches in diameter and larger as follows:

a. Hydrostatic Testing

1) Subject valve bodies to an internal hydrostatic pressure equivalent to twice the water-rated pressure of the valve.

2) Metallic valves rating pressures shall be based at 100 degrees F.

3) Plastic valves rating pressures shall be based at 73 degrees F, or at a higher temperature according to material type.

4) During the hydrostatic test, there shall be no visible leakage through the valve body, end joints, or shaft seals, nor shall parts of the valve be permanently deformed.

5) Allow test duration of at least 10 minutes, in order to allow visual examination for leakage.

b. Seat Testing

1) Test the valves for leaks in the closed position, with the pressure differential across the seat equal to the water rated pressure of the valve.

2) Provide a test duration of at least 10 minutes, in order to allow visual examination for leakage.

3) The leakage rate shall be the more stringent of the following:

a) As recommended by the reference standard for that type of valve; or

b) Leakage past the closed valve not to exceed one fluid ounce per hour per inch diameter for metal seated valves, and drop-tight for resilient seated valves.

c. Performance Testing

1) Shop-operate the valves from the fully-closed to the fully-open position, and reverse under no-flow conditions in order to demonstrate that the valve assembly operates properly.

E. Certification

1. Prior to shipment of valves with sizes larger than 12-inches in diameter, submit certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

F. Valve Markings

1. Permanently mark valve bodies in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

A. General

1. Provide materials suitable for the intended application.

2. Provide materials in contact with potable water listed as compliant with NSF Standard 61.

3. Ensure that materials not indicated are of high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

4. Unless otherwise indicated, provide valve and actuator bodies conforming to the following requirements:

a. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings

b. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

c. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

d. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel

e. NSF Standard 61: Materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

A. Bodies

1. Provide valve bodies that are cast, molded (in the case of plastic valves), forged, or welded, of the materials indicated, and with smooth interior passages.

2. Provide wall thicknesses uniform and in agreement with the applicable standards for each type of valve, without casting defects, pinholes, and other defects that could weaken the body.

3. Perform welds on welded bodies by certified welders and ground welds smooth.

4. Provide valve ends as indicated, and rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections

1. Unless otherwise indicated, valves 2-1/2 inches in diameter and smaller may be provided with threaded end connections.

2. Provide valves 3 inches in diameter and larger with flanged end connections.

3. Flanges, bolts and gaskets shall be as specified in Section 40 05 00 - Piping, General.

C. Bonnets

1. Connect valve bonnets to the body by clamping, screwing, or flanging.

2. Provide bonnets of the same material, temperature, and pressure rating as the body.

3. Make provisions for the stem seal with the necessary glands, packing nuts, and yokes.

D. Stems

1. Provide valve stems of the materials indicated, or, if not indicated, of the best commercially-available material for the specific service, with adjustable stem packing, O-rings, chevron V-type packing, or other suitable seal.

E. Stem Guides

1. Provide stem guides spaced with an L/R ratio not to exceed 200:1. Submit calculations for L/R ratios and guide spacing to the ENGINEER for review.

2. Stem guides shall have slotted holes and shall be adjustable in two directions.

3. Construct submerged stem guides from Type 316 stainless steel.

F. Internal Parts

1. Provide internal parts and valve trim as indicated for each individual valve.

2. Where not indicated, construct valve trim from Type 316 stainless steel or other material best-suited for the intended service.

G. Nuts and Bolts

1. Unless otherwise indicated, provide nuts and bolts on valve flanges and supports in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork and Section 40 05 00 – Piping, General.

2.4 VALVE ACTUATORS

A. Valve actuators shall be as indicated and as specified in Section 43 30 12 – Valve and Gate Actuators

2.5 VALVE ACCESSORIES

A. Provide valves complete with the accessories required to provide a functional system.

2.6 SPARE PARTS

A. Furnish the required spare parts, suitably packaged and labeled with the valve name, location, and identification number.

B. Furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve.

C. Spare parts are intended for use by the OWNER, after expiration of the correction of defects period.

2.7 MANUFACTURERS

A. Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the indicated valves.

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION AND TRIAL OPERATION

A. General

1. Install valves, actuating units, stem extensions, valve boxes, and accessories in accordance with the manufacturer's written instructions and as indicated.

2. Adequately brace gates in order to prevent warpage and bending under the intended use.

3. Firmly support valves in order to avoid undue stresses on the pipe.

B. Access

1. Install valves in a manner to provide easy access for actuation, removal, and maintenance, and to avoid interference between valve actuators and structural members, handrails, and other equipment.

C. Valve Accessories

1. Where combinations of valves, sensors, switches, and controls are indicated, properly assemble and install such items such that systems are compatible and operating properly.

2. Clearly note the relationship between interrelated items on Shop Drawing submittals.

D. Trial Operation

1. After installation, schedule trial operation witnessed by the ENGINEER and the OWNER representative.

2. All valves shall be cleaned thoroughly of all foreign materials and final adjustments made. The valves shall then be operated through one complete cycle from a fully closed position to a fully open position and back to a fully closed position to verify that the assembly is functional.

3. For control valves that operate in multiple operating scenarios, the CONTRACTOR shall simulate all operational scenarios including the hydraulic power units, pilot control system or pneumatic air supply system to demonstrate compliance to the specifications.

4. A field leakage test meeting the maximum allowable specified requirement shall be conducted.

5. Test certificate shall be signed by the valve manufacturer and the CONTRACTOR and shall be submitted to the ENGINEER.

END OF SECTION

SECTION 43 30 52 - MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 43 30 00 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 43 30 00 - Valves, General.

PART 2 -- PRODUCTS

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron. The float, seat, and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material ensuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.

D. Manufacturers, or Equal

1. **A.R.I. Flow Control**

2.2 GLOBE CHECK VALVE

A. General

1. The globe check valves shall Include interior and exterior coating in accordance with AWWA C550 and ends to match piping.

2. Pressure Rating: Initial pressure of 250 psig minimum.

3. 316 Stainless Steel helical or conical spring.

4. ASTM 304 Stainless steel valve seat with integral EPDM seat seal.

5. ASTM Type 304 Stainless Steel dual guided disc (top and bottom).

B. Construction

1. The body material shall be Stainless Steel.

2. End Connections: Flanged, Class 150

C. Manufacturers, or Equal

1. **Clow Valve Company**

2. **Kennedy**

3. **Apco/DeZurik**

4. **Mueller/Pratt**

2.3 BACKFLOW PREVENTER VALVE

A. General

1. Provide backflow preventers that work on the reduced pressure principle.

2. Provide drain lines with air gaps.

3. The backflow preventer valves shall be in accordance with AWWA C511 – Reduced-Pressure Principle Backflow Prevention Assembly.

B. Construction

1. The preventers shall consist of 2 spring-loaded check valves, an automatic differential pressure relief valve, drain valves, and shut-off valves.

2. The body material shall be bronze or cast iron, for a working pressure of not less than 150 psig, with bronze or stainless steel trim.

C. Maintenance Access

1. Provide separate access covers for the check valves and the relief valve.

2. Provide top-entry access to check valve components.

D. Manufacturers, or Equal

1. **Cla-Val Company**

2. **Febco (CMB Industries)**

3. **Watts, ACV**

4. **Wilkins Regulator Division (Zurn Industries)**

2.4 CORPORATION STOPS

A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.

B. Manufacturer, or Equal

1. **Ford Meter Box Company, Inc.**

2. **James Jones Company (Watts, ACV)**

3. **Mueller Company**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Backflow preventers shall be installed in raw and potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.

B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with Section 43 30 52 - Miscellaneous Valves.

C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

END OF SECTION