Technical Specifications

FOR

MASTER PUMP STATION 6600, LS 616 & LS 617 IMPROVEMENTS

CIP

Lee County Utilities
1500 Monroe Street
Fort Myers FL
33901

ISSUE FOR BID

LEE COUNTY UTILITIES
WATER AND WASTEWATER TECHNICAL SPECIFICATIONS
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Relocation and Rehabilitation of Biofiltration Odor Control System – General Arrangements Ecopure Mini Start-up Operation.

END TOC

CERTIFICATION 1

PROFESSIONAL ENGINEER'S CERTIFICATION FOR KEVIN LEE HIGGINSON, PE

PROJECT NAME: LEE COUNTY UTILITIES
MASTER PUMP STATION 6600, LS 616 & LS 617 IMPROVEMENTS

The following sections of the Technical Specifications in the Issued for Bid submittal for the above referenced project were prepared under my direction and supervision.

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DIVISION 9 - FINISHES

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DIVISION 31 – EARTHWORK

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31 23 23	Backfilling

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DIVISION 32 – EXTERIOR IMPROVEMENTS

32 10 01 Pavement Repair and Restoration
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32 31 13 Chain Link Fencing and Gate
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DIVISION 33 – UTILITIES

33 05 01 Leakage Tests
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CERTIFICATION 2

PROFESSIONAL ENGINEER'S CERTIFICATION FOR A. EMMETT ANDERSON, PE

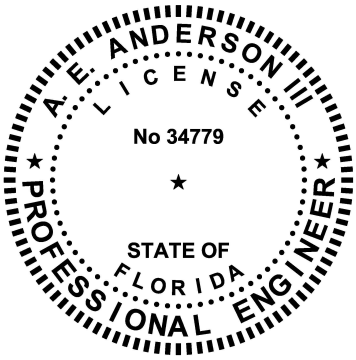
PROJECT NAME: LEE COUNTY UTILITIES
MASTER PUMP STATION 6600, LS 616 & LS 617 IMPROVEMENTS

DIVISION 3 – CONCRETE

03 30 00 Cast-in-Place Concrete

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07 90 01 Waterproofing, Damproofing and Caulking
07 90 02 Sealants and Caulking



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CERTIFICATION 3

PROFESSIONAL ENGINEER'S CERTIFICATION FOR MICHAEL NIXON, PE

PROJECT NAME: LEE COUNTY UTILITIES
MASTER PUMP STATION 6600, LS 616 & LS 617 IMPROVEMENTS

DIVISION 43- PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPEMENT

43 21 13 Diesel Backup Pump System

DIVISION 44- POLLUTION AND WASTE CONTROL EQUIPMENT

44 31 21 Pre-Engineered Biofiltration Odor Control System (Bid Alternate)
44 31 22 Relocation and Rehabilitation of Biofiltration Odor Control System

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CERTIFICATION 4

PROFESSIONAL ENGINEER'S CERTIFICATION FOR MICHAEL FADINI, PE

PROJECT NAME: LEE COUNTY UTILITIES
MASTER PUMP STATION 6600, LS 616 & LS 617 IMPROVEMENTS

DIVISION 26 - ELECTRICAL

26 05 02	Basic Electrical Materials & Methods
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26 05 19	Low Voltage Wires & Cables
26 05 26	Grounding & Bonding for Electrical Systems
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26 36 13	Safety Switches and Disconnects
26 43 00	Surge Protective Devices (SPDs)
26 50 00	Lighting Fixture

DIVISION 40 PROCESS INTEGRATION

40 95 13	Instrumentation and Controls

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END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Work

B. Constraints

C. Work by Others

D. CONTRACTOR's Use of Site

E. Work Sequence

F. Owner Occupancy

1.2 DESCRIPTION OF WORK

A. MPS 6600, LS 616, and LS 617 Improvements shall be in accordance with the Contract Documents. The CONTRACTOR shall furnish all shop drawings, working drawings, labor, materials, equipment, tools, services and incidentals necessary to complete all work required by these Specifications and as shown on the Contract Drawings. A general description of the project is listed below.

The Contractor shall complete the following work at MPS 6600, LS 616, and LS 617 site as depicted on plans and described herein including, but not limited to:

1. Clearing, grubbing and site preparation at LS 616.

2. Installation of new concrete equipment slabs at LS 616 and LS 617.

3. Installation of new coated chain-link fencing at LS 617.

4. Installation of bypass pumping systems, including flow-thru plug, bypass pumping, bypass piping, fittings and accessories.

5. Demolition of existing piping, concrete pads, etc.

6. MPS 6600 wet well rehabilitation, including pump base plate adjustments, new IET liner system, and new pipe brackets and bolts.

7. New diesel backup pump system with standard fuel tank and new concrete slab for diesel pump at MPS 6600

8. New diesel pump suction and discharge piping

9. New equipment pads, ductwork, drains, power and control wiring for odor control system. Performance testing the odor control system.

10. Electrical and controls improvements, including new supports.

11. Instrumentation system upgrades compliant with current County SCADA standards

B. The CONTRACTOR shall perform the work complete, in place and ready for continuous service and shall include any repairs, replacements, and/or restoration required as a result of damages that occur during construction and prior to acceptance by the COUNTY and ENGINEER.

1. Only one sewer bypass is allowed at a time unless approved by the ENGINEER OR COUNTY.

2. Sidewalks next to LS 616 will need to be closed due to school/pedestrian impacts.

C. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.

2. Sole responsibility for adequacy of plant and equipment.

3. Maintaining the Work areas and sites in a clean and acceptable manner.

4. Maintaining existing facilities in service at all times except where specifically provided for otherwise herein.

5. Protection of finished and unfinished Work.

6. Repair and restoration of Work damaged during construction.

7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.

8. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor

bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.

D. Implied and Normally Required Work: It is the intent of these Specifications to provide the OWNER with complete operable systems, subsystems and other items of Work. Any part or item of Work which is reasonably implied or normally required to make each installation satisfactorily and completely operable is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

E. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

1.3 CONTRACTOR'S USE OF SITE

A. In addition to the requirements of the General Conditions, limit use of site and premises for work and storage to allow for the following:

1. Coordination of the Work under this CONTRACT with the work of the other contractors where Work under this CONTRACT encroaches on the Work of other contractors.

2. OWNER occupancy and access to operate existing facilities.

3. Coordination of site use with ENGINEER.

4. Responsibility for protection and safekeeping of products under this CONTRACT.

5. Providing additional off site storage at no additional cost to OWNER as needed.

1.4 WORK SEQUENCE

A. Construct Work in stages to accommodate OWNER's use of premises during construction period and in accordance with the limitations on the sequence of construction specified. Coordinate construction schedules and operations with ENGINEER.

B. Coordinate Work of all subcontractors.

1.5 OWNER OCCUPANCY

A. OWNER will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with OWNER's representative in all construction operations to minimize conflict, and to facilitate OWNER usage.

B. Conduct operations so as to inconvenience the general public in the least.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

A. Starting Work: Start Work by the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

SECTION 01 14 00

MAINTENANCE OF OPERATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section sets forth the requirements for scheduling and performing the work to keep existing utilities in continuous, reliable operation.

B. Related Work Described Elsewhere:

1. Section 01 51 00 Sewer Bypass Pumping

1.2 WORK INCLUDED

A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to maintain existing utilities in service during construction. Contractor shall also keep on hand adequate equipment, supplies, and incidentals to repair pipe breaks and to contain and dispose of all leaked materials.

B. Before any work begins, the Contractor shall submit for County and Engineer review a Maintenance of Flow (MOF) Plan. The Maintenance of Flow Plan shall include all procedures to be performed by the Contractor to maintain continuous operation of the County's existing utility services. The Plan shall also include emergency response and remedial action measures. Any spills will be fine in accordance with FDEP regulation.

1.3 JOB CONDITIONS

A. The Contractor shall familiarize themselves with the site, including the locations and conditions of the existing utilities in and around the work zones where relocation or rehabilitation of existing utilities is required. The location of storm sewer inlets, drainage swales, and runoff patterns should be identified, and a Stormwater Pollution Prevention Plan developed to contain potential releases.

B. The Contractor shall carry out his or her operations in accordance with all applicable OSHA regulations, including confined space entry requirements, as well as local, county, and state requirements, and in accordance with the approved MOF Plan. In addition, the Contractor shall protect the public and

County employees from harm while performing the work by using barricades, warning lights and other means as necessary.

C. During by-pass operations the Contractor shall maintain access to all areas of the facility behind and around the areas impacted by construction.

D. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required shall be furnished and maintained by the Contractor. The cost shall be included in the appropriate bid items.

E. The Contractor shall schedule the work in such a manner so that all existing utility systems are maintained in continuous operation. All short-term or partial utility system shutdowns shall be approved in writing by the County. If, in the opinion of the County, a shutdown is not required in order for the Contractor to perform the work, the Contractor shall utilize alternative methods to accomplish the work. The County shall be provided a minimum of ten (10) workdays' notice of Contractor's need for any existing utility system shutdown.

F. Required shutdowns shall not begin until all materials are on-hand, pre-assembled, as possible, and ready for installation. Upon commencement of the shutdown period the Contractor shall proceed with the work continuously, start to finish, until the work is completed, and the system is tested, cleared for service, and ready for operation. If the Contractor completes all required work before the specified shutdown period has ended the County may immediately place the system back in service.

G. The County shall have the authority to order work stopped or prohibited which would, in County's opinion, unreasonably result in stopping or inhibiting the necessary functions of existing utilities.

H. The County reserves the right to cancel scheduled shutdowns if conditions warrant. Delays to the Contractor caused by cancellations will be considered in evaluating requests for a time extension. They will not be considered an entitlement to additional compensation. However, compensation may be considered at County's sole discretion.

1.4 SUSPENSION OF WORK

A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. The orders and decisions of the County as to suspensions shall be final and binding. During

suspension of the work from any cause, the work shall be suitably covered and protected so as to preserve it from injury by the weather or otherwise; and, if the County shall so direct, surplus materials shall be removed.

1.5 SUBMITTALS

A. The Contractor shall submit a proposed work sequence plan at the pre-construction meeting showing all critical items of work and anticipated shut down times.

B. Submit a detailed schedule and process description for all required testing at least 14 days prior to the testing activity

C. Maintenance of Flow Plan

1. The Contractor shall prepare a Maintenance of Flow Plan that describes in detail the work that will be performed by the Contractor to maintain continuous operation of the County's existing utility services within 14 days from the start of site mobilization.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 UTILITY SHUTDOWNS

A. One (1) week before a scheduled utility shutdown, a coordination meeting shall be held at the site with the Contractor, County, and Engineer in attendance. The purpose for the coordination meeting shall be to review all procedures listed in the Maintenance of Flow Plan, verify availability of all necessary personnel, review contingency procedures to address issues that may arise and how they will be addressed.

B. The Contractor shall request any shutdown in writing from the County a minimum of (10) business days in advance of a proposed shutdown.

C. Required shutdowns shall not begin until all materials are on-hand, pre-assembled to the extent possible, and ready for installation. Upon commencement of the shutdown period, the Contractor shall proceed with the work continuously, start to finish, until the work is completed, and the system is tested, cleared for service, and ready for operation. If the Contractor completes all required work before the specified shutdown period has ended the County may immediately place the system back in service. All facilities shall be tested and in operating condition before final tie-ins are made.

END OF SECTION

SECTION 01 22 13

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Explanation and Definitions

B. Measurement

C. Payment

D. Schedule of Values

1.2 EXPLANATION AND DEFINITIONS

A. The following explanation of the Measurement and Payment for the bid form items is made for information and guidance. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the CONTRACTOR of the necessity of furnishing such as a part of the Contract.

1.3 MEASUREMENT

A. The quantities set forth in the bid form are approximate and are given to establish a uniform basis for the comparison of bids. The OWNER reserves the right to increase or decrease the quantity of any class or portion of the work during the progress of construction in accord with the terms of the Contract.

1.4 PAYMENT

A. Payment shall be made for the items listed on the Bid Form on the basis of the work actually performed and completed, such work including but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, clean up, restoration of disturbed areas, and all other appurtenances to complete the construction and installation of the work as shown on the drawings and described in the specifications.

B. Unit prices are used as a means of computing the final figures for bid and Contract purposes, for periodic payments for work performed, for determining value of additions or deletions and wherever else reasonable.

1.5 SCHEDULE OF VALUES

A. Approval of Schedule: Submit for approval a preliminary schedule of values, in duplicate, for all of the Work. Prepare preliminary schedule in accordance with the General Conditions. Submit preliminary schedule of values within 10 calendar days after the Effective Date of the Agreement. Submit final schedule of values in accordance with the General Conditions.

B. Format: Utilize a format similar to the Table of Contents of the Project Specifications. Identify each line item with number and title of the major specification. Identify site mobilization, bonds and insurance. Include within each line item, a direct proportional amount of CONTRACTOR's overhead profit.

C. Revisions: With each Application for Payment, revise schedule to list approved Change Orders.

1.6 APPLICATION FOR PAYMENT

A. Present required information in typewritten form or on electronic media printout.

B. Execute certification by signature of authorized officer.

C. Use data from approved Schedule of Values.

D. Stored Materials: When payment for materials stored is permitted, submit a separate schedule for Materials Stored showing line item, description, previous value received, value incorporated into the Work and present value.

E. Change Orders: List each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of work.

F. Final Payment: Prepare Application for Final Payment as required in the General Conditions.

G. Submit an updated construction schedule for each Application for Payment.

PART 2 EXECUTION

2.1 LUMP SUM ITEMS

A. The work for each Lump Sum pay item shall be constructed as shown and described on the Drawings and Specifications.

B. Payment shall be made at the lump sum price stated in the pay for each item and shall be pro-rated for the actual work completed based on an approved schedule of

values detailing work to be completed under the specific pay item, unless otherwise noted.

C. Each lump sum price shall include all of the Contractor's costs to complete the construction exclusive of payment items provided for elsewhere in the pay form.

D. Each lump sum price shall include, but not be limited to, the following:

1. Excavation (including rock/cemented soils excavation)

2. Dewatering and disposal of surplus water

3. Bracing, sheeting and shoring

4. Compaction and earth stabilization

5. Restoration including grading, seeding, sod, curbing, asphalt, concrete drives and sidewalks, etc.

6. Testing, startup, placing system into operation and acceptance including all required materials and equipment.

7. Training by manufacturer's representative

8. Operation and maintenance manuals

9. Appurtenant work and materials as required for a complete and operable system.

2.2 MEASUREMENT AND PAYMENT

Bid Items 1a through 1f: Mobilization, Demobilization

a. Measurement and payment shall be at the lump sum amount for each Bid Item listed below and shall include all labor, material, and equipment necessary for the Contractor to mobilize a demobilize. Mobilization shall be the preparatory work and operations in mobilizing for beginning work on the project, including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies and incidentals to the project site, pre-construction videos, clearing and grubbing, removal and replacement of stone cover at MPS 6600, and for the establishment of temporary offices, storage buildings, staging areas, safety equipment and first aid supplies, sanitary and other facilities, as required by the Contract Documents and applicable laws and regulations. The costs of bonds, required insurance, permits and any other preconstruction expense necessary for the

start of the work, excluding the cost of construction materials, shall also be included in this item. Demobilization shall be the work of removing temporary facilities, project signs, erosion control, temporary fencing, etc. from the site and any site restoration

b. Partial payments for Bid Items 1a-1c will be made in accordance with the following schedule:

Percent of Original Contract Amount Earned	Allowable Percent of the Lump Sum Price for the Item
5	25
10	50
25	75
50	100

These payments will be subject to the standard retainage provided in the agreement. Payment shall be made under respective bid items 1a – 1c. Payment of the retainage will be made after completion of the work and demobilization.

Bid Item 1a. MPS 6600 Mobilization and Demobilization
Bid Item 1b. LS 616 Mobilization (Bid Alternate 1)
Bid Item 1c. LS 617 Mobilization (Bid Alternate 2)
Bid Item 1d. MPS 6600 Demobilization
Bid Item 1e. LS 616 Demobilization (Bid Alternate 1)
Bid Item 1f. LS 617 Demobilization (Bid Alternate 2)

Bid Items 2a, 2b and 2c: Sewer Bypass

Measurement and payment shall be at the a lump sum amount for each Bid Item listed below and shall include all labor, material and equipment necessary to temporarily bypass the sewer flows around MPS 6600, LS 616, and LS 617 to facilitate continued operation of the County's wastewater system during installation of the proposed improvements including, but not limited to, bypass pumps, floats and alarms; protection of existing above ground and underground utilities; all ancillary items as indicated on the drawings and specified unless indicated elsewhere.

Bid Item 2a. MPS 6600 Sewer Bypass
Bid Item 2b. LS 616 Sewer Bypass (Bid Alternate 1)
Bid Item 2c. LS 617 Sewer Bypass (Bid Alternate 2)

Bid Items 3a, 3b and 3c: Pump Station Improvements

Measurement and Payment shall be made at the Contract Lump Sum price for all pump station improvements not covered under other bid items as shown on the plans, which shall include contract administration; survey documents for record drawing preparation by the engineer;

erosion control; yard piping; dewatering; protection of existing facilities; site control and maintenance; furnishing and delivering to site equipment and materials; equipment installation, replacement, and demolition; coatings; piping and fittings; valves; manufacturer's warranty; Concrete and soil testing; concrete work and supports; electrical, instrumentation and controls; startup, testing and manufacturers' startup services; preparation of project documentation; site restoration; and all related work to provide a complete and fully functional system as shown in the Contract Documents.

Bid Item 3a: MPS 6600 Pump Station Improvements
Bid Item 3b: LS 616 Pump Station Improvements (Bid Alternate 1)
Bid Item 3c: LS 617 Pump Station Improvements (Bid Alternate 2)

Bid Item 4: MPS 6600 Wetwell Rehabilitation

Measurement and Payment for MPS 6600 Pump Station Rehabilitation shall be made at the Contract Lum Sum Price, which shall include rehabilitation and replacement work for existing material and equipment in the existing wetwell as directed by the Owner, as described herein. This work may include the following, but not limited to, IET coating touch up and repairs only for existing deficiencies resulting from the proposed work such as core drilling, vertical pipe bracket repairs and/or replacement, and leveling and remounting existing pump base plates. The Work also includes complying with the OSHA, confirmed space entry, as well as all required permits.

Bid Item 5: MPS 6600 Odor Control System Relocation and Rehabilitation or Replacement

Measurement and Payment for Odor Control System Relocation and Rehabilitation shall be made based on the Contract Lump Sum amount for relocation and rehabilitation of the existing Odor Control Equipment, including electrical control panel, odor control unit, connection to water source, air duct with supports, replacement of odor control media, tested and fully functional, as stated and/or depicted in the Contract Documents.

Bid Item 6: MPS 6600 New Pre-Engineered Biofiltration Odor Control System (Bid Alternate 3)

Measurement and Payment for Bid Item 6 (Bid Alternate 3), if accepted, shall be at the Contract Lump Sum Amount, including all labor, materials, equipment and incidentals required to install and test the skid mounted dual-technology biotrickling filter with carbon polishing odor control system (System) complete with all appurtenances for a fully functional system.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work Progress

B. Private Land

C. Work Locations

D. Open Excavations

E. Test Pits

F. Maintenance of Traffic

G. Maintenance of Flow

1.2 WORK PROGRESS

A. Furnish personnel and equipment which will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress which will allow the completion of the work within the time stipulated in the Bid of these Specifications. If at any time such personnel appears to the ENGINEER to be inefficient, inappropriate or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the CONTRACTOR to increase the efficiency, change the character or increase the personnel and equipment, and the CONTRACTOR shall conform to such order. Failure of the ENGINEER to give such order shall in no way relieve the CONTRACTOR of his obligations to secure the quality of the work and rate of progress.

1.3 PRIVATE LAND

A. Do not enter or occupy private land outside of easements, except by permission of OWNER. Construction operations shall be conducted in accordance with Section 01 57 00.

1.4 WORK LOCATIONS

A. Structures and pipelines shall be located substantially as indicated on the Drawings, but the ENGINEER reserves the right to make such modifications in locations as may

be found desirable to avoid interference noted on the Drawings, such notation is for the CONTRACTOR's convenience and does not relieve him from laying and jointing different or additional items where required.

1.5 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The CONTRACTOR shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by the public and workmen.

1.6 TEST PITS

A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the CONTRACTOR. Test pits shall be backfilled immediately after their purpose has been satisfied and maintained in a manner satisfactory to the ENGINEER. The costs for such test pits shall be borne by the CONTRACTOR.

1.7 MAINTENANCE OF TRAFFIC

A. Traffic Regulation shall be in accordance with Sections 01 55 26.

B. All projects and work on highways, roads, and streets, shall have a traffic control plan, (TCP), as required by Florida Statute and Federal regulations. All work shall be executed under the established plan and Department approved procedures. The TCP is the result of considerations and investigations made in the development of a comprehensive plan for accommodating vehicular and pedestrian traffic through the construction zone.

C. The complexity of the TCP varies with the complexity of the traffic problems associated with a project. Many situations can be covered adequately with reference to specific sections from the Manual on Uniform Traffic Control Devices (MUTCD), the Traffic Control Devices Handbook (TCDH), or Roadway and Traffic Design Standard Series 600.

1.8 MAINTENANCE OF FLOW

A. Provide for the flow of sewers, drains, courses interrupted during the progress of the work, and shall immediately cart away and remove all offensive matter. The entire procedure of maintaining existing flow shall be fully discussed with the ENGINEER well in advance of the interruption of any flow.

PART 2 PRODUCTS

2.1 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed work shall be carefully protected from damage in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the CONTRACTOR at his own expense.

B. All structures shall be protected in a manner approved by the ENGINEER. Should any of the floors or other parts of the structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the CONTRACTOR at his own expense and to the satisfaction of the ENGINEER. Special attention is directed to shoring, sheeting and bracing requirements, described in Section 31 40 00. If, in the final inspection of the work, any defects, faults or omissions are found, the CONTRACTOR shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. The CONTRACTOR shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the contract.

C. Take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the OWNER.

PART 3 EXECUTION

3.1 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. Sequence and schedule work in a manner to preclude delays and conflicts between the work of various trades and contractors. Each trade shall keep informed as to the work of other trades on the project and shall execute their work in a manner that will not interfere with the work of other trades.

3.2 DIAGRAMMATIC NATURE OF DRAWINGS

A. Where layout is diagrammatic, such as pipelines, conduits, ductwork, etc., it shall be followed as closely as other work will permit. Changes from diagrams shall be made as required to conform to the construction requirements.

B. Before running lines, carefully verify locations, depths and sizes and confirm that lines can be run as contemplated without interfering with other construction. Any deviation shall be referred to the ENGINEER for approval before lines are run. Minor changes in location of the equipment, fixtures, piping, etc., from those shown on the Drawings, shall be made without extra charge if so directed by the ENGINEER before installation.

C. Determine the locations and sizes of equipment, fixtures, conduit, ducts, openings, etc., in order that there will be no interference in the installation of the work or delay in the progress of other work. In the event that interferences develop, the ENGINEER's decision regarding relocation of work will be final.

D. Any changes made necessary through failure to make proper arrangements to avoid interference shall not be considered as extras. Cooperate with those performing other work in preparation of interference drawings, to the extent that the location of piping, ductwork, etc., with respect to the installations of other trades shall be mutually agreed upon by those performing the work.

3.3 PROVISIONS FOR LATER INSTALLATION

A. Where any work cannot be installed as the construction is progressing, provide for boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. Arrange for chases, holes, and other openings in the masonry, concrete or other work and provide for subsequent closure after placing equipment. Arrangement for and closure of openings shall be subject to the approval of the ENGINEER and all costs therefor shall be included in the contract price for the work.

3.4 COORDINATION

A. The CONTRACTOR shall be fully responsible for the coordination of his work and the wok of his employees, subcontractors, and suppliers with the OWNER, and regulatory agencies, and assure compliance with schedules.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination

B. Preconstruction Conference

C. Progress Meetings

1.2 COORDINATION

A. General: Coordinate scheduling, submittals, and Contract work to assure efficient and orderly sequence of installation of interdependent construction elements.

1.3 PRECONSTRUCTION CONFERENCE

A. General: Prior to commencement of the Work, in accordance with the General Conditions, the OWNER will conduct a preconstruction conference to be held at a predetermined time and place.

B. Delineation of Responsibilities: The purpose of the conference is to designate responsible personnel, to establish a working relationship among the parties and to identify the responsibilities of the OWNER, plant personnel and the CONTRACTOR/VENDOR. Matters requiring coordination will be discussed and procedures for handling such matters, established. The agenda will include:

1. Submittal procedures
2. Partial Payment procedures
3. Maintenance of Records
4. Schedules, sequences and maintenance of facility operations
5. Safety and First Aid responsibilities
6. Change Orders and Field Directive Changes
7. Use of site
8. Housekeeping
9. Equipment delivery

C. Attendees: The preconstruction conference is to be attended by the representatives of the CONTRACTOR/VENDOR, the OWNER, and ENGINEER. Representatives of regulatory agencies, subcontractors, and principal suppliers may also attend when appropriate.

D. Chair and Minutes: The preconstruction conference and construction progress meetings will be chaired by the Engineer who will also arrange for the keeping and distribution of minutes to all attendees.

1.4 PROGRESS MEETINGS

A. Meeting Frequency and Format: Schedule progress meetings on at least a monthly basis or more frequently as warranted by the complexity of the Project, to review the Work, discuss changes in schedules, maintain coordination and resolve potential problems. Invite OWNER, ENGINEER and all CONTRACTOR/VENDORs. Suppliers may be invited as appropriate. Minutes of the meeting will be maintained by the ENGINEER and reviewed by ENGINEER prior to distribution by the ENGINEER. Distribute reviewed minutes to attendees within 2 calendar days after each meeting.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 32 16

PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Form of Schedules

B. Content of Schedules: Submit for approval, a preliminary progress schedule in accordance with the General Conditions.

C. Schedule Revisions

D. Submittal Requirements

1.2 FORM OF SCHEDULES

A. Prepare schedules in form of a horizontal bar chart.

1. Provide separate horizontal bar for each trade or operation.

2. Utilize a horizontal time scale and identify first workday of each week.

3. Utilize scale and spacings to allow space for notations and future revisions.

B. Utilize a listing format which chronologically indicates the order of start of each item of work.

C. Identify each listing by major specification section numbers.

1.3 CONTENT OF SCHEDULES

A. Completion Dates: Show the beginning and ending contract dates stated in documents. Schedules showing completion prior to the contract completion date will be accepted but in no event will they be considered basis for a claim for delay against the OWNER by the CONTRACTOR for the period between the early completion date and the completion date provided in the Contract Documents.

B. Show complete sequence of construction by activity.

C. Show dates for beginning and completion of each major element of construction and installation dates for major items of equipment. Elements shall include, but not be limited to, the following:

1. Shop drawing receipt from supplier/manufacturer submitted to ENGINEER, review and return to supplier/manufacturer

2. Material and equipment order, manufacturer, delivery, installation, and checkouts

3. Performance tests and supervisory services activity

4. Construction of various facilities

5. Demolition

6. Excavation, sheeting, shoring, dewatering

7. Concrete placement sequence

8. Piping and equipment installation

9. Electrical work activity

10. Plumbing work activity

11. Connection to existing sewers

12. Water main installation

13. Miscellaneous concrete placement

14. Subcontractor's items of work

15. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving

16. Final cleanup

17. Allowance for inclement weather

18. Coordination with concurrent Work on site

D. Show projected percentage of completion for each item as of first day of each month.

1.4 SCHEDULE REVISIONS

A. As a minimum, revise construction schedule every 30 calendar days to reflect changes in progress of Work for duration of Contract.

B. Indicate progress of each activity at date of submittal.

C. Show changes occurring since previous submittal of schedule.

1. Major change in scope
2. Activities modified since previous submittal
3. Revised projections of progress and completion
4. Other identifiable changes

D. Provide a written report as needed to define:

1. Problem areas, anticipated delays, and impact on schedule
2. Corrective action recommended and its effect
3. Effect of changes on schedules of other Contractors

1.5 SUBMITTAL REQUIREMENTS

A. Schedule: Submit final progress schedule in accordance with the General Conditions.

B. For preliminary and final submittal of construction progress schedule and subsequent revisions thereof furnish three copies to ENGINEER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS SECTION)

SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of Requirements

B. Submittal Procedures

C. Specific Submittal Requirements

D. Action on Submittals

E. Repetitive Review

1.2 DESCRIPTION OF REQUIREMENTS

A. This section specifies procedural requirements for Shop Drawings, product data, samples, and other miscellaneous Work-related submittals.

B. Procedures concerning items such as listing of manufacturers, suppliers, subcontractors, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and schedule of values are specified elsewhere.

C. Work-Related Submittals:

1. Substitution or "Or Equal" Items:

a. Includes material or equipment CONTRACTOR requests ENGINEER to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of particular supplier.

2. Shop Drawings:

a. Includes technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports, instructions, design mix formulas, measurements, and similar information not in standard printed form.

b. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.

3. Product Data:

a. Includes standard printed information on manufactured products, and systems that has not been specially prepared for this Project, including manufacturer's product specifications and installation instructions, catalog cuts, standard wiring diagrams, printed performance curves, mill reports, and standard color charts.

4. Samples:

a. Includes both fabricated and manufactured physical examples of materials, products, and units of work, partial cuts of manufactured or fabricated work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing.

b. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.

5. Working Drawings:

a. When used in the Contract Documents, the term “working drawings” shall be considered to mean the CONTRACTOR’S plans for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities control systems, forming and falsework for underpinning; temporary by-pass pumping and for such other work as may be required for construction but does not become an integral part of the project.

b. Copies of working drawings shall be submitted to the ENGINEER at least fourteen (14) calendar days (unless otherwise specified by the ENGINEER) in advance of the required work.

c. Working drawings shall be signed by a registered Professional Engineer currently licensed to practice in the State of Florida and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use.

6. Miscellaneous Submittals:

a. Work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, Operating and Maintenance Manuals, workmanship bonds,

survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the Work.

1.3 SUBMITTAL PROCEDURES

A. Scheduling:

1. Submit for approval, a preliminary schedule of shop drawings and samples submittals, in duplicate, and in accordance with the General Conditions.

2. Prepare and transmit each submittal to ENGINEER sufficiently in advance of scheduled performance of related work and other applicable activities.

B. Coordination:

1. Coordinate preparation and processing of submittals with performance of work. Coordinate each submittal with other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.

2. Coordinate submission of different units of interrelated work so that one submittal will not be delayed by ENGINEER's need to review a related submittal. ENGINEER may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

C. Submittal Preparation:

1. Stamp and sign each submittal certifying to review of submittal, verification of products, field measurement, field construction criteria, coordination of information within submittal with requirements of the Work and the Contract Documents, coordination with all trades, and verification that product will fit in space provided.

2. Transmittal Form: In the transmittal form forwarding each specific submittal to the ENGINEER include the following information as a minimum.

a. Date of submittal and dates of previous submittals containing the same material.

b. Project title and number.

c. Submittal and transmittal number.

d. Contract identification.

e. Names of:

(1) Contractor
(2) Supplier
(3) Manufacturer

f. Identification of equipment and material with equipment identification numbers, model numbers, and Specification section number.

g. Variations from Contract Documents and any limitations which may impact the Work.

h. Drawing sheet and detail number as appropriate.

D. Resubmittal Preparation:

1. Comply with the requirements described in Submittal Preparation. In addition:

a. Identify on transmittal form that submittal is a resubmission.

b. Make any corrections or changes in submittals required by ENGINEER's notations on returned submittal.

c. Respond to ENGINEER's notations:

(1) On the transmittal or on a separate page attached to CONTRACTOR's resubmission transmittal, answer or acknowledge in writing all notations or questions indicated by ENGINEER on ENGINEER's transmittal form returning review submission to CONTRACTOR.

(2) Identify each response by question or notation number established by ENGINEER.

(3) If CONTRACTOR does not respond to each notation or question, resubmission will be returned without action by ENGINEER until CONTRACTOR provides a written response to all ENGINEER's notations or questions.

d. CONTRACTOR initiated revisions or variations:

(1) On transmittal form identify variations or revisions from previously reviewed submittal, other than those called for by ENGINEER.

(2) ENGINEER's responsibility for variations or revisions is established in the General Conditions.

1.4 SPECIFIC SUBMITTAL REQUIREMENTS

A. Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, comply with requirements specified herein for each indicated type of submittal.

B. Requests for Substitution or "Or Equal"

1. Collect data for items to be submitted for review as substitution into one submittal for each item of material or equipment in accordance with the General Conditions.

2. Submit with other scheduled submittals for the material or equipment allowing time for ENGINEER to evaluate the additional information required to be submitted.

3. If CONTRACTOR requests to substitute for material or equipment specified but not identified in Specifications as requiring submittals, schedule substitution submittal request in Submittal schedule and submit as scheduled.

C. Shop Drawings:

1. Check all drawings, data and samples before submitting to the ENGINEER for review. Each and every copy of the drawings and data shall bear CONTRACTOR's stamp showing that they have been so checked. Shop drawings submitted to the ENGINEER without the CONTRACTOR's stamp will be returned to the CONTRACTOR for conformance with this requirement. All shop drawings shall be submitted through the CONTRACTOR, including those from any subcontractors.

2. Submit newly prepared information, with graphic information at accurate scale. Indicate name of manufacturer or supplier (firm name). Show dimensions and clearly note which are based on field measurement; identify materials and products which are included in the Work; identify revisions. Indicate compliance with standards and notation of coordination requirements with other work. Highlight, encircle or otherwise indicate variations from Contract Documents or previous submittals.

3. Include on each drawing or page:

a. Submittal date and revision dates.

b. Project name, division number and descriptions.

c. Detailed specifications section number and page number.

d. Identification of equipment, product or material.

e. Name of CONTRACTOR and Subcontractor.

f. Name of Supplier and Manufacturer.

g. Relation to adjacent structure or material.

h. Field dimensions, clearly identified.

i. Standards or Industry Specification references.

j. Identification of deviations from the Contract Documents.

k. CONTRACTOR's stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.

l. Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.

4. Provide 8-inch by 3-inch blank space for CONTRACTOR and ENGINEER stamps.

5. Submittals:

a Submittals shall be clear and legible, printed or typed. Submittals received that are not so, shall be returned to be resubmitted when in legible form. Each item of submittal shall be submitted to the ENGINEER for review a minimum of fourteen (14) days prior to requiring a response.

1. Shop drawings include custom-prepared data of all forms including drawings, diagrams, data sheets, schedules, templates, patterns reports, calculations, instructions, measurements and similar information not in standard printed form applicable to other projects.

2. Product data includes standard printed information on materials, products and systems, not custom-prepared for this project, other than the designation of selections from available choices.

3. Samples include both fabricated and not fabricated physical examples of materials, products and work: both as complete units and as smaller portions of units of work, either for limited visual inspection or (where indicated) for more detailed testing and analysis.

4. Miscellaneous submittals related directly to the work (non-administrative) include warranties, guarantees, maintenance agreements, workmanship bonds, project photographs/videos, survey

data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, record drawings, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work and not defined as shop drawings, product data or samples.

5. Submit three (3) hard copies plus one (1) electronic copy of each Shop Drawing.

6. Distribution:

a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only approved information is in possession of installer.

b. Maintain one set of product data (for each submittal) at Project site.

c. Mark five (5) additional copies with the date of approval and forward to the ENGINEER for use in field and for OWNER's records.

D. Product Data:

1. Preparation:

a. Collect required data into single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project or are not included in submittal, mark copies to clearly show such information is not applicable.

b. Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, submit data as a Shop Drawing and not as product data.

2. Submittals:

a. Submittal is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal is final when returned by ENGINEER marked "Approved" or "Approved as Noted".

b. Submit three (3) copies.

3. Distribution:

a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only approval information is in possession of installer.

b. Maintain one set of product data (for each submittal) at Project site, available for reference by ENGINEER and others.

c. Mark five (5) additional copies with the date of approval and forward to the ENGINEER for use in field and for OWNER records.

E. Samples:

1. Preparation:

a. Where possible, provide samples that are physically identical with proposed materials or products to be incorporated into the Work. Where variations in color, pattern or texture are inherent in material or product represented by sample, submit multiple units (not less than 3 units) showing approximate limits of variations.

b. Provide full set of optional samples where ENGINEER's selection required. Prepare samples to match ENGINEER's selection where so indicated.

c. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards.

d. Submit samples for ENGINEER's visual review of general generic kind, color, pattern, texture, and for final check of coordination of these characteristics with other related elements of work.

2. Submittals:

a. At CONTRACTOR's option, and depending upon nature of anticipated response from ENGINEER, initial submittal of samples may be either preliminary or final submittal.

b. A preliminary submittal, consisting of a single set of samples, is required where specifications indicate ENGINEER's selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with ENGINEER's "Action" marking.

c. Final Submittals: Submit three (3) sets of samples in final submittal, one (1) set will be returned.

3. Distribution:

a. Maintain returned final set of samples at Project site, in suitable condition and available for quality control comparisons throughout course of performing work.

b. Returned samples intended or permitted to be incorporated in the Work are indicated in Specification sections, and shall be in undamaged condition at time of use.

F. Mock-Ups:

1. Mock-ups and similar samples specified in Specification sections are recognized as special type of samples. Comply with samples submittal requirements to greatest extent possible. Process transmittal forms to provide record of activity.

G. Miscellaneous Submittals:

1. Inspection and Test Reports:

a. Classify each inspection and test report as being either "Shop Drawings" or "product data", depending on whether report is specially prepared for Project or standard publication of workmanship control testing at point of production. Process inspection and test reports accordingly.

2. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds:

a. Refer to Specification sections for specific requirements. Submittal is final when returned by ENGINEER marked "Approved" or "Approved as Noted".

b. In addition to copies desired for CONTRACTOR's use, furnish two (2) executed copies. Provide two (2) additional copies where required for maintenance data.

3. Survey Data:

a. Refer to Specification sections for specific requirements on property surveys, building or structure condition surveys, field measurements, quantitative records of actual Work, damage surveys, photographs, and similar data required by Specification sections. Copies will not be returned.

(1) Survey Copies: Furnish two (2) copies. Provide ten (10) copies of final property survey (if any).

(2) Condition Surveys: Furnish two (2) copies.

4. Certifications:

a. Refer to Specification sections for specific requirement on submittal of certifications. Submit seven (7) copies. Certifications are submitted for review of conformance with specified requirements and information. Submittal is final when returned by ENGINEER marked "Approved".

5. Closeout Submittals:

a. Refer to Specification Section 01 77 00 for specific requirements on submittal of closeout information, materials, tools, and similar items.

(1) Record Documents: Section 01 77 00.

(2) Materials and Tools: Spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

(3) Operating and maintenance data.

H. Operation and Maintenance Manuals:

1. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.

I. General Distribution:

1. Unless required elsewhere, provide distribution of submittals to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of work.

1.5 ACTION ON SUBMITTALS

A. ENGINEER's Action:

1. General:

a. Except for submittals for record and similar purposes, where action and return on submittals are required or requested, ENGINEER will review each submittal, mark with appropriate action, and return. Where submittal must be held for coordination, ENGINEER will also advise CONTRACTOR without delay.

b. ENGINEER will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

B. Action Stamp:

1. Approved:

a. Final Unrestricted Release: Where submittals are marked "Approved", Work covered by submittal may proceed PROVIDED IT COMPLIES WITH CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.

2. Approved As Noted:

a. When submittals are marked "Approved as Noted", Work covered by submittal may proceed PROVIDED IT COMPLIES WITH BOTH ENGINEER'S NOTATIONS OR CORRECTIONS ON SUBMITTAL AND WITH Contract Documents. Acceptance of Work will depend on that compliance. Re-submittal is not required.

3. Comments Attached - Confirm or Resubmit:

a. When submittals are marked "Examined and Returned for Correction", do not proceed with Work covered by submittal. Do not permit Work covered by submittal to be used at Project site or elsewhere where Work is in progress.

b. Revise submittal or prepare new submittal in accordance with ENGINEER's notations in accordance with Paragraph 1.3D of this section. Resubmit submittal without delay. Repeat if necessary to obtain different action marking.

1.6 RE-SUBMITTAL REVIEW

A. Cost of Subsequent Reviews: Shop Drawings and Operation and Maintenance Manuals submitted for each item will be reviewed no more than twice at the OWNER's expense. All subsequent reviews will be performed at times convenient to the ENGINEER and at the CONTRACTOR's expense based on the ENGINEER's then prevailing rates including all direct and indirect costs and fees. Reimburse the OWNER for all such fees invoiced to the OWNER by the ENGINEER.

B. Time Extension: Any need for more than one resubmission, or any other delay in ENGINEER's review of submittals, will not entitle CONTRACTOR to extension of the Contract Time.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Abbreviations and Symbols

B. Reference Standards

C. Definitions

1.2 RELATED SECTIONS

A. Information provided in this section is used where applicable in individual Specification Sections, Divisions 2 through 16.

1.3 REFERENCE ABBREVIATIONS

A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers

ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
Fed. Spec.	Federal Specifications
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry

SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

1.4 REFERENCE STANDARDS

A. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent which is indicated or intended.

B. Precedence: The duties and responsibilities of the OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees are set forth in the Contract Documents and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. Any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority, to undertake responsibility contrary to the powers of the ENGINEER as set forth in the Contract Documents cannot be assigned to the ENGINEER or any of the ENGINEER's consultants, agents or employees.

1.5 DEFINITIONS

A. In these Contract Documents the words furnish, install and provide are defined as follows:

1. Furnish (Materials): to supply and deliver to the project ready for installation and in operable condition.

2. Install (services or labor): to place in final position, complete, anchored, connected in operable condition.

3. Provide: to furnish and install complete. Includes the supply of specified services. When neither furnish, install or provide is stated, provided is implied.

1.6 LCU APPROVED MATERIALS LIST

A. The CONTRACTOR shall refer to the most resent Approved Materials List, as of the date of the advertisement for these contract documents.

B. The Approved Materials List located on LCU website constitutes a part of these contract documents.

1.7 LCU STANDARD DETAILS

A. The CONSTRACTOR shall refer to the most resent LCU Standard Details, as of the date of the advertisement for these contract documents.

B. The Standard Details located on LCU website constitutes a part of these contract documents.

1.8 LCU DESIGN MANUAL

A. The CONSTRACTOR shall refer to the most resent LCU Design Manual, as of the date of the advertisement for these contract documents.

B. The Design Manual located on LCU website constitutes a part of these contract documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Abbreviations

B. Standards for Abbreviations

1.2 RELATED SECTIONS

A. Abbreviations provided in this section are used where applicable in individual Specification Sections, Divisions 2 through 16.

1.3 ABBREVIATIONS

A. Abbreviations which may be used in Divisions 1 through 16 for units of measure are as follows:

alternating current ..... ac
American wire gauge ..... AWG
ampere(s) ..... amp
ampere-hour(s) ..... AH
annual ..... ann
Ampere Interrupting Capacity ..... AIC
atmosphere(s) ..... atm
average ..... avg

biochemical oxygen demand ..... BOD
Board Foot ..... FBM
brake horsepower ..... bhp
Brinell Hardness ..... BH
British thermal unit(s) ..... Btu

calorie (s) ..... cal
carbonaceous biochemical oxygen demand ..... CBOD
Celsius (centigrade) C
Center to Center ..... C to C
centimeter(s) ..... cm
chemical oxygen demand ..... COD
coefficient, valve flow ..... C_v
cubic ..... cu
cubic centimeter(s) cc
cubic feet per day ..... cfd
cubic feet per hour ..... cfh
cubic feet per minute ..... cfm
cubic feet per minute, standard conditions ..... scfm
cubic feet per second ..... cfs
cubic foot (feet) ..... cu ft
cubic inch(es) ..... cu in
cubic yard(s) ..... cu yd

decibels ..... dB
decibels (A scale) ..... dBa
degree(s) ..... deg
dewpoint temperature ..... dpt
diameter ..... dia
direct current ..... dc
dissolved oxygen ..... DO
dissolved solids ..... DS
dry-bulb temperature ..... dbt

efficiency ..... eff
elevation ..... el

entering water temperature.....ewt
entering air temperature ..... eat
equivalent direct radiation..... edr

face area ..... fa
face to face..... f to f
Fahrenheit ..... F
feet per day..... fpd
feet per hour ..... fph
feet per minute..... fpm
feet per second..... fps
foot (feet) ..... ft
foot-candle..... fc
foot-pound ..... ft-lb
foot-pounds per minute..... ft-lb/min
foot-pounds per second .....ft-lb/sec
formazin turbidity unit(s) ..... FTU
frequency..... freq

gallon(s)..... gal
gallons per day ..... gpd
gallons per day per
cubic foot ..... gpd/cu ft
gallons per day per
square foot..... gpd/sq ft
gallons per hour..... gph
gallons per minute ..... gpm
gallons per second ..... gps
gas chromatography and
mass spectrometry ..... GC-MS
gauge ..... ga
grain(s) ..... gr
gram(s) ..... g
grams per cubic centimeter .....gm/cc

Heat Transfer Coefficient.....U
height..... hgt
Hertz..... Hz
horsepower..... hp
horsepower-hour .....hp-hr
hour(s) ..... hr
humidity, relative..... rh
hydrogen ion concentration .....pH

inch(es)..... in
inches per second .....ips
inside diameter .....ID

Jackson turbidity unit(s) ..... JTU

kelvin..... K
kiloamperes..... kA
kilogram(s) .....kg
kilometer(s) .....km
kilovar (kilovolt-amperes
reactive) .....kvar
kilovolt(s)..... kV
kilovolt-ampere(s)..... kVA
kilowatt(s).....kW
kilowatt-hour(s) .....kWh

linear foot (feet)..... lin ft
liter(s).....L

megavolt-ampere(s)..... MVA
meter(s).....m
micrograms per liter ..... ug/L
miles per hour .....mph
milliampere(s) ..... mA
milligram(s) ..... mg
milligrams per liter..... mg/L
milliliter(s)..... mL
millimeter(s) ..... mm
million gallons ..... MG
million gallons per day..... mgd
millisecond(s) ..... ms
millivolt(s) ..... mV
minute(s) ..... min

mixed liquor suspended
solids.....MLSS

nephelometric turbidity
unit..... NTU
net positive suction head.....NPSH
noise criteria.....nc
noise reduction coefficient.....NRC
number.....no

ounce(s).....oz
outside air .....oa
outside diameter ..... OD

parts per billion..... ppb
parts per million..... ppm
percent..... pct

phase (electrical) .... ph
pound(s) ..... lb
pounds per cubic foot ..... pcf
pounds per cubic foot
per hour ..... pcf/hr
pounds per day ..... lbs/day
pounds per day per
cubic foot ..... lbs/day/cu ft
pounds per day per
square foot ..... lbs/day/sq ft
pounds per square foot ..... psf
pounds per square foot
per hour ..... psf/hr
pounds per square inch ..... psi
pounds per square inch
absolute ..... psia
pounds per square inch
gauge ..... psig
power factor ..... PF
pressure drop or
difference ..... dp
pressure, dynamic
(velocity) ..... vp
pressure, vapor ..... vap pr

quart(s) ..... qt

Rankine ..... R
relative humidity ..... rh
resistance ..... res
return air ..... ra
revolution(s) ..... rev
revolutions per minute ..... rpm
revolutions per second ..... rps
root mean squared ..... rms

safety factor ..... sf
second(s) ..... sec
shading coefficient ..... SC
sludge density index ..... SDI

Sound Transmission
Coefficient ..... STC
specific gravity ..... sp gr
specific volume ..... Sp Vol
sp ht at constant pressure ..... Cp
square ..... sq
square centimeter(s) ..... sq cm
square foot (feet) ..... sq ft
square inch (es) ..... sq in
square meter(s) ..... sq m
square yard(s) ..... sq yd
standard ..... std
static pressure ..... st pr
supply air .... sa
suspended solids ..... SS

temperature ..... temp
temperature difference ..... TD
temperature entering ..... TE
temperature leaving ..... TL
thousand Btu per hour ..... Mbh
thousand circular mils ..... kcmil
thousand cubic feet ..... Mcf
threshold limit value ..... TLV
tons of refrigeration ..... tons
torque ..... TRQ
total dissolved solids ..... TDS
total dynamic head ..... TDH
total kjeldahl nitrogen ..... TKN
total oxygen demand ..... TOD
total pressure ..... TP
total solids ..... TS
total suspended solids ..... TSS
total volatile solids ..... TVS

vacuum ..... vac
viscosity ..... visc
volatile organic chemical ..... VOC
volatile solids ..... VS
volatile suspended solids ..... VSS
volt(s) V
volts-ampere(s) ..... VA
volume ..... vol

watt(s) ..... W
watthour(s) ..... Wh
watt-hour demand ..... WHD
watt-hour demand meter ..... WHDM
week(s) ..... wk
weight ..... wt
wet-bulb ..... WB
wet bulb temperature ..... WBT

yard(s) ..... yd
year(s) ..... yr

1.4 STANDARD FOR ABBREVIATIONS

A. Use ASME Y1.1-1989, "Abbreviations for use on Drawings and in Text" for abbreviations for units of measure not included in Paragraph 1.3.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 43 00

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. Inspection Services

C. Inspection of Materials

D. Quality Control

E. Costs of Inspection

F. Acceptance Tests

G. Failure to Comply with Contract

1.2 RELATED SECTIONS

A. Section 01 33 00 - Submittals: Specific Submittal Requirements

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Certificate Submittals: Furnish the ENGINEER authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

1.4 INSPECTION SERVICES

A. OWNER's Access: At all times during the progress of the Work and until the date of final completion, afford the OWNER and ENGINEER every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. Replace work rejected due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, with satisfactory

work at no additional cost to the OWNER. Replace as directed, finished or unfinished work found not to be in strict accordance with the Contract, even though such work may have been previously approved and payment made therefor.

B. Rejection: The OWNER and the OWNER's Authorized Representatives have the right to reject materials and workmanship which are defective or require correction. Promptly remove rejected work and materials from the site.

C. Inferior Work Discoveries: Failure or neglect on the part of the OWNER or the OWNER's Authorized Representatives to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the OWNER or the OWNER's Authorized Representatives at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.

D. Removal for Examination: Should it be considered necessary or advisable by the OWNER or the OWNER's Authorized Representatives, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such Work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.

E. Operation Responsibility: Assume full responsibility for the proper operation of equipment during tests and instruction periods. Make no claim for damage which may occur to equipment prior to the time when the OWNER accepts the Work.

F. Rejection Prior to Warranty Expiration: If at anytime prior to the expiration of any applicable warranties or guarantees, equipment is rejected by the OWNER, repay to the OWNER all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices, and upon the receipt of the sum of money, OWNER will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. Do not remove the equipment from the premises of the OWNER until the OWNER obtains from other sources, equipment to take the place of that rejected. The OWNER hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that the OWNER may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.

1.5 INSPECTION OF MATERIALS

A. Premanufacture Notification: Give notice in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and

the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

B. Testing Standards: Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized, applicable test codes except as may otherwise be stated herein.

1.6 QUALITY CONTROL

A. Testing

1. Field and Laboratory

a. Provide personnel to assist the ENGINEER in performing the following periodic observation and associated services.

(1) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.

(2) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by ENGINEER.

(3) Masonry: Sample and test mortar, bricks, blocks and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.

b. When specified in Divisions 1 through 44 of the Contract Documents, provide an independent laboratory testing facility to perform required testing. Qualify the laboratory as having performed previous satisfactory work. Prior to use, submit to the ENGINEER for approval.

c. Cooperate with the ENGINEER and laboratory testing representatives. Provide at least 24 hours notice prior to when specified testing is required. Provide labor and materials, and necessary facilities at the site as required by the ENGINEER and the testing laboratory.

d. Provide an independent testing agency, a member of the National Electrical Testing Association, to perform inspections and tests specified in Division 16 of these Specifications.

2. Equipment: Coordinate and demonstrate test procedures as specified in the Contract Documents or as otherwise required during the formal tests.

3. Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.

B. Reports

1. Certified Test Reports: Where transcripts or certified test reports are required by the Contract Documents, meet the following requirements:

a. Before delivery of materials or equipment submit and obtain approval of the ENGINEER for all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents. Perform all testing in an approved independent laboratory or the manufacturer's laboratory. Submit for approval reports of shop equipment tests within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

2. Certificate of Compliance: At the option of the ENGINEER, or where not otherwise specified, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:

a. Manufacturer has performed all required tests

b. Materials to be supplied meet all test requirements

c. Tests were performed not more than one year prior to submittal of the certificate

d. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified

e. Identification of the materials

1.7 COSTS OF INSPECTION

A. OWNER's Obligation: Initial inspection and testing of materials furnished under this Contract will be performed by authorized Representatives or inspection bureaus supplied by and a cost to the CONTRACTOR, unless otherwise expressly specified. If subsequent testing is necessary due to failure of the initial tests or because of

rejection for noncompliance, re-testing shall be performed by the CONTRACTOR at the CONTRACTOR'S expense until satisfactory results have been attained.

B. CONTRACTOR's Obligation: Include in the Contract Price, the cost of all shop and field tests of equipment and other tests specifically called for in the Contract Documents.

C. Reimbursements to OWNER:

1. Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by the OWNER for compliance. Reimburse the OWNER for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.

2. Reimburse OWNER for the costs of any jobsite inspection between the hours of 7:00 p.m. and 6:00 a.m.

3. Reimburse OWNER for all costs associated with Witness Tests which exceed 5 Calendar Days per kind of equipment.

1.8 ACCEPTANCE TESTS

A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.

B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.

1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests.

2. Conduct field tests in the presence of the ENGINEER. Perform the field tests to demonstrate that under all conditions of operation each equipment item:

a. Has not been damaged by transportation or installation
b. Has been properly installed
c. Has been properly lubricated
d. Has no electrical or mechanical defects
e. Is in proper alignment
f. Has been properly connected
g. Is free of overheating of any parts
h. Is free of all objectionable vibration

i. Is free of overloading of any parts
j. Operates as intended

3. Pumps: After all pumps have been completely installed and working under the direction of the manufacturer, conduct in the presence of the Engineer tests necessary to indicate that pump operation conforms to these specifications. Field tests shall include all pumps under this section. Supply all water or wastewater, labor, equipment and incidentals required to complete the field test. Diesel pump performance testing will be for a 72-hour period, 7 am – 7 pm without issues.

4. If the pump performance does not meet these specifications, corrective measures shall be taken or pumps shall be removed and replaced with pumps which satisfy the conditions specified.

C. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the OWNER, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents. Performance testing for Odor Control System will be for a 72-hour period, 7 am – 7 pm without issue.

1.9 FAILURE TO COMPLY WITH CONTRACT

A. Unacceptable Materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the Work and replace it with acceptable material without additional cost to the OWNER. Fulfill all obligations under the terms and conditions of the Contract even though the OWNER or the OWNER's Authorized Representatives fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 51 00

SEWER BYPASS PUMPING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the wetwell for wetwell improvements and electrical and controls improvements for existing equipment. Contractor shall provide Silent Pak Enclosures or equivalent for the sewer bypass pumps.

B. For MPS 6600 the bypass pumping shall only occur during the day from the hours of 7:00 AM to 6:00 PM. Work when bypassing is limited to the hours from 8:00 AM to 5:00 PM. Flow shall be restored to the wetwell and existing submersible pumps outside of these hours. An exemption to the standard work hours, weekends and holidays may be granted and would need to be coordinated and subject to approval by with LCU with a minimum of 48 hours' notice. No bypass shall occur on the weekends. In the event that flow bypassing must be terminated quickly, flow shall be restored to the wetwell immediately.

C. For LS 616 work hours during sewer bypass 7 am – 6 pm. Work hours when bypassing, 8 am – 5 pm. New panels shall be constructed ready for existing wire terminations during bypass. All other wiring and work shall be completed prior to going on bypass. The bypass systems shall stay in place during testing of the new panels and controls. Bypass systems shall pump out of existing wetwells and into connection points in existing valve vaults. An exemption to the standard work hours, weekends and holidays may be granted and would need to be coordinated and subject to approval by with LCU with a minimum of 48 hours' notice.

D. For LS 617 work hours during sewer bypass 7 am – 6 pm. Work hours when bypassing, 8 am – 5 pm. . New panels shall be constructed ready for existing wire terminations during bypass. All other wiring and work shall be completed prior to going on bypass. The bypass systems shall stay in place during testing of the new panels and controls. Bypass systems shall pump out of existing wetwells and into connection points in existing valve vaults. An exemption to the standard work hours, weekends and holidays may be granted and would need to be coordinated and subject to approval by with LCU with a minimum of 48 hours' notice.

E. Bypass operations for 616 and 617 shall not occur at the same time.

F. The County may elect to provide remote telemetry units so monitor the bypass pumping.

G. The design, installation and operation of the temporary pumping systems shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least three (3) references of projects of a similar size and complexity as this project performed by his firm within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

H. Related Work Described Elsewhere:

1. Section 01 14 00 Maintenance of Operations

1.2 SUBMITTALS

A. The Contractor shall prepare with the vendor a specific, detailed description of the proposed pumping system and submit it and the vendor's references.

B. The Contractor shall submit to the County and Engineer detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage, spill contingency plan, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the County and Engineer.

C. The plan shall include but not be limited to details of the following:

1. Staging areas for pumps;

2. Sewer plugging method and types of plugs;

3. Number, size, material, location and method of installation of suction piping;
4. Number, size, material, method of installation and location of installation of discharge piping;

5. Bypass primary and standby pump sizes, model, capacity, number

of each size to be on site and power requirements;

6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);

7. Thrust and restraint block sizes and locations;

8. Use of temporary pipe supports

9. Method of noise control for each pump and/or generator;

10. Any temporary pipe supports and anchoring required;

11. Calculations for selection of bypass pumping pipe size;

12. Schedule for installation of and maintenance of bypass pumping lines;

13. Bypass duration for each construction segment;

14. Plan indicating selection location of bypass pumping line locations;

15. Layout to overcome any site limitations;

16. Measures for odor reduction;

17. Spill contingency plan;

18. Redundancy (pumps and power);

19. Monitoring program;

20. Alarm/Notification program;

21. Verification of staff qualifications that will operate and maintain system;

22. Measures to be taken for tropical storm and hurricane preparedness

23. Methods to facilitate access over and around bypass piping in coordination with the Contractor’s traffic control plan

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel-engine powered. Pumps and number of pumps shall be suitable for flow variabilities.

B. The Contractor shall provide the necessary stop/start controls for each pump.

C. Discharge Piping - In order to prevent the accidental spillage of flows all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints.

D. Pumps used shall meet County ordinance noise limits. Supplemental means of sound attenuation shall be utilized by the Contractor as required by the County to minimize disruption to the adjacent residents.

PART 3 – EXECUTION

3.1 DESIGN REQUIREMENTS

A. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the proposed work area. Contractor shall provide plan showing measures to be taken to handle extreme wet weather flows during heavy rain events.

B. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

C. Bypass pumping system shall be capable of bypassing the flow around the work area and of releasing any amount of flow up to full available flow into the work area as necessary for satisfactory performances of work.

D. Bypass operations shall take place without the need to shut down the influent mains or pump stations upstream of the stations where work is being performed.

E. Auto-Dialer: An auxiliary auto-dialing remote notification system will be wired into the by-pass system to notify the contractor's and the County's representatives in the event of a system change. The auto-dialer can store approximately 8 phone numbers that will automatically dial the next representative, if the call is not acknowledged. The list of emergency contacts shall be developed during the Contractor's preparation of the bypass plan. The power source for the auto-dialer will be the same power source as the primary pump, and a 24-hour auxiliary battery within the auto-dialer as back-up (if power is lost, auto-dialer will call). There will be (2) separate alarms:

1. ALARM #1: "Primary pump has shut down, press 9 to acknowledge". This indicates the primary pump has not started due to some mechanical failure. Ex: Belt break, low oil pressure, etc. If the primary strainer is clogged, this alarm will not be sent.

2. ALARM #2: "Backup pump is now in operation, press 9 to acknowledge". This indicates the backup pump are now in operation.

F. It is the Contactor's responsibility install flow monitoring equipment if desired to confirm wastewater flows as part of furnishing a bypass system sized adequately for potential incoming flows. The bypass systems will need to be capable of pumping the following at peak hour:

STATION	DEMAND (GPM)	TOTAL DYNAMIC HEAD (FT)
MPS 6600	2719	139
LS 616	360	60
LS 617	73	47

3.2 PERFORMANCE REQUIREMENTS

A. It is essential to the operation of the existing sewage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.

B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

C. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

D. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding.

E. The Contractor shall protect water resources, wetlands and other natural resources.

F. The Contractor shall provide a means to seal odors within the bypass manholes to minimize odors during the temporary diversion.

3.3 FIELD QUALITY CONTROL AND MAINTENANCE

A. Tests: The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The test shall be performed at 1 ½ time the maximum bypass line operation pressure. The Engineer and County will be given 24 hours' notice prior to testing.

B. Tests: Contractor shall coordinate with the County to identify and exercise all valves as part of the bypass plan development.

C. Tests: the bypass system shall be test run for 24 hours prior to being put into operation.

D. Inspection: Contractor shall inspect bypass pumping system every two hours to ensure that the system is working correctly. Monitoring logs shall be maintained and available for inspection upon request.

E. Maintenance Service: The Contractor shall insure that the temporary pumping system is properly maintained, and a responsible operator shall be on hand at all times when pumps are operating.

F. Extra Materials: Spare parts for pumps and piping shall be kept on site as required. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.4 PREPARATION

A. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the County and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.

B. During all bypass pumping operation, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage and regulatory fines caused by the bypass system due to human or mechanical failure.

3.5 INSTALLATION AND REMOVAL

A. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

B. When working inside manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

C. The installation of the bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off active streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor must place the bypass pipelines in trenches and cover with temporary pavement. The bypass pipelines must not impede access. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to preconstruction condition and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the County.

END OF SECTION

SECTION 01 55 26

TRAFFIC REGULATION

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. General Requirements

B. Traffic Control

1.2 RELATED SECTIONS (NOT APPLICABLE)

1.3 GENERAL REQUIREMENTS

A. Work within the LCDOT ROW will require the CONTRACTOR to obtain a ROW Permit.

B. All projects and work on highways, roads, and streets, shall have a traffic control plan (TCP), as required by Florida Statute and Federal regulations. All work shall be executed under the established plan and Department approved procedures. The TCP is the result of considerations and investigations made in the development of a comprehensive plan for accommodating vehicular and pedestrian traffic through the construction zone.

C. The complexity of the TCP varies with the complexity of the traffic problems associated with a project. Many situations can be covered adequately with reference to specific sections from the Manual on Uniform Traffic Control Devices (MUTCD), the Traffic Control Devices Handbook (TCDH), or Roadway and Traffic Design Standard Series 600.

D. The CONTRACTOR shall be responsible for providing safe and expeditious movement of traffic through construction zones. A construction zone is defined as the immediate areas of actual construction and all abutting areas that are used by the CONTRACTOR, and which interfere with the driving or walking public.

E. Remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

F. Before starting work, the CONTRACTOR shall submit to the Lee County Department of Transportation, with copy to the ENGINEER, a detailed schedule of his operations a minimum of fourteen (14) days prior to beginning work for approval. This shall include, but not be limited to, type and extent of temporary paving, and drawings and lists describing materials and traffic control methods to be used. Approval shall not relieve the CONTRACTOR of

his obligation to provide a safe and proper crossing. Work within the LCDOT ROW will require the Contractor to obtain ROW permit.

1.4 TRAFFIC CONTROL

A. Any part of the work performed within the ROW shall include, but not be limited to, such items as proper construction warning signs, signals, lighting devices, marking, barricades, channelization, and hand signaling devices. The CONTRACTOR shall be responsible for installation and maintenance of all devices and requirements for the duration of the Construction period.

B. The CONTRACTOR shall adhere to and follow all stipulations and conditions of the approved issued ROW permit as it relates to the work.

C. The CONTRACTOR shall also be responsible for notifying Police, Fire, and other Emergency Departments whenever construction is within roadways and of the alternate routes. Monthly status reports shall be provided to these Departments, as a minimum.

D. The CONTRACTOR shall be responsible for removal, relocation, or replacement of any traffic control device in the construction area which exists as part of the normal pre-construction traffic control scheme. Any such actions shall be performed by the CONTRACTOR under the supervision, and in accordance with the Specifications, of the Owner, unless otherwise specified.

E. The CONTRACTOR shall immediately notify the Owner of any vehicular or pedestrian safety or efficiency problems incurred as a result of the construction of the project.

F. The CONTRACTOR shall be responsible for notifying all residents of any road construction and limited access at least 72 hours in advance.

PART 2 PRODUCTS NOT USED.

PART 3 EXECUTION NOT USED.

END OF SECTION

SECTION 01 57 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Requirements

B. Temporary Utilities

C. Temporary Construction

D. Barricades and Enclosures

E. Fences

F. Security

G. Temporary Controls

H. Traffic Regulation

I. Field Offices and Sheds

1.2 GENERAL REQUIREMENTS

A. Plant and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles, roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the Work and which are not herein described or specified in detail. The CONTRACTOR shall accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.

B. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.

C. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the OWNER and the OWNER's Authorized Representatives, including the ENGINEER, for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents,

deaths, injuries, or damage at the site during occupancy or partial occupancy of the site by CONTRACTOR's forces while performing any part of the Work.

D. Hazard Communication: Furnish two copies of the CONTRACTOR's Hazard Communication Program required under OSHA regulations before beginning on site activities. Furnish two copies of amendments to Hazard Communications Program as they are prepared.

1.3 TEMPORARY UTILITIES

A. Water: Provide all necessary and required water without additional cost, unless otherwise specified. If necessary, provide and lay water lines to the place of use; secure all necessary permits; pay for all taps to water mains and hydrants and for all water used at the established rates.

B. Light and Power: Provide without additional cost to the OWNER temporary lighting and power facilities required for the proper construction and inspection of the Work. If, in the ENGINEER's opinion, these facilities are inadequate, do NOT proceed with any portion of the Work affected thereby. Maintain temporary lighting and power until the Work is accepted.

C. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the Work or existing facilities.

D. Sanitary Facilities: Provide sufficient sanitary facilities for construction personnel. Prohibit and prevent nuisances on the site of the Work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the Work.

E. Connections to Existing Utilities:

1. Unless otherwise specified or indicated, make all necessary connections to existing facilities including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electricity. In each case, obtain permission from the OWNER or the owning utility prior to undertaking connections. Protect facilities against deleterious substances and damage.

2. Thoroughly plan in advance all connections to existing facilities. Have on hand at the time of undertaking the connections, all material, labor and required equipment. Proceed continuously to complete connections in minimum time. Arrange for the operation of valves or other appurtenances on existing utilities, under the direct supervision of the owning utility.

1.4 TEMPORARY CONSTRUCTION

A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the

sufficiency and safety of all such temporary work or bridges and for any damage which may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the OWNER and the OWNER's representatives from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

1.5 BARRICADES AND ENCLOSURES

A. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the Work, barriers and lights necessary for the protection of Workmen and the Public. Provide suitable barricades, lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the Work causes obstructions to normal traffic, excavation sites, or constitutes in any way a hazard to the public.

B. Barricades and Lights:

1. Protect all streets, roads, highways, excavations and other public thoroughfares which are closed to traffic; use effective barricades which display acceptable warning signs. Locate barricades at the nearest public highway or street on each side of the blocked section.

2. Statutory Requirements: Install and maintain all barricades, signs, lights, and other protective devices within highway rights-of-way in strict conformity with applicable statutory requirements by the authority having jurisdiction.

1.6 FENCES

A. Existing Fences: Obtain written permission from the OWNER prior to relocating or dismantling fences which interfere with construction operations. Reach agreements with the fence owner as to the period the fence may be left relocated or dismantled. Install adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.

B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the Work.

1.7 SECURITY

A. Preservation of Property:

1. Preserve from damage, all property along the line of the Work, in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Preserve from damage, public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, and public streets. Note: Normal wear and tear of streets resulting from legitimate use by the CONTRACTOR are not considered as damage.

Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract.

2. In case of failure on the part of the CONTRACTOR to restore property or make good on damage or injury, the OWNER may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due, or which may become due the CONTRACTOR under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the OWNER and not contemplated by the Contract Documents, the CONTRACTOR will be compensated, in accordance with the General Conditions, provided that such property has not been damaged through fault of the CONTRACTOR or the CONTRACTOR's employees.

B. Public Utility Installations and Structures:

1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately-owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property which may be affected by the Work are deemed included hereunder.

2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the ENGINEER in preparing the Drawings. These data are not guaranteed for completeness or accuracy, and the CONTRACTOR is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.

3. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.

4. Remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the Work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept responsibility for any injury, damage, or loss which may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.

5. Repair or replace any water, electric, sewer, gas, irrigation, or other service connection damaged during the Work with no addition to the Contract price.

6. At all times in performance of the Work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the owners thereof to that end.

7. Give written notice to the owners of all public utility installations and structures affected by proposed construction operations, sufficiently in advance of breaking ground in any area or on any unit of the Work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Chiefs of Police, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 24 hours notice to all affected property owners whenever service connections are taken out of service.

C. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.

D. Protection of Trees and Lawn Areas:

1. Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the CONTRACTOR or CONTRACTOR's employees with new stock of similar size and age, at the proper season, at no additional cost to the OWNER.

2. Leave lawn areas in as good condition as before the start of the Work. Restore areas where sod has been removed by seeding or sodding.

1.8 TEMPORARY CONTROLS

A. During Construction:

1. Keep the site of the Work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the site if such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. Remove from the site all surplus materials and temporary structures when they are no longer needed.

3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

4. Safely store volatile wastes in covered metal containers and remove from the site daily.

5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.

B. Smoke Prevention:

1. Strictly observe all air pollution control regulations.

2. Open fires will be allowed only if permitted under current ordinances.

C. Noises:

1. Maintain acceptable noise levels in the vicinity of the Work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.

2. Supply written notification to the OWNER sufficiently in advance of the start of any work which violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

D. Hours of Operation:

1. Refer to the supplemental conditions section for hours of operation.

2. Do not carry out nonemergency work, including equipment moves, on Sundays without prior written authorization by the OWNER. No work shall be performed on holidays or weekends unless otherwise specified or approved.

E. Dust Control:

1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.

2. Adequately protect buildings or operating facilities which may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.

F. Temporary Drainage Provisions:

1. Provide for the drainage of stormwater and any water applied or discharged on the site in performance of the Work. Provide adequate drainage facilities to prevent damage to the Work, the site, and adjacent property.

2. Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the OWNER's facilities and the Work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.

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

G. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

1.9 TRAFFIC REGULATION

A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.

B. Access: Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when the CONTRACTOR has obtained permission from the owner or tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point.

1.10 FIELD OFFICES AND SHEDS

A. CONTRACTOR's Office: Erect, furnish, and maintain a field office with a telephone. Have an authorized agent present at this office at all times while the Work is in progress. Keep readily accessible copies of the Contract Documents, required record documents, and the latest approved shop drawings at this field office.

B. Material Sheds and Temporary Structures: Provide material sheds and other temporary structures of sturdy construction and neat appearance.

C. Location: Coordinate location of field offices, material sheds and temporary structures with ENGINEER and OWNER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 61 00

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description

B. Substitutions

C. Manufacturer's Written Instructions

D. Transportation and Handling

E. Storage, Protection and Maintenance

F. Manufacturer's Field Quality Control Services

G. Post Startup Services

H. Special Tools and Lubricating Equipment

I. Lubrication

1.2 DESCRIPTION

A. Proposed Manufacturers List: Within 15 calendar days of the date of the Notice to Proceed, submit to the ENGINEER a list of the names of proposed manufacturers, materialmen, suppliers and subcontractors, obtain approval of this list by OWNER prior to submission of any working drawings. Upon request submit evidence to ENGINEER that each proposed manufacturer has manufactured a similar product to the one specified and that it has previously been used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.

B. Furnish and install Material and Equipment which meets the following:

1. Conforms to applicable specifications and standards.

2. Complies with size, make, type, and quality specified or as specifically approved, in writing, by ENGINEER.

3. Will fit into the space provided with sufficient room for operation and maintenance access and for properly connecting piping, ducts and services, as

applicable. Make the clear spaces that will be available for operation and maintenance access and connections equal to or greater than those shown and meeting all the manufacturers' requirements. Make all provisions for installing equipment furnished at no increase in Contract Price.

4. Manufactured and fabricated in accordance with the following:

   a. Design, fabricate, and assemble in accordance with best engineering and shop practices.

   b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

   c. Provide two or more items of same kind identical, by same manufacturer.

   d. Provide materials and equipment suitable for service conditions.

   e. Adhere to equipment capabilities, sizes, and dimensions shown or specified unless variations are specifically approved, in writing, in accordance with the Contract Documents.

   f. Adapt equipment to best economy in power consumption and maintenance. Proportion parts and components for stresses that may occur during continuous or intermittent operation, and for any additional stresses that may occur during fabrication or installation.

   g. Working parts are readily accessible for inspection and repair, easily duplicated and replaced.

5. Use material or equipment only for the purpose for which it is designed or specified.

1.3 SUBSTITUTIONS

A. Substitutions:

1. CONTRACTOR's requests for changes in equipment and materials from those required by the Contract Documents are considered requests for substitutions and are subject to CONTRACTOR's representations and review provisions of the Contract Documents when one of following conditions are satisfied:

   a. Where request is directly related to an "or equal" clause or other language of same effect in Specifications.

   b. Where required equipment or material cannot be provided within Contract Time, but not as result of CONTRACTOR's failure to pursue Work promptly or to coordinate various activities properly.

c. Where required equipment or material cannot be provided in manner compatible with other materials of Work, or cannot be properly coordinated therewith.

2. CONTRACTOR'S Options:

a. Where more than one choice is available as options for CONTRACTOR's selection of equipment or material, select option compatible with other equipment and materials already selected (which may have been from among options for other equipment and materials).

b. Where compliance with specified standard, code or regulation is required, select from among products which comply with requirements of those standards, codes, and regulations.

c. "Or Equal": For equipment or materials specified by naming one or more equipment manufacturer and "or equal", submit request for substitution for any equipment or manufacturer not specifically named.

B. Conditions Which are Not Substitution:

1. Requirements for substitutions do not apply to CONTRACTOR options on materials and equipment provided for in the Specifications.

2. Revisions to Contract Documents, where requested by OWNER or ENGINEER, are "changes" not "substitutions".

3. CONTRACTOR's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute basis for a Change Order, except as provided for in Contract Documents.

1.4 MANUFACTURER'S WRITTEN INSTRUCTIONS

A. Instruction Distribution: When the Contract Documents require that installation, storage, maintenance and handling of equipment and materials comply with manufacturer's written instruction's, obtain and distribute printed copies of such instructions to parties involved in installation, including six copies to ENGINEER.

1. Maintain one set of complete instructions at jobsite during storage and installation, and until completion of work.

B. Manufacturer's Requirements: Store, maintain, handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's written instructions and in conformity with Specifications.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult ENGINEER for further instructions.

2. Do not proceed with work without written instructions.

C. Performance Procedures: Perform work in accordance with manufacturer's written instructions. Do not omit preparatory steps or installation procedures, unless specifically modified or exempted by Contract Documents.

1.5 TRANSPORTATION AND HANDLING

A. Coordination with Schedule: Arrange deliveries of materials and equipment in accordance with Construction Progress Schedules. Coordinate to avoid conflict with work and conditions at site.

1. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Protect bright machined surfaces, such as shafts and valve faces, with a heavy coat of grease prior to shipment.

3. Immediately upon delivery, inspect shipments to determine compliance with requirements of Contract Documents and approved submittals and that material and equipment are protected and undamaged.

B. Handling: Provide equipment and personnel to handle material and equipment by methods recommended by manufacturer to prevent soiling or damage to materials and equipment or packaging.

1.6 STORAGE, PROTECTION, AND MAINTENANCE

A. On-site storage areas and buildings:

1. Conform storage buildings to requirements of Section 01 57 00.

2. Coordinate location of storage areas with ENGINEER and OWNER.

3. Arrange on site storage areas for proper protection and segregation of stored materials and equipment with proper drainage. Provide for safe travel around storage areas and safe access to stored materials and equipment.

4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

5. Store materials such as pipe, reinforcing and structural steel, and equipment on pallets, blocks or racks, off ground.

6. PVC Pipe may be damaged by prolonged exposure to direct sunlight and the CONTRACTOR shall take necessary precautions during storage and installation to avoid this damage. Pipe shall be stored under cover and installed with sufficient backfill to shield it from the sun.

7. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

B. Interior Storage:

1. Store materials and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible.

2. Store materials and equipment, subject to damage by elements, in weathertight enclosures.

3. Maintain temperature and humidity within ranges required by manufacturer's instructions.

C. Accessible Storage: Arrange storage in a manner to provide easy access for inspection and inventory. Make periodic inspections of stored materials or equipment to assure that materials or equipment are maintained under specified conditions and free from damage or deterioration.

1. Perform maintenance on stored materials of equipment in accordance with manufacturer's instructions, in presence of OWNER or ENGINEER.

2. Submit a report of completed maintenance to ENGINEER with each Application for Payment.

3. Failure to perform maintenance, to notify ENGINEER of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

D. OWNER's Responsibility: OWNER assumes no responsibility for materials or equipment stored in buildings or on-site. CONTRACTOR assumes full responsibility for damage due to storage of materials or equipment.

E. CONTRACTOR's Responsibility: CONTRACTOR assumes full responsibility for protection of completed construction. Repair and restore damage to completed Work equal to its original condition.

F. Special Equipment: Use only rubber-tired wheelbarrows, buggies, trucks, or dollies to wheel loads over finished floors, regardless if the floor has been protected or not. This applies to finished floors and to exposed concrete floors as well as those covered with composition tile or other applied surfacing.

G. Surface Damage: Where structural concrete is also the finished surface, take care to avoid marking or damaging surface.

1.7 MANUFACTURER'S FIELD QUALITY CONTROL SERVICES

A. General:

1. Provide manufacturer's field services in accordance with this subsection for those tasks specified in other sections.

2. Provide training as specified in Section 01 79 00.

3. Include and pay all costs for suppliers' and manufacturers' services, including, but not limited to, those specified.

B. Installation Instruction: Provide instruction by competent and experienced technical representatives of equipment manufacturers or system suppliers as necessary to resolve assembly or installation procedures which are attributable to, or associated with, the equipment furnished.

C. Installation Inspection, Adjustments and Startup Participation:

1. Provide competent and experienced technical representatives of equipment manufacturers or system suppliers to inspect the completed installation as follows.

a. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.

b. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

c. Verify that wiring and support components for equipment are complete.

d. Verify that equipment or system is installed in accordance with the manufacturer's recommendations, approved shop drawings and the Contract Documents.

e. Verify that nothing in the installation voids any warranty.

2. Provide manufacturer's representatives to perform initial equipment and system adjustment and calibration conforming to the manufacturer's recommendations and instructions, approved shop drawings and the Contract Documents.

3. Obtain ENGINEER's approval before start-up of equipment. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.

4. Furnish ENGINEER with three copies of the following. When training is specified, furnish the copies at least 24 hours prior to training.

   a. "Certificate of Installation, Inspection and Start-up Services" by manufacturers' representatives for each piece of equipment and each system specified, certifying:

      (1) That equipment is installed in accordance with the manufacturers' recommendations, approved shop drawings and the Contract Documents.

      (2) That nothing in the installation voids any warranty.

      (3) That equipment has been operated in the presence of the manufacturer's representative.

      (4) That equipment, as installed, is ready to be operated by others.

   b. Detailed report by manufacturers' representatives, for review by ENGINEER of the installation, inspection and start-up services performed, including:

      (1) Description of calibration and adjustments if made; if not in Operation and Maintenance Manuals, attach copy.

      (2) Description of any parts replaced and why replaced.

      (3) Type, brand name, and quantity of lubrication used, if any.

      (4) General condition of equipment.

      (5) Description of problems encountered, and corrective action taken.

      (6) Any special instructions left with CONTRACTOR or ENGINEER.

D. Field Test Participation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to participate in field testing of the equipment specified in Section 01 43 00.

E. Trouble-Free Operation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to place the equipment in trouble-free operation after completion of start-up and field tests.

1.8 POST START-UP SERVICES

A. General: Provide Post Start-up Services in accordance with this subsection for equipment specified in other sections.

B. Site Visit: Provide the services of an authorized service representative for each equipment manufacturer or system supplier to make a final site visit after the equipment or system has been in operation for at least 6 months, but no longer than 11 months. Furnish assistance to OWNER's operating personnel in making adjustments and calibrations required to determine that the equipment and system is operating in conformance with design, manufacturer's, and specification requirements. Instruct the personnel in a review of proper operation and maintenance procedures.

C. Certificate: Furnish "Certificate of Post Start-up Services" cosigned by ENGINEER and the manufacturer's representative, certifying that this service has been performed. Use form provided in this section, and furnish OWNER with three copies.

1.9 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

A. General: Furnish, per manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)

B. Time of Delivery: Deliver special tools and lubricating equipment to OWNER when unit is placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.

C. Quality: Provide tools and lubricating equipment of a quality meeting equipment manufacturer's requirements.

1.10 LUBRICATION

A. General: Where lubrication is required for proper operation of equipment, incorporate in the equipment the necessary and proper provisions in accordance with manufacturer's requirements. Where possible, make lubrication automated and positive.

B. Oil Reservoirs: Where oil is used, supply reservoir of sufficient capacity to lubricate unit for a 24-hour period.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Requirements

B. Scheduling of Shutdown

1.2 RELATED SECTIONS

A. Section 32 10 01 – Pavement Repair and Restoration

1.3 GENERAL REQUIREMENTS

A. CONTRACTOR shall be responsible for all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:

1. Make its several parts fit together properly.
2. Uncover portions of the work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Remove samples of installed work as specified for testing.
6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

B. Coordination: Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.

C. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.

D. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without the ENGINEER's concurrence.

1.4 SUBMITTALS

A. Submit a written request to the ENGINEER well in advance of executing any cutting or alteration which affects:

1. Work of the OWNER or any separate contractor.
2. Structural value or integrity of any element of the project or work.
3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
4. Efficiency, operational life, maintenance or safety of operational elements.
5. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the work.
2. Description of affected work.
3. The necessity for cutting, alteration or excavation.
4. Effect on work of OWNER or any separate contract, or on structural or weatherproof integrity of work.
5. Description of proposed work:

   a. Scope of cutting, patching, alteration, or excavation.
   b. Trades who will execute the work.
   c. Products proposed to be used.
   d. Extent of refinishing to be done.

6. Alternatives to cutting and patching.
7. Cost proposal, when applicable.
8. Written permission of any separate contractor whose work will be affected.

C. SUBMIT WRITTEN NOTICE TO THE ENGINEER DESIGNATING THE DATE AND THE TIME THE WORK WILL BE UNCOVERED.

1.5 SCHEDULING OF SHUTDOWN

A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the OWNER's normal operation is minimal. Overtime, night and weekend work without additional compensation from the OWNER, may be required to make these connections, especially if the connections are made at times other than those specified.

B. Request for Shutdowns: Submit a written request for each shutdown to the OWNER and the ENGINEER sufficiently in advance of any required shutdown.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with specifications and standards for each specific product involved.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of projects, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of the work.

C. Report unsatisfactory or questionable conditions to the ENGINEER in writing; do not proceed with work until the ENGINEER has provided further instructions.

3.2 PREPARATION

A. Provide adequate temporary support as necessary to assure structural value or integrity or affected portion of work.

B. Provide devices and methods to protect other portions of project from damage.

C. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work, and maintain excavations free from water.

D. Material Removal: Cut and remove all materials to the extent shown or as required to complete the Work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials which are not salvageable from the site.

3.3 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.

C. Employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

E. Restore work which has been cut or removed; install new products to provide completed work in accord with requirements of contract documents.

F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to nearest intersection.
2. For an assembly, refinish entire unit.

3.4 PAVEMENT RESTORATION

A. Restore all pavement or roadway surfaces in accordance with Section 32 10 01 – Pavement Repair and Restoration.

B. The restoration of existing street paving, including underdrains, if any are encountered, where damaged, shall be restored by the CONTRACTOR and shall be replaced or rebuilt using the same type of construction as was in the original. The CONTRACTOR shall be responsible for restoring all such work, including subgrade, base courses, curb and gutter or other appurtenances where present. The CONTRACTOR shall obtain and pay for at his own expense such local or other governmental permits as may be necessary for the opening of streets and shall satisfy himself as to any requirements other than those herein set forth which may affect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.

C. This section does not describe the construction of new road surfaces or the complete resurfacing of existing pavements.

D. In all cases, the CONTRACTOR will be required to maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract for a period of 12 months after the acceptance of the Contract, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.

E. The CONTRACTOR shall do all the final resurfacing or repaving of streets or roads, over the excavations that he has made and he shall be responsible for relaying paving surfaces of roads that have failed or been damaged, at any time before the termination of the maintenance period on account of work

done by him and he shall resurface or repave over any tunnel jacking, or boring excavation that shall settle or break the surface, shall be repaved to the satisfaction of the OWNER and at the CONTRACTOR's sole expense. Backfilling of trenches and the preparation of subgrades shall conform to the requirements of excavation and backfilling of pipeline trenches.

F. Where pipeline construction crosses paved streets, the CONTRACTOR may elect, at no additional cost to the OWNER, to place the pipe by the jacking or boring or tunneling method in lieu of cutting and patching of the paved surfaces.

END OF SECTION

SECTION 01 74 00

CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. General Requirements

B. Disposal Requirements

1.2 GENERAL REQUIREMENTS

A. Execute cleaning during progress of the work and at completion of the work.

1.3 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 DURING CONSTRUCTION

A. Execute daily cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.

B. Provide onsite containers for the collection of waste materials, debris and rubbish. All waste materials including containers, food debris and other miscellaneous materials must be disposed of daily in onsite containers.

C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.2 FINAL CLEANING

A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:

1. Thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.

2. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.

3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.

4. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.

B. Employ experienced workers, or professional cleaners, for final cleaning.

C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace air-handling filters if units were operated during construction.

H. Clean ducts, blowers, and coils if air-handling units were operated without filters during construction.

I. Vacuum clean all interior spaces, including inside cabinets.

J. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

K. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

L. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.

M. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment which may have become soiled during installation.

N. Perform touch-up painting.

O. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

P. Remove erection plant, tools, temporary structures and other materials.

Q. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

3.3 FINAL INSPECTION

A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ENGINEER.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 01 77 00

CONTRACT CLOSE OUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Warranties and Bonds

B. Record Drawings

C. Special Tools

1.2 WARRANTIES AND BONDS

Prior to final payment deliver to the OWNER the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period. Show OWNER as beneficiary of these documents.

1.3 RECORD DRAWINGS

At the site keep and maintain one record copy of all Contract Documents, reference documents and all technical documents submitted in good order. As the work progresses the Engineer or his designated representative shall record on one set of reproducible drawings all changes and deviations from the original Plans. He shall record the exact location of all changes in vertical and horizontal alignment by offsets and ties at each; sewer, water, electric, gas, communication and other services by off-set distance to permanent improvements such as building and curbs.

Prior to acceptance of the project and before final payment is made, the Engineer shall submit one (1) set of reproducible drawings, two (2) sets of blueline or blackline prints, all marked "Drawings of Record". These Record Drawings must be certified by the Florida Registered Professional Engineer, who prepared the plans and signs and seals these plan, and submits AutoCAD compatible diskette copy of the drawings, and other applicable related records to the Department of Lee County Utilities.

These Record Drawings must be certified by the Florida Registered Professional Engineer, who prepared the plans and signs and seals these plans. The Record Drawings shall include vertical and horizontal alignment of all water, sewer, and effluent reuse lines, valves, tees, bends, reducers, hydrants, pump stations, service connections, meter boxes and/or pads, and other pertinent structures. Pipeline runs in excess of 152.4m, (500'), without fittings shall include vertical alignment information at 152.4m, (500') intervals. Said alignment shall be tied to permanent improvements, such as roadway and/or railroad centerlines and rights-of-way, building and property

corners, and shall be certified by a Professional Land Surveyor, licensed in the State of Florida. The Professional Land Surveyor can coordinate with the Contractor to install the necessary appurtenances on buried utilities to facilitate the survey after construction is completed. In addition, property strap numbers and street names shall be shown on the plan.

On a case by case basis, Lee County Utilities may waive the requirement for certification by a Professional Land Surveyor, licensed in the State of Florida. However, prior consent must first be obtained from Lee County Utilities. The County shall withhold final acceptance of the project until the requirement for record drawings and related records has been met. Record Drawings without detailed field verified horizontal and vertical locations of all facilities shown will be rejected.

1.4 SPECIAL TOOLS

Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.

For each type of equipment provided under this CONTRACT, furnish a complete set of all special tools including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Furnish only tools of high grade, smooth forged alloy tool steel. Manufacture grease guns of the lever type.

Furnish and erect one or more neat and substantial steel wall cases or cabinets with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description

B. Quality Assurance

C. Submittals

D. Format and Contents

1.2 DESCRIPTION

A. Scope: Provide individual hard copies for each location and for the office, a total of 3 locations, 2 copies each. All locations and office shall be provided with an electronic copy.

1.3 QUALITY ASSURANCE

A. Reference Codes and Specifications: No current government or commercial specifications or documents apply.

1.4 SUBMITTALS

A. Prior to the Work Reaching 50 Percent Completion, submit to the ENGINEER for approval two copies of the manual with all specified material. Submit the approval copies with the partial payment request for the specified completion. Within 30 days after the ENGINEER's approval of the two-copy submittal, furnish to the ENGINEER the remaining eight (8) copies of the manual. Provide space in the manual for additional material. Submit any missing material for the manual prior to requesting certification of substantial completion.

1.5 FORMAT AND CONTENTS

A. Prepare and arrange each copy of the manual as follows:

1. One copy of an equipment data summary (see sample form) for each item of equipment.

2. One copy of an equipment preventive maintenance data summary (see sample form) for each item of equipment.

3. One copy of the manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.

4. List of electrical relay settings and control and alarm contact settings.

5. Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.

6. One valve schedule giving valve location, fluid, and fluid destination for each valve installed. Group all valves in same piping systems together in the schedule. Obtain a sample of the valve numbering system from the ENGINEER.

7. Furnish all O&M Manual material on 8-1/2 by 11 commercially printed or typed forms or an acceptable alternative format.

B. Organize each manual into sections paralleling the equipment specifications. Identify each section using heavy section dividers with reinforced holes and numbered plastic index tabs. Use 3-ring, hard-back binders Type No. VS11 as manufactured by K&M Company, Torrence, CA, or equal. Punch all loose data for binding. Arrange composition and printing so that punching does not obliterate any data. Print on the cover and binding edge of each manual the project title, and manual title, as furnished and approved by the ENGINEER.

C. Leave all operating and maintenance material that comes bound by the equipment manufacturer in its original bound state. Cross-reference the appropriate sections of the CONTRACTOR's O&M manual to the manufacturers' bound manuals.

D. Label binders Volume 1, 2, and so on, where more than one binder is required. Include the table of contents for the entire set, identified by volume number, in each binder.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

NOTE: Fill in name of Project.

Lee County Utilities

_____

Equipment Data Summary

Equipment Name: Specification Reference:

Manufacturer:

Name:

Address:

Telephone:

Number Supplied: Location/Service:

Model No: Serial No:

Type:

Size/Speed/Capacity/Range (as applicable):

Power Requirement (Phase/Volts/Hertz):

Local Representative:

Name:

Address:

Telephone:

NOTES:

NOTE: Fill in name of Project.

Lee County Utilities

_____

Preventive Maintenance Summary

Equipment Name: Location:

Manufacturer:

Name:

Address:

Telephone:

Model No: Serial No:

Maintenance Task	Lubricant/Part	D W M Q SA A	O&M Manual Reference

NOTES:

*D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

SECTION 01 78 36

WARRANTIES AND BONDS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

A. Compile specified warranties and bonds, as indicated in the Solicitation.

B. Co-execute submittals when so specified.

C. Review submittals to verify compliance with Contract Documents.

D. Submit to the ENGINEER for review and transmittal to OWNER.

1.2 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Two (2) original signed copies are required.

C. Table of Contents. Neatly typed in orderly sequence. Provide complete information for each items.

1. Product or work item.
2. Firm, with name of principal, address and telephone number.
3. Scope.
4. Date of beginning warranty, bond or service and maintenance contract.
5. Duration of warranty, bond or service maintenance contract.
6. Provide information for OWNER's personnel:
    a. Proper procedure in case of failure.
    b. Instances which might affect the validity of warranty or bond.
7. CONTRACTOR, name of responsible principal, address and telephone number.

1.3 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2" x 11", punch sheets for standard 3-post binder.
    a. Fold larger sheets to fit into binders.

2. Cover: Identify each packet with typed or printed title “WARRANTIES AND BONDS” list:
   a. Title of Project
   b. Name of CONTRACTOR

C. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of 2 inches.

1.4 WARRANTY SUBMITTAL REQUIREMENTS

A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer’s warranty period shall be concurrent with the CONTRACTOR’s warranty for one (1) year, unless otherwise specified, commencing at the time of substantial completion.

B. The CONTRACTOR shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under Division 11, 13, 14, 15, and 16 and which has a 1 HP motor, or which lists for more than $1,000. The ENGINEER reserves the right to request warranties for equipment not classified as major. The CONTRACTOR shall still warrant equipment not considered to be “major” in the CONTRACTOR’s one-year warranty period even though certificates of warranty may not be required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 79 00

TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Training

1.2 TRAINING

A. Training: Provide the services of knowledgeable, technically competent, factory trained specialists to instruct (Pump Station) personnel in the operation and maintenance of the equipment and system components listed in Paragraph B. The OWNER will furnish training classroom space.

1. Coordinate services with the OWNER, with a minimum of 30 days prior notice.

2. Provide a combination of classroom and "hands-on" instruction designed to completely familiarize operating and maintenance personnel with the systems theory, standard operating procedures, safety features and emergency procedures, and general maintenance of all components.

3. Conduct all training at the (Pump Station) during regular hours on weekdays.

B. Provide training for the following:

Specification	Equipment Name	Minimum Hours
43 21 13	10JSVG-DJDS-68H-ZC	2
44 31 21	Performance testing assistance/training	1-trip 8 hrs

C. Length of Training: The minimum lengths of training sessions are listed in Paragraph B. above.

D. Credentials: Submit for approval, credentials of equipment manufacturer representatives who are to be course instructors at least 14 days prior to a proposed training session.

E. Scheduling: Submit training outline and other information described in paragraphs G through K for approval at least 14 days prior to the proposed date for the training

sessions. Verify scheduling with the OWNER at least 14 days prior to the training sessions.

F. Number of Copies: For each training class, provide instructional material for at least ten attendees plus five extra copies, plus duplicate copies of all audio-visual aids utilized during each training course.

G. Training Outline Submission: Provide a proposed training outline including the topics presented in Paragraph K. Identify specific components and procedures in the proposed training outline.

H. Training Topic Detail: Detail specific training topics. Describe "hands-on" demonstrations planned for the training. Reference training aids to be utilized in the training (i.e., video tapes, slides, transparencies) and attach where applicable.

I. Training Handouts: Attach training handouts to the proposed training outline.

J. Training Segment Duration: Indicate the duration of each training segment.

K. Training Outline:

1. Equipment Operation

    a. Describe equipment's operating (process) function.

    b. Describe equipment's fundamental operating principles and dynamics.

    c. Identify equipment's mechanical, electrical and electronic components and features.

    d. Identify all support equipment associated with the operation of the subject equipment.

2. Detailed Component Description

    a. Identify and describe in detail each component's function.

    b. Where applicable, group related components into subsystems.

    c. Identify, and describe in detail, equipment safety features and control interlocks.

3. Equipment Preventive Maintenance

    a. Describe preventive maintenance inspection procedures required to perform and inspect the equipment in operation, and spot potential trouble symptoms (anticipate breakdowns).

    b. Outline recommended routine lubrication and adjustments (preventive maintenance).

4. Equipment Troubleshooting

    a. Define recommended systematic troubleshooting procedures.

    b. Provide component specific troubleshooting checklists.

    c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

5. Equipment Corrective Maintenance

    a. Describe recommended equipment preparation requirements.

    b. Identify and describe the use of special tools required for maintenance of the equipment.

    c. Describe component removal/installation and disassembly/ assembly procedures.

    d. Perform at least two "hands-on" demonstrations of common corrective maintenance repairs.

    e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

    f. Define recommended torquing, mounting, calibration, and alignment procedures and settings, as appropriate.

    g. Describe recommended procedures to check/test equipment following corrective repair.

L. Certificate: Provide "Certificate of Instructional Services" signed by ENGINEER and equipment representative, verifying that training has been accomplished to satisfaction of all parties. Use form provided in this section, and furnish ENGINEER with three copies.

M. Substantial Completion: Training provided by manufacturers' representative, ENGINEER and OWNER does not constitute substantial completion.

N. Equipment Use: Use of equipment for training will not void manufacturers' or contract warranties.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project_____

Equipment_____

Specification.Section_____

Contract_____

I hereby certify the equipment Manufacturers' Representative has instructed OWNER's personnel in startup operation and maintenance of this equipment as required in the Contract Documents.

MANUFACTURER'S REPRESENTATIVE

Signature _____

Name: (print) _____

Title: _____

Representing _____

CONTRACTOR

Signature _____ Date _____

Name (print) _____

Title _____

ENGINEER

Signature _____ Date _____

Name (print) _____

Title _____

COMMENTS:

Complete and submit three copies of this form to ENGINEER upon completion of training as required by Specification Section 01 79 00.

(NO TEXT FOR THIS PAGE)

SECTION 02 21 13

LINES AND GRADES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General

B. Surveys

C. Datum Plane

D. Protection of Survey Data

1.2 GENERAL

A. Construct all work in accordance with the lines and grades shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

1.3 SURVEYS

A. Reference Points: Base horizontal and vertical control points will be designated by the ENGINEER and used as datum for the Work. Perform all additional survey, layout, and measurement work.

B. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the CONTRACTOR.

1.4 DATUM PLANE

A. All elevations indicated or specified refer to the North American Vertical Datum 1988 (NAVD 88), and are expressed in feet and decimal parts thereof, or in feet and inches.

1.5 PROTECTION OF SURVEY DATA

A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and benchmarks made or established for the Work. Reestablish them if disturbed and bear the entire expense of checking reestablished marks and rectifying work improperly installed.

B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Furnish copies of such data to the ENGINEER for use in checking the CONTRACTOR's layout. Data considered of value to the OWNER will be transmitted to the OWNER by the ENGINEER with other records on completion of the Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 02 40 00

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: All work necessary for the removal and disposal of buildings, structures, foundations, piping, equipment and roadways, or any part thereof including masonry, steel, reinforced concrete, plain concrete, electrical facilities, and any other material or equipment shown or specified to be removed.

B. Basic Procedures and Schedule: Carry out demolition so that adjacent structures, which are to remain, are not endangered. Schedule the work so as not to interfere with the day to day operation of the existing facilities. Do not block doorways or passageways in existing facilities.

C. Additional Requirements: Provide dust control and make provisions for safety.

1.2 SUBMITTALS

A. Provide all submittals, including the following, as specified in Division 1.

B. Site Inspection: Visit the site and inspect all existing structures. Observe and record any defects which may exist in buildings or structures adjacent to but not directly affected by the demolition work. Provide the OWNER with a copy of this inspection record and obtain the (ENGINEER's) (OWNER's) approval prior to commencing the demolition.

1.3 QUALITY ASSURANCE

A. Limits: Exercise care to break concrete sufficiently for removal in reasonably small masses. Where only parts of a structure are to be removed, cut the concrete along limiting lines with a suitable saw so that damage to the remaining structure is held to a minimum.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION OF EXISTING DRAWINGS

A. Drawings of existing structures and equipment will be available for inspection at the office of the (ENGINEER) (OWNER).

3.2 PROTECTION

A. General Safety: Provide warning signs, protective barriers, and warning lights as necessary adjacent to the work as approved or required. Maintain these items during the demolition period.

B. Existing Services: Undertake no demolition work until all mechanical and electrical services affected by the work have been properly disconnected. Cap, reroute or reconnect interconnecting piping or electrical services that are to remain in service either permanently or temporarily in a manner that will not interfere with the operation of the remaining facilities.

C. Hazards: Perform testing and air purging where the presence of hazardous chemicals, gases, flammable materials or other dangerous substances is apparent or suspected, and eliminate the hazard before demolition is started.

3.3 DEMOLITION REQUIREMENTS

A. Explosives: The use of explosives will not be permitted.

B. Protection: Carefully protect all mechanical and electrical equipment against dust and debris.

C. Removal: Remove all debris from the structures during demolition and do not allow debris to accumulate in piles.

D. Access: Provide safe access to and egress from all working areas at all times with adequate protection from falling material.

E. Protection: Provide adequate scaffolding, shoring, bracing railings, toe boards and protective covering during demolition to protect personnel and equipment against injury or damage. Cover floor openings not used for material drops with material substantial enough to support any loads placed on it. Properly secure the covers to prevent accidental movement.

F. Lighting: Provide adequate lighting at all times during demolition.

G. Closed Areas: Close areas below demolition work to anyone while removal is in progress.

H. Material Drops: Do not drop any material to any point lying outside the exterior walls of the structure unless the area is effectively protected.

I. No burning or fires will be permitted.

3.4 DISPOSAL OF MATERIALS

A. Final Removal: Remove all debris, rubbish, scrap pieces, equipment, and materials resulting from the demolition unless otherwise indicated. Take title to all demolished materials and remove such items from the site.

B. OWNER's Property: In addition to any items which may be shown, the following items remain the property of the OWNER. Remove carefully, without damage, all items listed or shown, and stockpile as directed.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Comply with all requirements of the Contract, including Drawings, General Provisions, Special Provisions and Division 01 Specification Sections.

B. Code references

1. Florida Building Code (FBC) 2020 Edition.
2. ACI 301, "Structural Concrete for Buildings."
3. ACI 318, "Building Code Requirements for Reinforced Concrete."
4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Minor equipment pads and pipe encasements.
2. Structural Concrete – All other concrete.

B. Related Sections:

1. Division 31 - Earthwork
2. Division 07 – Thermal and Moisture Protection
3. Division 09 – Finishes

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submittals:

1. Design Mixtures: Submit concrete mixture proportions, characteristics and location for use for each concrete mixture. Submittal shall include documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength and shall consist of field strength records (field test data) or trial mixtures in accordance with ACI 301, 4.2.3.4.a or 4.2.3.4.b, respectively. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
2. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Engineer.

F. Samples: None.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.

7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semi rigid joint filler.
12. Joint-filler strips.
13. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 318, "Building Code Requirements for Reinforced Concrete."
4. ACI 350, "Environmental Engineering Concrete Structures."
5. ACI 305, "Hot Weather Concreting."
6. ACI 306, "Cold Weather Concreting."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: None.

I. Pre-installation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement, if applicable.

B. Waterstops: Store water stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties for liquid containment structures that have an integral water stop that is tightly welded to the tie.
4. Furnish ties for exposed concrete that are the cone-washer type. The cones shall be made of approved wood or plastic. Common wire will not be allowed for form ties

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy-Steel Reinforcing Bars: None.

D. Galvanized Reinforcing Bars: None.

E. Epoxy-Coated Reinforcing Bars: None.

F. Stainless-Steel Reinforcing Bars: None.

G. Steel Bar Mats: None.

H. Plain-Steel Wire: ASTM A 82/A 82M. None.

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Epoxy-Coated Wire: None.

K. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

L. Deformed-Steel Welded Wire Reinforcement: None.

M. Galvanized-Steel Welded Wire Reinforcement: None.

N. Epoxy-Coated Welded Wire Reinforcement: None.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel deformed bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type II, gray, no substituted are allowed. Cement replacement by weight can be up 20% of the total weight, replace with Fly Ash and/or Slag.

a. Fly Ash: ASTM C 618, Class F.
b. Slag: ASTM 989, Grade 120

B. Normal-Weight Aggregates: ASTM C 33, Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. Use Clean, sharp, natural silica sand free of loam, clay, lumps, and other deleterious substances. Dune sand, bank run sand, and manufactured sand are not acceptable.

2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter. Coarse aggregate shall comply with the following:

a. Crushed stone, processed from natural rock or stone.
b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank-run gravel are not allowed.
c. Coarse Aggregate Size: ASTM C33/C33M, No. 57 stone, unless otherwise approved by ENGINEER.

B. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BoMetals, Inc.
b. Greenstreak.
c. Vinylex Corp.
2. Profile: Ribbed with center bulb.
3. Dimensions: 6 inches by 3/8 inch thick or 9 inches by 3/8 inch thick; nontapered.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
b. Greenstreak; Hydrotite.
c. Vinylex Corp.; Swellseal.
d. Sika; Sika Swell S-2.

C. Self-sealing, non-swelling preformed joint sealant Waterstop: Shall provide a lasting, watertight bond on both fresh and cured concrete surfaces.

1. Products: Henry Company; Synko-Flex Waterstop.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class C. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fortifiber Building Systems Group; Moistop Plus.
b. Raven Industries Inc.; Vapor Block 6.
c. Reef Industries, Inc.; Griffolyn Type-65 or Type-85.
d. Stego Industries, LLC; Stego Wrap, 10 mil Class C.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.8 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. ChemMasters; Chemisil Plus.
    b. ChemTec Int'l; ChemTec One.
    c. Conspec by Dayton Superior; Intraseal.
    d. Curecrete Distribution Inc.; Ashford Formula.
    e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
    f. Edoco by Dayton Superior; Titan Hard.
    g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.

C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Advanced Floor Products; Retro-Plate 99.
    b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
    c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.9 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Allowed for non-liquid containment structures.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. BASF Construction Chemicals - Building Systems; Kure 200.
    b. ChemMasters; Safe-Cure Clear.

c. Conspec by Dayton Superior; W.B. Resin Cure.
d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
e. Edoco by Dayton Superior; Res X Cure WB.
f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
g. L&M Construction Chemicals, Inc.; L&M Cure R.
h. Meadows, W. R., Inc.; 1100-CLEAR.
i. SpecChem, LLC; Spec Rez Clear.
j. Symons by Dayton Superior; Resi-Chem Clear.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: Provide preformed expansion joint filler complying with ASTM D 1752, Type I (sponge rubber) or Type II (cork).

B. Semi rigid Joint Filler: Two-component, semi rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022 thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Reference Section 1.04.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash and/or slag as needed to reduce the total amount of Portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash only: 20 percent by weight.
2. Slag only: 20 percent by weight.
3. Fly Ash + Slag: 20 percent by weight.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: If required by Architectural contract drawings, add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.13 CONCRETE MIXTURES

A. Minor equipment pads and pipe encasements:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Concrete mixture proportions in accordance with accepted design mixes. Reference Section 1.04.

B. Structural Concrete:

1. Minimum Compressive Strength: Reference Design Criteria Sheet S-02.
2. Concrete mixture proportions in accordance with accepted design mixes. Reference Section 1.04.
3. Concrete mixes at exterior walls, foundations that are subjected to hydrostatic pressures and water bearing walls and slabs at containment structures shall have Xypex Admin C-500 Red Admixture with Red Oxide pigment for confirmation. Dosage rate shall meet the manufacturer’s recommendation of 1% to 1.5% by weight of cement

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturers recommended tape.

B. Bituminous Vapor Retarders: if applicable.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 90 01 " Sealants and Caulking," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in water stops according to manufacturer's written instructions.

C. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary

to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
    c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
    d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
4. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
5. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 12-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the

manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

   1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and

other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel

reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: ~~Owner~~ Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.
8. Water levels for hydraulic structures.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds

specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer, but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 05 50 01

GALVANIZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: All galvanizing of metals when such coating is specified, except as otherwise shown, specified or required.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 123 - Specification for Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A 153 - Specification for Zinc Coating (Hot-Dip) On Iron and Steel Hardware
3. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
4. ASTM A 385 - Practice for Providing High-Quality Zinc-Coatings (Hot-Dip)
5. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric
6. ASTM A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
7. ASTM A 121 - Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
8. ASTM A 143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
9. ASTM A 384 - Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanization of Steel Assemblies
10. ASTM B 6 - Specification for Zinc (Slab Zinc)
11. MIL-P-21035B - Paint High Zinc Dust Content, Galvanizing Repair
12. MIL-P-26915C - Primer Coating Zinc Dust Pigmented for Steel Surfaces

PART 2 PRODUCTS

2.1 MATERIALS

A. Standard: Meet the requirements of ASTM B 6 and "Prime Western" grade, or equal, for zinc for galvanizing, zinc coating or plating.

PART 3 EXECUTION

3.1 PREPARATION

A. General: Blast clean or grind smooth wrought metals and castings. Tumble and grind flush all high spots when a smooth coat is required for castings. Normalize castings to prevent cracking.

B. Base Metal Cleaning: Thoroughly clean base metal. Remove all welding slag and burrs. Remove surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation, by blast cleaning, by immersion in a caustic bath, acid pickle and flux or other approved method.

C. Product Preparation: Fabricate structural steel products and assemblies to be galvanized in accordance with ASTM A 143, A 384, A385 and Class I guidelines as shown in "Recommended Details of Galvanized Structures" as published by American Hot-Dip Galvanizers Association, Inc.

3.2 APPLICATION

A. Hot Dip: Use the hot-dip process for galvanizing as required by the appropriate ASTM and American Hot-Dip Galvanizers Association, Inc. specifications.

1. Do not allow the dipping to come in contact with or rest upon the dross during the operation.

2. Do not use procedures tending to agitate the dross.

B. Required Facilities: Perform the galvanizing and coating in a plant having the required facilities to produce the quality of coatings specified and with ample capacity for the volume of work required. Handle and ship galvanized material in a manner which will avoid damage to the zinc coating.

C. Requirements: Perform galvanizing in accordance with the requirements of the following specifications:

	Item	ASTM
1.	Iron and steel products	A 123
2.	Iron and steel hardware	A 153
3.	Chain for chainwheel operators	A 153
4.	Chainwheels and Guides	A 123
5.	Steel sheets	A 924
6.	Assembled products	A 385 & A 123
7.	Steel chain link fence fabric	A 392 Class II
8.	Steel pipe	A 53
9.	Steel barbed wire	A 121

3.3 INSTALLATION

A. Field Coating for Touch-Up: Coat all field welds, abraided areas where damage is more than 3/16-inch wide or uncoated cut edges in material more than 1/10-inch thick with an organic zinc-rich paint complying with MIL-P-21035B or MIL-P-26915C in multiple coats to dry film thickness of 8 mils.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 07 90 01

WATERPROOFING, DAMPPROOFING AND CAULKING

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all materials, labor, equipment, and incidentals required to perform all through wall flashing work, waterproofing, dampproofing, caulking, and related work necessary for the proper completion of the project as required by the Drawings and as specified herein.

B. Dampproof the exterior surfaces of all exterior poured- in-place concrete walls or concrete masonry foundation walls from the top of the footings up to 6 inches below finished grade.

1.2 APPLICABLE SCHEDULE

A. Deliver all materials in original manufacturer's packages with labels and seals intact. Handle and store in accordance with manufacturer's instructions.

B. Inspect job conditions for defects which would prevent proper installation of caulking. Do not proceed until defects have been corrected.

C. Caulk all exterior wall joints between metal wall panels and adjacent materials, between frames in openings and adjacent materials, between masonry and cast-in-place concrete, brick paver expansion and control joints and all other joints shown on the Drawings or required for the completion of the Work.

D. Caulk all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, expansion and control joints in ceramic tile and brick pavers, exterior window and door frames, louvers, and all other joints shown on the drawings or required for the completion of the Work.

E. Joints noted as "caulk", "caulking", or "sealant" shall be caulked with the sealant specified herein.

F. Furnish and place through wall flashing in exterior masonry walls as shown on the Drawings.

G. Furnish and place vapor barrier under all building structure slabs contacting soil as specified herein.

1.3 SUBMITTALS

A. Submit two representative samples of any or all other proposed materials and

installation method required for the work of this Section as requested by the County.

PART 2 PRODUCTS

2.1 DAMPPROOFING

A. Dampproofing shall be Bitumastic Black Solution by the Koppers Company, Inc., Dehydrating 4 by W.R. Grace and Co., or equal.

2.2 CAULKING

A. Caulking Compound: One component, synthetic rubber base sealant, soft curing, nonstaining, conforming to F.S. TT-S-00230 and Thiocol's Building Trade Performance Specifications for Type 1 Class B sealants. Colors shall match material receiving caulking, as directed by the County.

B. Interior Silicone Sealant: F.S. TT-001543 for perimeter of plumbing fixtures against walls and floors and joints between laminated plastic counters and walls shall be transparent.

C. Primer: As recommended by caulking compound manufacturer.

D. Back-up Material: Closed cell foam polyethylene, or similar nonbituminous material as recommended by manufacturer of caulking compound and completely compatible with selected compound.

2.3 HYDRAULIC CEMENT

A. Material for quick-set hydraulic cement shall be Waterplug as manufactured by Thoro System Products, or equal.

2.4 VAPOR BARRIER

A. Vapor barrier shall be 10 mil thick polyethylene sheet with a vapor transmission rating of 0.20 perms. Laps between adjacent sheets shall be 10 inches minimum. Vapor barrier shall be carefully inspected by the County prior to concrete placement. Additional polyethylene sheet required for repair or replacement of damaged vapor barrier shall be furnished and installed by the Contractor as directed by the County at no additional cost to the County.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation of Dampproofing

1. Surface to be treated shall be free from oil and dirt and shall be in the proper condition as indicated by the manufacturer prior to the application of the dampproofing material. The concrete shall have been completely cured and the surface shall be dry and free from frost at the time of application.
2. Surfaces to be dampproofed shall receive two (2) heavy coats 10 mils thick, the first coat being carefully applied so that "holidays" or untreated air-bubble depressions in the surface shall be completely filled and the second coat will guarantee a 100% coating of the surface.
3. Particular care shall be given to the application of dampproofing at all construction joints which are encountered.
4. The number of coats specified is in addition to primer coats as recommended by the manufacturer.

B. Installation of Caulking

1. Surface Preparation: Clean metal surfaces free of grease, oil, wax, lacquer, and other foreign residue by wiping with a clean cloth moistened with a suitable solvent. Scrape or brush masonry surfaces clean. Apply appropriate primer to contact surfaces.
2. Joint Preparation: Joints to be caulked having a depth in excess of 3/8-inch shall be packed with back-up material. Round back-up material shall be sized to require 20 percent to 5 percent compression upon insertion. In joints not of sufficient depth to allow packing, install polyethylene bond-breaking tape at back of joint. Avoid lengthwise stretching of back-up material. Cut all corners, avoid wrapping around corners.
3. Application: Apply compound with pressure flow gun with nozzle of proper size and shape to suit width of joint, promptly after mixing and with sufficient pressure to fill joint. Apply as a continuous operation horizontally in one direction and vertically from bottom to top, except joints having excessive widths where compound might sag, the joints shall be built up with excessive beads. Finish joints smooth and slightly covered.
4. Cleaning: Immediately clean adjacent material which may be soiled by caulking operation.

C. Installation of Quick-Set Hydraulic Cement

1. The surface shall be cleaned and free of dirt, loose mortar particles, paints, films, protective coatings, efflorescence, laitance, form treatments, curing compounds, and other materials.
2. Cut out crack at least 3/4 inches wide and deep, cutting back into wall slightly. Flush away all cuttings and dirt. Force water-plug into prepared crack with a round tool and smooth out. Form cove at junction.
3. To be applied under manufacturer's recommendations.

END OF SECTION

SECTION 07 90 02
JOINT SEALANTS

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are reread to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM) Publications: C 920-79 Elastomeric Joint Sealants

1.2 SUBMITTALS

A. Division 01 – General Requirements

B. Certificates of Conformance or Compliance: Submit certificates from the manufacturers attesting that materials meet the specified requirements.

C. Manufacturer's Descriptive Data: Submit complete descriptive data for each type of material. Clearly mark data to indicate the type the Contractor intends to provide. Data shall state conformance to specified requirements. Data for sealant and calking shall include application instructions, shelf life, mixing instructions for multicomponent sealants, and recommend cleaning solvents.

1.3 DELIVERY AND STORAGE

A. Deliver materials to the job site in the manufacturers' external shipping containers, unopened, with brand names, date of manufacture, and material designation clearly marked thereon. Containers of elastomeric sealant shall be labeled as to type, class, grade, and use. Carefully handle and store all materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degree F or less than 40 degree F.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Subject to compliance with requirements provide products manufactured by single source. Acceptable manufacturers include Tremco, or approved equal.

2.2 MATERIALS

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience. Products shall conform to the reference documents listed for each use. Color of sealant and calking shall match adjacent surface color unless specified otherwise. For ASTM C 920 sealants, use a sealant that has been tested on the type(s) of substrate to which it will be applied.

B. Interior Calking or Sealant: Provide ASTM C 920, Type M, Grade NS, Class 12.5, Use NT. Color of caulking or sealant shall be selected by Owner from manufacturer's full range.

C. Exterior Sealant: For joints in vertical surfaces, provide ASTM C 920, Type M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type M, Grade P, Class 25, Use T. Color of sealant shall be selected by Owner from manufacturer's full range.

D. Latex rubber modified, acrylic emulsion polymer sealant compound; manufacturer's standard, one part, nonsag, mildew resistant, acrylic emulsion sealant complying with ASTM C834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent

E. Floor Joints Sealant: Provide ASTM C-920, Type S or M, Grade P, Class 25, Use T. Color of sealant shall be selected by Owner from manufacturer's standard colors.

F. Primer for Sealant: Use a non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

G. Bond Breakers: Use the type of consistency recommended by the sealant manufacturer for the particular application.

H. Silicone Joint Sealants: Use Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT

I. Backstops: Use glass fiber roping or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by the sealant manufacturer. Backstop material shall be compatible with the sealant. Do not use oakum and other types of absorptive materials as backstops.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Surfaces shall be clean, dry to the touch, and free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Where adequate grooves have not been provided, clean out grooves to a depth of ½" and grind to a minimum width of ¼" without damage to the adjoining work. No grinding shall be required on metal surfaces.

B. Steel Surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a solvent that leaves no residue.

C. Copper or Bronze Surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. Use non-staining solvents recommended by the item manufacturer.

3.2 SEALANT PREPARATION

A. Do not modify the sealant by addition of liquids, solvents, or powders. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.3 APPLICATION

A. Backstops: Where joint cavities are constructed deeper than indicated, tightly pack the back or bottom with backstop material to provide a joint of the depth indicated. Install backstops dry and free of tears or holes.

B. Primer: Just prior to application of the sealant or calking compound, clean out all loose particles from joints. Apply primer in accordance with compound manufacturer's directions. Do not apply primer to exposed finish surfaces.

C. Bond Breaker: Provide bond breakers as recommended by the sealant manufacturer for each type of joint and sealant used.

D. Sealant and Caulking Compounds: Use a compound that is compatible with the material to and against which it is applied. Do not use a compound that has exceeded its shelf life or has become too jelled to be discharged in a continuous flow from the gun. Apply the compound in accordance with the

manufacturer's printed instructions. Force the compound into the joints with sufficient pressure to fill the joints solidly. Compound shall be uniformly smooth and free from wrinkles.

E. Interior Sealant and Caulking: Provide sealant or caulking at all exposed joints in the building and at all joints indicated to receive sealant or caulking.

F. Exterior Sealant: Provide sealant at all joints around the perimeter of openings and at all exposed joints on the building and at all joints indicated to receive sealant.

G. Floor Joints Sealants: Provide sealant in all control joints and in other floor joints indicated or specified.

H. Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated

3.4 PROTECTION AND CLEANING

A. Protection: Protect areas adjacent to joints from compound smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

B. Cleaning: Immediately scrape off fresh compound that has been smeared on masonry and rub clean with a solvent as recommended by the compound manufacturer. Upon completion of compound application, remove all remaining smears and stains resulting therefrom and leave the work in a clean and neat condition.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 INTENT

A. The intent of this Specifications is to provide the material and workmanship necessary to produce complete protection of the surfaces to be coated for Lee County Utilities. This includes all surface preparation, pre-treatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, clean-up, and appurtenant work, all in accordance with the requirements of the Contract Documents. Throughout this specification “ENGINEER” refers to the Lee County Utilities Project Manager or Contract Manager. And “OWNER” refers to Lee County Utilities.

1.2 PURPOSE

A. The purpose of this Specification is to generally outline the work contemplated for the painting and protective coating work performed for Lee County Utilities, including Contract Operations, Capital Improvement Projects, and Developer Contributed Assets as defined under Scope below; together with the General Conditions, Special Provisions and all other Technical Specifications included herewith. All paints and materials used on interior tank or treatment unit surfaces shall conform to AWWA and/or Florida Department of Environmental Protection (FDEP) regulations as they may apply to potable water or wastewater service. The manufacturer furnishing the coating material may be required to furnish certification to the ENGINEER/OWNER that the materials meet these provisions.

1.3 DESCRIPTION

A. The extent of painting work is shown on the project drawings, contracts and schedules, and as specified herein.

B. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as otherwise specified or shown on the drawings.

1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.

C. The work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, tanks, vessels, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise indicated.

D. Paint all exposed surfaces normally painted in the execution of a building project whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, or are not specifically excluded from the painting work, paint these the same as adjacent similar materials or areas. If color or finish is not designated, the OWNER will select these from standard colors available for the materials systems specified.

1.4 PAINTING NOT INCLUDED

A. The following categories of work are not included as part of the field-applied finish work, unless otherwise noted on the drawings or in the Contract Documents.

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, metal fabrications, hollow metal work, and similar items. Also, for fabricated components such as shop-fabricated or factory-built mechanical and electrical equipment or accessories.

2. Pre-Finished Items: Unless otherwise shown or specified, do not include painting when factory-finishing or installer finishing is specified for such items as, but not limited to, finished electrical equipment including light fixtures, switchgear and distribution cabinets.

3. Concealed Surfaces: Unless otherwise shown or specified, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas. Painting of galvanized work that will be concealed in the completed work is not required. Do not paint structural steel to be encased in concrete, nor structural steel specified not to be painted under Division 5. Except for touch-up as specified in Part 3, painting of shop primed structural steel and ferrous metals that will be concealed in the completed work is not required.

4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plating, copper, bronze and similar finished materials will not require finish painting, unless otherwise specified.

5. Operating and Machined Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, machined surfaces, grease fittings, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise specified.

a. Do not paint over any code-requiring labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

6. Other Surfaces: Do not apply to glass, manhole frames and covers, aluminum platform gratings, stair treads, door thresholds, concrete wearing surfaces, or other walking surfaces unless otherwise specified.

1.5 CODES, STANDARDS AND REGULATIONS

A. The work herein specified shall be performed in a legally acceptable manner, and it shall be the responsibility of the CONTRACTOR to obtain any and all licenses, permits, and legal approvals required to perform the work specified.

B. All material and work covered by this specification shall comply with all currently approved or accepted provisions of applicable codes and standards published by the following organizations:

ANSI - American National Standards Institute
11 West 42nd
New York, NY 10036
212-642-4900

API - American Petroleum Institute
1220 L Street N.W.
Washington, DC 20005
202-682-8000

ASTM - American Society for Testing and Materials
100 Barr Harbor Dr.
West Conshohocken, PA. 19428
610-832-9500

AWS - American Welding Society
550 N.W. LeJeune Rd.
Miami, FL 33126
305-443-9353

AWWA - American Water Works Association
6666 West Quincy Avenue
Denver, CO. 80235
303-794-7711

FM - Factory Mutual Research
1151 Boston-Providence Turnpike
Norwood, MA 02062
617-762-4300

NACE - National Association of Corrosion Engineers
PO Box 218340
Houston, TX 77218
1440 South Creek Dr.
Houston, TX. 77084-4906
713-492-0535

NEMA - National Electrical Manufacturer's Association
2101 L Street N.W. Ste. 300
Washington DC 20037
202-457-8400

NFPA - National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269-9101
617-770-3000

OSHA - Occupational Safety and Health Act
U.S. Department of Labor
Occupational Safety & Health Administration
8040 Peters Rd. Bldg. H-100
Fort Lauderdale, FL 33324
954-424-0242

SAE - Society of Automotive Engineers
400 Commonwealth Dr.
Warrendale PA. 15096-0001
412-776-4841

SSPC - Steel Structures Painting Council
40 24th Street
Pittsburgh, PA 15222
412-281-2331

SSPWC - Standard Specifications for Public Works Construction
Building News, Inc.
3055 Overland Avenue
Los Angeles, CA 90034
310-202-7775

UBC - Uniform Building Code
Published by ICBO

UL - Underwriters Laboratories Inc.
333Psingsten Rd.
Northbrook IL. 67062
312-273-4255

C. The CONTRACTOR shall comply with all applicable Federal, state, and local laws and ordinances.

1.6 ACCEPTABLE COATING MANUFACTURERS

A. Material manufacturers specified herein represent the standard of quality for the industrial coating systems approved by the ENGINEER. For proposed substitutes, it is the responsibility of the CONTRACTOR to furnish satisfactory documentation from the manufacturer of the proposed substitute or “or-equal” product that the material meets the specified requirements and is equivalent or better than the listed materials in the following properties:

1. Quality
2. Durability
3. Resistance to abrasion and physical damage
4. Life expectancy
5. Ability to recoat in future
6. Solids content by volume
7. Dry film thickness per coat
8. Compatibility with other coatings
9. Suitability for the intended service and environment
10. Resistance to chemical attack
11. Temperature limitations in service and during application
12. Type and quality of recommended undercoats and topcoats
13. Ease of application
14. Ease of repairing damaged areas
15. Stability of colors

B. The cost of all testing and analyzing of any proposed substitute materials that may be required by the ENGINEER, shall be paid by the CONTRACTOR. If the proposed substitution requires changes in the contract work, the CONTRACTOR shall bear all such costs involved and the costs of allied trades affected by the substitution. These

substitutions for other manufacturers must be made and approved prior to the bid date opening.

1.7 SUBMITTALS

A. Coating Materials List: The CONTRACTOR shall provide six (6) copies of a coating materials list which indicates the manufacturer and the coating number, keyed to the coating schedule herein, for approval of the ENGINEER. The submittals shall be made sufficiently in advance of the coating operations to allow ample time for checking, correcting, resubmitting and rechecking.

B. Paint Manufacturer's Information: For each paint system to be used, the CONTRACTOR shall submit the following listed data prior to beginning painting operations.

1. Paint manufacturer's data sheet for each product used.

2. Technical and performance information that demonstrates compliance with the system performance and material requirements.

3. Paint manufacturer's instructions and recommendations on surface preparation and application.

4. Colors available for each product (where applicable).

5. Compatibility of shop and field applied coatings (where applicable).

6. Material safety data sheet for each product used.

C. Samples and Manufacturer's Certificate: Provide all submittals, including the following, as specified in Division 1.

1. Submit manufacturer's standard color chart for color selection.

2. 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.

3. Where equipment is customarily shipped with a standard finish, submit samples of the proposed color and finish for approval prior to shipping.

4. Furnish affidavits from the manufacturer certifying that materials furnished conform to the requirements specified and that paint products have been checked for compatibility.

5. Submit a supplementary schedule of paint products with mil thickness, and solids by volume, including all paint applied in the shop and in the field.

Provide a schedule that is in accordance with the recommendations of the paint manufacturer.

6. Furnish affidavits from the manufacturer certifying that coatings in immersion service contain no water-soluble solvents or corrosion inhibitive (active) pigments with slight water solubility.

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.

1.8 DELIVERY AND STORAGE

A. Deliver all coating materials to the job site in original, new and unbroken, sealed packages and containers bearing manufacturer's name and label, and the following information, all of which shall be plainly legible at the time of use:

1. Name or title of material.

2. Fed. Spec. number, if applicable.

3. Manufacturer's stock number and date of manufacturer.

4. Manufacturer's formula or specification number.

5. Manufacturer's batch number.

6. Manufacturer's name.

7. Contents by volume, for major pigment and vehicle constituents.

8. Thinning instructions.

9. Application instructions.

10. Color name and number.

11. Expiration date.

B. Store paint materials and painting tools and equipment, including solvents and cleaning materials, in a well ventilated, dry area and away from high heat. Do not store in building or structure being painted, nor leave overnight therein. Follow manufacturer's recommendations for the safe storage of paints and solvents. CONTRACTOR shall store materials in compliance with all local, state, and federal regulations.

1.9 QUALITY ASSURANCE

A. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve the CONTRACTOR of his responsibility to perform the work in accordance with these Specifications.

B. Inspection Devices: The CONTRACTOR shall furnish, until final acceptance of the work, inspection devices in good working condition for the detection of holidays, measurement of surface profile, and measurement of dry film thicknesses of the protective coatings. Surface preparation comparison visual standards, profile and dry film thickness devices shall be made available for the ENGINEER's use at all times while coating is being done. The CONTRACTOR shall provide 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.

1.10 MANUFACTURER'S REPRESENTATIVE

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support and as may be necessary to resolve field problems attributable or associated with the manufacturer's products furnished under this contract or the application thereof.

1.11 SAFETY AND HEALTH REQUIREMENTS

A. General: The CONTRACTOR shall provide and require use of personal protective and safety equipment for persons working in or about the project site, in accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR 1910, 1915, and 1926) its revisions, and all other applicable regulations. The CONTRACTOR shall also comply with the coating manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets in the handling of potentially hazardous or harmful materials.

B. Head and Face Protection and Respiratory Devices: The CONTRACTOR shall require all persons to wear protective helmets while in the vicinity of the work. In additions, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying, half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion proof. Forced air ventilation shall be provided to reduce the concentration of air contaminants to the degree such that a hazard does not exist and to assist in the proper curing of coatings applied in a confined area. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels permitted under OSHA regulations, the CONTRACTOR shall provide and require the use of approved hearing protection devices.

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

F. Temporary Access: All temporary ladders and scaffolding shall conform to applicable safety requirements. Scaffolding shall be erected where requested by the ENGINEER to facilitate inspection and shall be moved by the CONTRACTOR to locations as requested by the ENGINEER.

G. Cloths and cotton waste that might constitute a fire hazard shall be placed in fire resistant closed metal containers until removed from the project site or destroyed at the end of each workday.

1.12 WARRANTY

A. All work covered under the Contract shall be guaranteed against defective workmanship and materials for a period of one (1) year after completion and acceptance of the work. A first anniversary inspection will be scheduled by the CONTRACTOR during the eleventh (11th) month following acceptance of the work. A report shall be furnished to the OWNER describing the condition of the paint system and other work covered under the Contract. Tank draining shall be coordinated with the OWNER. Any latent defects found during this inspection shall be promptly repaired by the CONTRACTOR at no additional cost to the OWNER. Any location where coats of paint have peeled off, bubbled or cracked, and any location where rusting is evident, shall be considered a failure of the paint system. The CONTRACTOR shall make repairs at all points where failures are observed by removing the deteriorated coating, cleaning the surfaces and recoating with the same paint system. Any such repair work shall be completed by the CONTRACTOR within thirty (30) days after written notice of such defects unless otherwise negotiated.

B. Failure on the part of the CONTRACTOR to schedule this warranty inspection will not relieve him of warranty responsibility and any defects found by the OWNER after the normal warranty period will be assumed to have occurred during the one (1) year while the warranty was in effect.

PART 2 PRODUCTS AND COATING SYSTEMS

2.1 GENERAL

A. Definitions: The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pre-treatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

B. 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.

C. 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.

D. 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, subject to the approval of the ENGINEER, a barrier coat shall be applied between all existing prime coats and subsequent field coats to insure compatibility.

E. 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.

F. Substitute or "Or-Equal" Products

1. 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 COLORS AND FINISHES

A. All colors and shades of colors for all coats of paint shall be as selected or specified. Paint colors, surface treatment, gloss, and finishes, are indicated or specified in the "schedules" of the contract documents. Color and gloss not indicated or specified will be selected by the OWNER.

B. Each coat shall be of a slightly different shade, as directed by the ENGINEER, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples or shall be customer mixed to match color samples furnished by the ENGINEER. Final acceptance of colors will be from samples applied on the job.

C. Color Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.

D. Paint Coordination: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Furnish information to manufacturers, fabricators, suppliers and others where necessary on the characteristics of the finish materials to be used, to ensure compatible prime coats of use. Provide barrier coats over incompatible primers or remove and re-prime as required.

E. Color Coding: All exposed piping in structures, aboveground or in pipe trenches, shall be color code painted in strict accordance with the color code chart presented in Paragraph 3-15 of this section. All colors shall be as specified or as selected by the OWNER.

2.3 UNDERCOATS AND THINNERS

A. Undercoats: Provide undercoat paint produced by the same manufacturer as the finish coats.

B. Thinners: Use only thinners approved by the paint manufacturer and use only within recommended limits.

2.4 INDUSTRIAL COATING SYSTEMS

A. The CONTRACTOR shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.

B. Protective Coating Materials: Products shall be standard coatings produced by recognized manufacturers regularly engaged in production of such materials for application on essentially identical facilities to those proposed in this project. Where requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than ten (10) successful applications of the proposed manufacturer's products, which have been proven over a three (3) year period of time, demonstrating compliance with this specification requirement.

C. EPOXY FLOOR COATINGS (Basis of Design – Tnemec)

1. System No. 290-1: Aliphatic Moisture Cured Urethane (Thin Film with Increased Chemical Resistance, UV Stability, and Durability)

This system will provide a durable, long-wearing coating that bonds tightly to concrete and stands up under heavy foot traffic, frequent cleaning, spillage of water, oil, grease, or chemical, and UV Exposure. It is recommended that the 2nd and 3rd coat are the same color.

Moisture vapor transmission should not exceed three lbs per 1,000 ft² in a 24-hour period. (Reference ASTM F 1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.") Relative humidity should not exceed 80%. (Reference ASTM F 2170 "Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes.")

Note: For moisture content up to 15 lbs per 1,000 ft² or relative humidity up to 90%, Series 208 should be substituted for Series 201 as the primer. See manufacturer's latest written recommendations for Series 208 coverage rates.

Surface Preparation: Allow new concrete to cure for 28 days.

Mechanically abrade in accordance with NACE No.6/SSPC-SP13 to provide a minimum ICRI-CSP3 or greater surface profile.

1st Coat: Series 201 Epoxoprime	6.0-12.0 mils
On Horizontal surfaces where a nonskid finish is desired, broadcast 30-50 mesh clean, dry silica sand into the wet 1st coat at a rate of 5 lbs per 150 square feet.	
2nd Coat: Series 237 Tneme-Glaze	8.0-16.0 mils
3rd Coat: Series 290, with 44-600 UV Blocker added	2.0-3.0 mils*
Total Dry Film Thickness:	16.0- 31.0 mils
Minimum Dry Film Thickness:	18.0 mils

D. System No. N140-2: Epoxy/Epoxy/Epoxy or Urethane (Standard DIP System) (Basis of Design – Tnemec)

This system provides exceptional corrosion protection in atmospheric, immersion, and buried environments. This system is to be applied to new pipes. The 3rd coat is dependent on the exposure – for buried areas use an extra coat of high-solids epoxy, for UV-exposed, non-immersion areas use an aliphatic acrylic urethane. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: **Steel** - SSPC-SP6/NACE No.3 Commercial Blast Cleaning with a minimum 1.5 mil angular anchor profile. **Ductile Iron Pipe** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-04: External Pipe Surface condition. **Cast Ductile Fittings** - Uniformly abrasive blast using angular abrasive to a NAPF 500-03-05: Fitting Blast Clean #3 condition.

NOTE: If NSF Std. 61 compliance is required, Series N69 may NOT be used. Instead, use Series N140.

Shop Primer: Series N140 Pota-Pox Plus	2.0 – 10.0 mils
2nd Coat: Series N140 or Series N69	4.0 - 10.0 mils
3rd Coat (Buried or Immersion Areas Only):	
Series N140 or Series N69	4.0 - 10.0 mils
3rd Coat (UV Exposed, Non-immersion Areas Only):	
Series 1095	2.5 - 5.0 mils
Total Dry Film Thickness:	10.0 – 30.0 mils
Minimum Dry Film Thickness:	11.0 mils

E. System No. 1095-5: Acrylic Polyurethane (PVC or HDPE Pipe) (Basis of Design – Tnemec)

This system provides a user friendly, low VOC, aliphatic acrylic polyurethane coating which offers excellent color and gloss retention. Series 1095 has a semi-gloss finish. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

Surface Preparation: SSPC-SP1 followed by hand or power sanding to thoroughly and uniformly scarify and de-gloss the surface.

1st Coat: Series 66 Hi-Build Epoxoline	2.0 – 3.0 mils
2nd Coat: Series 1095 EnduraShield	2.5 – 5.0 mils
Total Dry Film Thickness:	4.5 – 8.0 mils
Minimum Dry Film Thickness:	5.0 mils

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.

B. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 6 hours of on-Site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating WORK.

B. Coating shall be done in a workmanlike manner so as 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 by the use of 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 specified herein, 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 all other procedures relative to coating shall be strictly observed. No

substitutes or other deviations will be permitted without written permission of the ENGINEER. The CONTRACTOR shall supply the ENGINEER with copies of each manufacturer's instructions in accordance with the requirements of Paragraph 1-07, "SUBMITTALS".

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and mixing of paint or other coating materials shall be performed only in those areas designated by the ENGINEER.

3.4 PREPARATION FOR COATING

A. General: All surfaces to receive protective coatings shall be cleaned as specified herein prior to application of said coatings. The CONTRACTOR shall examine all surfaces to be coated and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Do not paint over dirt, rust, scale, oil, grease, moisture, scuffed surfaces or other foreign material or in conditions otherwise detrimental to the formation of a durable paint bond and film.

B. Protection of Surfaces Not to be Coated: Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations. All 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 all 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.

C. Protection of Adjacent Work and Areas: Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair to the satisfaction of the OWNER any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

D. Protection of Painted Surfaces: Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning 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

A. General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

1. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

2. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly painted surfaces. Remove mildew in accordance with the paint manufacturer's recommendations.

3.7 PRESSURE WASH CLEANING FOR REPAINTING EXISTING CONCRETE

A. The entire structure is to be pressure washed at 3,000 to 5,000 psi with a solution of 50% water and bleach to yield a mixture with a minimum concentration of 2-1/2% sodium hypochlorite.

B. The entire structure is to be completely rinsed by pressure washing at 3,000 to 5,000 psi with potable water.

3.8 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

A. Surface preparation shall not begin until at least 30 days after the concrete has been placed.

B. All efflorescence, chalk, dust, dirt, oil and grease shall be removed by Detergent Cleaning per SSPC-SP1 before abrasive blast cleaning.

C. Concrete, concrete block masonry surfaces, previously painted concrete and masonry and deteriorated concrete and masonry surfaces to be coated shall be abrasive blast cleaned to remove laitance, paint, deteriorated concrete, and roughen the entire surface equivalent to the surface of the No. 80 grit flint sandpaper. Concrete shall have a consistent, even texture (void free) and shall be patched where needed.

D. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

E. If acid etching is required by the coating application instructions, the treatment shall be made after sandblasting. After acid etching, rinse surfaces with clean water to neutralize the acid and test the pH. The pH shall be between 7.0 and 8.0.

F. Surfaces shall be clean and dry and as recommended by the coating manufacturer before coating is started.

G. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhors Model DB or approved equal.

3.9 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on all work.

B. Clean drop cloths shall be used. All damage to surfaces resulting from the work hereunder shall be leaned, repaired, and refinished to the complete satisfaction of the ENGINEER, at no cost to the OWNER.

C. All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to ensure that they have been thoroughly cleaned and that they receive an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, alligatoring, 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 to ensure that edges, corners, crevices, welds, and similar

areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other approved precautionary measures.

3.10 SHOP COATING REQUIREMENTS

A. All 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 specified or approved color. The methods, materials, application, equipment and all other details of shop painting shall comply with these Specifications. If the shop primer requires top- coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.

B. All items of equipment, or parts and surfaces of equipment which are submerged when in service, with the exception of pumps and valves shall have all surface preparation and coating work performed in the field.

C. The interior surfaces of steel water reservoirs shall have all surface preparation and coating work performed in the field.

D. 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, switch-gear or main control boards, submerged parts of the pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the specified quality in the field. Such equipment shall be shop primed and finish coated 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.

E. For certain small pieces of equipment, the manufacturer may have a standard coating system which 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.

F. 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 6 months before finish coating, or less time if recommended by the coating manufacturer.

G. Damage to shop-applied coatings shall be repaired in accordance with this section and the coating manufacturer's printed instructions prior to finish painting.

H. 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.

3.11 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1", (SSPC-A-1), Steel Structures Painting Council.

B. Cleaned surfaces and all coats shall be inspected prior to 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 painted in the same working day.

D. Coatings shall be prepared, mixed and applied in accordance with the manufacturer's instructions and recommendations, and these Specifications. If directions differ, the most stringent requirements shall be followed.

E. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

F. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the coating materials. Remove the film, and if necessary, strain the material before using.

G. 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. Use stripe (brushed or gloved) painting for these areas.

H. Finish coats, including touch-up and damage repair coats shall be applied in a manner which will present a uniform texture and color matched appearance.

I. Job Conditions: The following job conditions will be strictly enforced during the application of coatings for the project.

1. Apply water-base coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

2. Apply solvent-thinned coatings only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F and 95 degrees F unless otherwise permitted by the paint manufacturer's printed instructions.

3. Do not apply paint in dust or smoke laden atmosphere, high winds, rain, fog or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

4. Do not apply coatings when the temperature is less than 5 degrees F above the dewpoint. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Weather Bureau psychometric tables.

5. Do not apply coatings when the outside air temperature is expected to drop below 45 degrees F or less than 5 degrees F above the dewpoint, within 8 hours after application of the coating.

6. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

J. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust-free.

K. General Considerations:

1. Apply paint as specified and in accordance with the manufacturer's directions. Use brushes for applying first coat on wood and on metals other than steel and sheet metal and items fabricated from steel and sheet metal. For other coats on wood, metal and other substrates, use applicators and techniques best suited for the type of material being applied.

2. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Paint surfaces behind movable equipment the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment with prime coat only before final installation of equipment.

4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

5. Paint the back sides of removable or hinged covers to match the exposed surfaces.

6. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated or specified.

7. Sand lightly between each succeeding enamel coat.

8. Omit the field prime coat on shop-primed surfaces and touch up painted metal surfaces which are not to be finished painted and which will not be exposed to view in the completed work. Do not omit primer on metal surfaces specified to be finish coated or on metal surfaces that will be exposed to view in the completed work.

L. Scheduled Painting:

1. Apply the first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

M. Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as specified or, if not specified, as recommended by coating manufacturer.

N. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed in mechanical equipment rooms and in occupied spaces, and on the outside or exterior of buildings or structures:

1. Mechanical items to be painted include, but are not limited to, the following:

a. Piping, valves, pipe hangers, and supports.
b. Pumps
c. Tanks
d. Duct work, insulation
e. Motors, mechanical equipment, and supports
f. Accessory items

2. Electrical items to be painted include, but are not limited to, the following:

a. Conduit and fittings
b. Switchgear

O. Prime Coats: Apply a prime coat to material, equipment and surfaces which are required to be painted or finished, and which have not been prime coated by others. Clean and prime unprimed ferrous metals as soon as possible after delivery of the metals to the job site. Recoat primed and sealed surfaces where there is evidence of suction spots or /unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

P. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surfaces imperfections.

Q. Pigmented, Opaque Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

R. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.12 CURING OF COATINGS

A. The CONTRACTOR shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by these Specifications, whichever is the more stringent requirement, prior to placing the completed coating system into service.

B. Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures: Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During curing periods, continuously exhaust air from a manhole in the lowest shell ring or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which time the forced air ventilation system shall operate continuously. For additional requirements, refer to the specific written instructions of the manufacturer for the coating system being applied.

3.13 COLOR CODING

A. All exposed piping shall be color coded. After the finish coat has been applied, label each line with stenciled legends identifying the nature of the pipe contents and the direction of flow. This stenciled identification shall appear in one or more places in the line as deemed necessary by the ENGINEER. Stencil legends shall be white for all pipe except white color coded pipe, which shall have black legends. Labels shall occur a minimum of every 15 feet of straight piping and at all bends. Minimum stencil size shall be two-inch letters for 4-inch and larger diameter piping and one-inch letters for 2-inch to 3-1/2-inch diameter piping.

Piping 1-1/2-inch diameter and smaller shall be identified using plastic wrap-around pipe markers.

B. Items to be coded but not specifically mentioned shall be coated in a color selected by the ENGINEER or OWNER.

C. All paints/coatings used in potable water contact areas must have AWWA and EPA classification and approvals.

D. All requirements of the Occupational Safety and Health Act (OSHA) concerning color coding and safety markings shall be considered part of these Specifications unless specifically excluded.

E. Any paint/coating requirements/specifications not specifically addressed in the foregoing shall be decided upon as required by the ENGINEER.

F. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per General Industry Safety Orders, Article 112, OSHA Occupational Safety and Health Standards 29CFR1910.

3.14 CLEAN-UP AND PROTECTION

A. Clean Up: During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each workday. Upon completion of painting work, clean window glass and other paint-spattered surfaces located on site and off site. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work of other trades located on site and off site, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting.

1. Provide "Wet Paint" signs, as required, to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

2. At the completion of work of other trades, touch up and restore all damaged or defaced painted surfaces.

3.15 APPEARANCE AND INSPECTION

A. All painting shall be accomplished in a workmanlike manner and shall be free of unsightly sags, runs, bubbles, drips, waves, laps, alligatoring, unnecessary brush marks and overspray or other physical defects and shall be uniform in color.

B. The CONTRACTOR shall provide all rigging, scaffolding and other equipment necessary for a satisfactory inspection of a complete paint system and acceptance by the ENGINEER/OWNER.

C. Inspection shall be conducted by an inspector selected by the ENGINEER/OWNER in the presence of the OWNER's representative and the CONTRACTOR or his representative. Provisions for calibrated and functional test equipment is the responsibility of the CONTRACTOR.

D. The paint film shall be free of pinholes and holidays as determined by the use of an approved holiday detector as defined in Paragraph 1-09 of this Section.

E. The paint film shall be randomly checked for dry film thickness as stipulated in the "Coating System" sections of these specifications. Thicknesses shall be checked with a properly calibrated and approved magnetic gauge as defined in Paragraph 1-09 of this Section.

3.16 REPAIR OF DEFECTS IN PAINT

A. Any defects discovered during inspection, such as low film millage, holidays or pinholes, shall be repaired with the same materials as used for the original finish coat(s). Excessive low millage could require extra full coat(s) of paint.

B. A final inspection will be conducted by the ENGINEER/OWNER or his representative after any necessary repairs and prior to final acceptance of the job.

3.17 DISINFECTION OF POTABLE WATER STORAGE TANKS

A. Description: This paragraph specifies disinfection procedures for potable water storage tanks.

B. Quality Assurance: The following documents are a part of this section as specified and modified. In case of conflict between the requirements of this paragraph and those of the listed documents, the requirements of this paragraph shall prevail.

Reference	Title
AWWA D105, latest revision	Disinfection of Water Storage Facilities

C. Information to be Provided: Affidavit of Compliance as described in AWWA D105.

D. After the tank has been painted and the interior surfaces have thoroughly dried, the CONTRACTOR shall remove all visible dirt and contaminating materials. The interior of the tank shall be disinfected in accordance with Chlorination Method 2 of AWWA D105. The CONTRACTOR shall furnish all of the chlorine required.

E. The CONTRACTOR shall be responsible for obtaining proper disinfection as determined by bacteriological testing. Samples for bacterial analyses will be taken and analyzed by the OWNER. Two consecutive samples are required to pass the bacteriological tests for the tank to comply with these disinfection requirements.

F. Water for filling the tank after the initial disinfection will be provided by the OWNER. If bacteriological testing shows the presence of coliform bacteria, the tank shall be redisinfected. The CONTRACTOR shall pay the OWNER for water required to fill the tank after the first filling at currently approved General Service water rates for the OWNER.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 09 96 35

IET COATING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section provides details for furnishing and installing the Integrated Environmental Technologies (IET) coating system where shown on the drawings for protection of concrete structures against hydrogen sulfide corrosion. Coating materials shall be as manufactured by Integrated Environmental Technologies. Installation shall be performed by workers experienced in the application of the coating to be used.

1. The existing wetwell coating system at MPS 6600 is Integrated Environmental Technologies.

PART 2 PRODUCTS

2.1 IET COATING SYSTEM

A. The IET Coating System shall be as distributed by Integrated Environmental Technologies, Santa Barbara, CA.

B. Polymorphic Resin shall be a 100% solids, two-component, highly modified polyester resin system, exhibiting no adhesion-interfering shrinkage upon curing. Resin shall cure rapidly within fifteen minutes to one hour without the use of heat or cooling at surface temperatures ranging from –30 degrees Fahrenheit to over +150 degrees. Excellent resistance to a broad range of corrosive chemicals, including sulfuric acid created by hydrogen sulfide gas as well as other chemicals typically found in sanitary sewers, and impact and abrasion attack shall be provided.

PART 3 EXECUTION

3.1 IET COATING

A. All pipes in service shall be plugged or bypassed before any work is started on the structure. No debris is to be flushed down the line.

B. Anyone entering the structure must conform to all OSHA requirements for “Confined Space Entry” equipment and permitting.

C. Surface preparation shall meet the requirements of IET Systems Data Sheets on Concrete Preparation and interior surfaces of manhole shall be sound, porous, dry, and free of dust, dirt, oil, grease and other contaminants prior to application of lining.

D. Interior surface of structure must be pressure washed at 5,000 psi and must be abrasive-blasted with an approved abrasive material (see LCU Approved Materials List) to remove all loose patching, old coatings and any contamination in the concrete. No silica sand shall be used.

1. "New" structures shall be abrasive-blasted to remove all oils and patch mud and to open pin holes and expose aggregate.

2. "Rehab" structures shall be abrasive-blasted to remove all loose patching, old coatings, and any contamination that penetrated the concrete. The finished interior of the structure shall be gray. The exposed invert/floor shall also be coated. Where there is severe deterioration of the mortar, place new concrete to match the original interior dimensions after abrasive-blasting and removal of all loose material and by-products of corrosion. Restore invert/floor to the original elevation.

3. Vacuum to remove all abrasives and debris.

E. Repair all leaks by injecting grout using an approved grout (see LCU Approved Materials List). Hydraulic cement shall not be used to stop any water leaks.

F. Clean and remove dust material with pressure washing for maximum adhesion. Blow dry concrete at 250 cfm with 120 psi.

G. Apply IET Systems Coating by the use of the IET Systems Spray Unit and IET Systems Spincaster. Apply IET coating at least three different intervals – prime coat, intermediate coat and finish coat, per IET Systems manufacturer instructions and specifications. The total thickness of the IET coating shall be at least 125 mils.

H. Inspect lining system for holidays, cracks and pinholes. Take particular care to check lining over brick, block, heavy spalled surfaces, and other very rough surfaces and locate holes in the lining caused by voids in bricks, block, concrete and structure joints. Fill voids and holidays in accordance with the lining system manufacturer's instructions.

I. Provide a five (5) year unlimited warranty on all workmanship and products. The work includes the surface preparation and application of the IET coating system, shall protect the structure for at least five (5) years from all leaks, and from failure due to corrosion from exposure to corrosive gases such as hydrogen sulfide.

END OF SECTION

SECTION 26 05 02

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: General requirements for providing basic electrical materials and methods.

B. Related Work Specified in Other Sections Includes:
1. Certain items of equipment, and various control devices including conduit and wiring which are indicated on electrical drawings to be connected, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems, and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.

C. Overall Application of Specifications: This Section applies to all sections of Division 26 and to other sections that include electrical equipment requirements except when in these individual sections requirements are otherwise specified to provide and install all materials necessary for a complete operational system.

D. Temporary Requirements: This Section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from existing to a new electrical system. This Section also applies to temporary rewiring of lighting and power circuits, instruments, and devices.

1.02 DEFINITIONS

A. Hazardous Areas: Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503. Hazardous areas as defined by the NEC as Class I, Division 1, Group D, or Class I, Division 2, Group D; hazardous areas as follows:
1. Class 1, Division 1, Group D
   a. Wet Wells
   b. Pretreatment
2. Class 1, Division 2, Group D
   a. Pump Rooms and Dry Well
   b. Odor control

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design requirements are specified in the applicable sections.

B. Performance Requirements: Performance requirements are specified in the applicable sections.

1.04 SUBMITTALS

A. General: Provide submittals for all electrical material and devices. Including the following:

1. Submit Technical Information Brochures at start of construction or within 30 days after Award of the Contract. Each brochure shall consists of an adequately sized, hard-cover, 3-ring binder for 8-1/2" X 11" sheets. Provide correct designation on outside cover and on end of brochure. When, in the judgment of the Engineer, one binder is not enough to adequately catalog all data, an additional binder will be required and data split as directed by the Engineer. Specific shop drawing submittals may be submitted separately after technical information brochures but before any equipment is purchased; provide index and schedule of shop drawings to be submitted within the technical information brochures.
2. First sheet in the brochure shall be a photocopy of the Electrical Index pages in these specifications. Second sheet shall be prepared by the Contractor, and shall list Project Addresses and phone numbers with key personnel for this project.
3. Provide reinforced separation sheets tabbed with the appropriate specification reference number.
4. The General Contractor shall review the brochures before submitting to the Engineer. No request for payment will be considered until the brochure has been submitted and reviewed completely.
5. Submit cost breakdown "Schedule of Values" for electrical work in the Technical Information Brochures. Cost of material and labor for each major item shall be shown.
6. Acceptance: When returned to Contractor, submittals will be marked with Engineer's stamp. If box marked "returned for correction resubmit" is checked, submittal is not approved and Contractor is to correct and resubmit as noted, otherwise submittal is approved and Contractor is to comply with notation making necessary corrections on submittal and resubmit for final record.
7. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, the ability of the material or equipment involved or the Mechanical/Electrical performance of equipment. Approval of shop drawings does not invalidate the plans and specifications if in conflict with the submittal. It is the contractor’s responsibility to request in writing and seek written approval from the engineer for all deviations of the plans and specifications.

B Product Data and Information: Provide complete list of electrical equipment and materials to be furnished showing manufacturer, catalog number, size, type, voltage rating and other pertinent information.

1. Provide catalog data on manufacturer's standard equipment and materials. Clearly indicate on catalog cuts the equipment and devices being proposed.
2. Identification: Provide complete schedule and listing of system and equipment identification labels with legends.

3. Material shall not be ordered or shipped until the shop drawings have been approved.
4. The Engineer's shop drawing review shall be for conformance with the design concept of the project and compliance with the Specifications and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the Drawings.
5. Shop drawings shall be stamped with the date checked by the contractor and a statement indicating that the shop drawings conform to the Specifications and the Drawings. This statement shall also list all exceptions to the Specifications and the Drawings. Shop drawings not so checked and noted shall be returned.

C. CONTRACTOR's Shop Drawings: Provide shop drawings on items manufactured for the Contract.
1. Provide connection diagram and schematic for each piece of electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless it is clearly marked to show the intended method of connection.
2. Provide diagrams showing connections to field equipment. Clearly differentiate between manufacturer's wiring and field wiring.
3. Provide raceway layout drawings showing conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes and conductor content and identification.
4. Where additions and modifications are made to existing equipment, provide drawings which include both retained existing equipment and new Work.

D. Coordination Drawings: Prepare to scale coordination drawings (1/4"=1'-0"); detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:
1. Indicate the proposed locations of major raceway systems, equipment, and materials. All dimensions shall be field verified at the job site and coordinated with the work of all other trades. Include the following:
   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
   b. Exterior wall and foundation penetrations.
   c. Fire-rated wall and floor penetrations.
   d. Equipment connections and support details.
   e. Sizes and location of required concrete pads and bases.

2. Record Documents: Prepare record documents, and in addition to the requirements specified in Division 1. As the work progresses, legibly record all field changes on a set of Project Contract Drawings, (the "Record Drawings"). Indicate installed conditions for:
   a. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch

electrical circuitry; and fuse and circuit breaker size and arrangements.

b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

c. Approved substitutions, and actual equipment and materials installed.

d. Record Drawings shall accurately show the installed condition of the following items: Power Riser Diagram(s). Equipment elevations (front views). Raceways and pullboxes. Conductor sizes and conduit fills. Control Wiring Diagram(s). Underground raceway and duct bank routing. Plan view, sizes and locations of distribution transformers and outdoor electrical equipment enclosure.

e. Submit a schedule of control wiring raceways and wire numbers, including the following information: Circuit origin, destination and wire numbers. Field wiring terminal strip names and numbers.

f. In addition to the schedule, provide point to point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers. Comply with PLC tag designation on all instrumentation and control cabling in and out of PLC racks.

g. The schedule of control wiring raceways and wire numbers and the point to point connection diagrams shall be in electronic Autocad and Word format (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted)

E. Operation and Maintenance Manuals: Prepare operation and maintenance manuals, and in addition to the requirements specified in other Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Complete parts list with stock numbers, including spare parts. A complete bill of material supplied, including serial numbers, ranges and pertinent data.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. A comprehensive index.
5. A complete "As Built" set of approved shop drawings.
6. A table listing of the "as left" settings for all timing relays and alarm and trip setpoints. A complete listing of As left programmable parameters for all drives, soft-starters and other microprocessor controlled equipment.
7. System schematic drawings "As Built", illustrating all components, piping and electric connections of the systems supplied under this Section.

1.05 QUALITY ASSURANCE

A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.

B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.

C. Labeling: Provide all electrical equipment and materials listed and approved by Underwriters Laboratories with the UL label or other OSHA recognized testing laboratories attached to it.

D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. When two or more units of the same class of material and equipment are required, provide the products of the same manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

B. Shipping and Packing: Provide materials and equipment suitably boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Clearly label such boxes, crates or enclosures with manufacturer's name, and name of material or equipment enclosed.

C. Acceptance at Site: Conform to acceptance requirements as required in Division 1. Repair or replace all materials and equipment damaged by handling and storage as directed at no additional Contract cost.

D. Storage and Protection: Protect materials and equipment from exposure to the elements and keep them dry at all times. Handle and store to prevent damage and deterioration in accordance with manufacturer's recommendations.

1.07 PROJECT CONDITIONS

A. General: The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets and circuit layouts. Connect and install all electrical elements and devices to form a workable system as required by the Contract Documents whether the connections and installations are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.

B. Schematics: In general the runs of feeders are shown schematically and are not intended to show exact routing and locations of raceways. Verify actual and final

arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by equipment dimensions.

C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.

D. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow the right of way for piping and conduit installed at the required slope.
   4. To clear connecting raceways, cables, wireways, cable trays, and busways of obstructions and of the working and access space of other equipment.

E. Coordinate the installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

F. Coordinate electrical testing of electrical, mechanical, and architectural items, so that functionally interdependent equipment and systems demonstrate successful interoperability.

G. Departure from Design: If departures are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval as soon as practicable but not later than the submittal of the raceway layout drawings. Do not make any departures without written approval.

PART 2 – PRODUCTS

2.01 FLOOR MATING

A. Provide rubber insulation mats on floor in front of electrical equipment extending 18” beyond. Mats to be minimum 3 feet wide or equal to isle width. Provide OSHA approved insulating mats meeting OSHA regulation 1910.137 with 30,000 volt insulating strength (Matworks or equal, 800 336-4604).

PART 3 – EXECUTION

3.01 ROUGH-IN

A. Final Location: Verify final locations for rough-ins with field measurements, vendor shop drawings and with the requirements of the actual equipment to be connected.

B. The Drawings are not intended to show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

C. Install each 3 phase circuit in a separate conduit unless otherwise shown.

D. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.

E. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

F. All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45 degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

G. All “LB” type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.02 ELECTRICAL INSTALLATIONS

A. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate electrical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
   3. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.
   4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
   5. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
   6. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   7. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
   8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of

governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

9. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER for resolution.
10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
11. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
12. Install access panel or doors where units are concealed behind finished surfaces.
13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

B. Homeruns: Drawings show most homerun circuits to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer. Changes shall be documented on record drawings. Homerun circuits shown on Drawings indicate functional wiring requirements for all circuits. Lighting and receptacle Circuits; no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.

3.03 CUTTING AND PATCHING

A. Perform cutting and patching as specified in Division 1. In addition to the requirements specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.
   c. Remove and replace Work not conforming to requirements of the Contract Documents.
   d. Remove samples of installed Work as specified for testing.
   e. Install equipment and materials in existing structures.
   f. Locate existing structural reinforcing where core drilled penetrations are required so as not to cut the steel reinforcing.
2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all the existing removed to the OWNER as directed.
3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
6. Patch finished surfaces and building components using new materials as specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

SECTION 26 05 11

SPECIAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install complete and make operational, electrical and process instrumentation systems for the Lee County Utilities Department as shown on the Drawings and as specified herein.

B. The work shall include furnishing, installing and testing the equipment and materials specified in other Sections of the Specifications and shown on the Drawings.

C. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost. The work shall include but not be limited to furnishing and installing the following:

1. New electrical service including coordination with utility company (LS-617 Only).
2. Ductbank systems for power, fiber optic, instrumentation and control signal distribution.
3. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.
4. Conduit, wiring and terminations for all field-mounted instruments furnished under other Divisions of these specifications, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters.
5. Install vendor furnished cables specified under other Divisions of these specifications.
6. Pre-wired pre-fabricated electrical equipment enclosure at Master Pump Station sites.
7. A complete raceway system for the Data Network Cables and specialty cable systems. Install the Data Network Cables and other specialty cable systems furnished under other divisions in accordance with system integrator and the system manufacturers' installation instructions. Review the raceway layout, prior to installation, with the system integrator and the cable manufacturer to ensure raceway compatibility with the systems and materials being furnished.
8. Complete grounding system and special grounds as required or noted.
9. Power and signal surge suppression systems.
10. Concrete work for pad mounted equipment.
11. Instrumentation and control conduit and wiring systems and installation of field instrumentation.
12. Arc Flash evaluation, short circuit and coordination study and electrical testing of equipment including SKM file of approved studies.

13. Lightning protection, bonding and grounding systems.
14. Electronic and hard copy project record drawings, vendor operation and maintenance manuals.
15. Furnish and install field instrumentation termination cabinets, mounting stands and sunshields.
16. Custom Control panels.
17. Shipping of the complete a/c units to Corrosion Solutions Inc. for factory installation of "heresite" corrosion protective coating.
18. Fiber optic cable termination and interconnecting wiring between fiber patch panel and network switches in the electrical equipment enclosure.
19. Lee County Utilities will self-perform work required to update SCADA servers at College Parkway for new pump station.

D. Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing site and structures in which work under this Division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the site and structures and noted the locations and conditions under which the work will be performed and that the bidder takes full responsibility for a complete knowledge of all factors governing the work.

E. Field verify all existing underground electrical and mechanical piping.

F. The Contractor shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads, buildings and structures to the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, building and yard lighting, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale on 22 x 34 sheets

G. The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

H. A single manufacturer shall provide variable frequency drives, panelboards, main breakers, transformers, disconnect switches, etc.

I. Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). No facility circuits shall be used unless approved by the engineer. Any temporary added shall be removed at job completion.

J. Complete coordination with other contractors. Contractor shall coordinate with all other contractor’s equipment submittals and obtain all relevant submittals.

K. Mount transmitters, process instruments, operator’s stations, etc. furnished under other Divisions of these specifications.

L. Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading and seeding is included. Excavation, bedding material, forms, concrete and backfill for underground raceways; forms and concrete for electrical equipment furnished herein is included in this Division.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:
1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
3. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
4. Z535.4, Product Safety Signs and Labels.
5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. National Fire Protection Association (NFPA): 70E.
7. Underwriters Laboratories, Inc. (UL).

1.03 RELATED WORK

A. Excavation and backfilling, including gravel or sand bedding for underground electrical work is specified in other Divisions.

B. Cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and reinforcing steel, is specified in other Divisions.

1.04 REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the latest edition of National Electrical Code (NEC) and with the latest edition of the following codes and standards:
1. National Electrical Safety Code (NESC)
2. Occupational Safety and Health Administration (OSHA)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. American National Standards Institute (ANSI)
6. Insulated Cable Engineers Association (ICEA)
7. Instrument Society of America (ISA)
8. Underwriters Laboratories (UL)
9. Factory Mutual (FM)
10. International Electrical Testing Association (NETA)
11. Institute of Electrical and Electronic Engineers (IEEE)
12. American Society for Testing and Materials (ASTM)
13. Electrical Safety in the Workplace (NFPA70E)
14. State and Local Codes and Ordinances

B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use. Where reference is

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

1.05 ENCLOSURE TYPES

A. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:
   1. NEMA 1 for dry, non-process indoor locations.
   2. NEMA 12 for "DUST" locations.
   3. NEMA 4X 316 SS powder coated white with continuous hinge, 3 point latch, screw down door clamps for all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" locations.
   4. NEMA 4X 316 SS powder coated white with continuous hinge, 3 point latch, screw down door clamps for "CORROSIVE" locations.
   5. NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D", "Class I Division 2 Group D" and "Class II Division 1" hazardous locations shown on the Drawings.

B. Unless otherwise specified herein or shown on the Drawings, junction boxes shall have the following ratings:
   1. NEMA rating as applicable and specified above.
   2. Have continuous hinge with quick connect door clamp. Flush mounted screw down fronts are not acceptable.

1.06 CODES, INSPECTION AND FEES

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. Completed electrical installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes.

B. Obtain all necessary permits and pay all fees required for permits and inspections.

1.07 TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 26 and other divisions supplying electrical equipment. Repair or replace all defective work and equipment. Refer to section 26 08 00, Acceptance Testing and Performance Verification and the individual sections, the following minimum tests and setting shall be performed. Submit test reports upon completion of testing in accordance with Section 26 08 00, Acceptance Testing and Performance Verification.

B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

C. The following minimum tests and settings shall be performed.
   1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for proper operation.
   2. Check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the measurement. Check ampere rating of thermal overloads for

motors and submit a typed record to the Engineer of the same, including driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.
4. Check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.
5. Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.
6. Check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.
7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.
8. Inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.
9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A", "B" and "C" phases.
10. Check all wire and cable terminations. Verify to the Engineer connections meet the equipments torque requirements.
11. Field set all transformer taps as required to obtain the proper secondary voltage.
12. Infra-red hot spot inspection shall be made of all electrical equipment including but not limited to switchgear, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Owner.

1.08 PHASE BALANCING

A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified herein.

1.09 EQUIPMENT IDENTIFICATION

A. Identify equipment (disconnect switches, control stations, etc) furnished under Division 26 with the name of the equipment it serves. Control panels, panelboards, main breakers, junction or terminal boxes, etc, shall have nameplate designations as shown on the Drawings. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular

machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background. Attach with brass nuts and bolts.

C. Electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the Engineer.

D. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

E. All voltages (e.g. 480 volts, 240 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1" high.

F. All receptacles, wall switches, lighting fixtures, photo cells, emergency lights, exit lights, etc. shall be identified with the panel and circuit to which it is connected. Identification shall be with machine generated labels with ¼" high letters.

1.10 SAFETY REQUIREMENTS

A. The Contractor shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:

1. Make sure that all persons responsible for operating cranes, draglines and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines and Similar Equipment Near Power Lines, as well as the U.S. Department of Labor OSHA Regulations, before commencing operation of said equipment.
2. Make sure that all cranes, draglines and other mobile equipment have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.
3. Warn all employees on the ground, new and old employees alike, of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.
4. If, during the course of construction, it becomes necessary for the contractor, or subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

1.11 ABBREVIATIONS OR INITIALS USED.

A/C	Air Conditioning
A.C.	Alternating Current
AFF	Above Finished Floor
AFG	Above Finished grade
AHU	Air Handler Unit
AIC	Amps interrupting Capacity
AL	Aluminum
AMP	Ampere
ANSI	American National Standards Institute
ATS	Automatic Transfer Switch
AUX	Auxiliary
AWG	American Wire Gauge
BKR	Breaker
^{o}C	Degrees Centigrade
CAB	Cabinet
C.	Conduit or Conductor
C.B.	Circuit Breaker
CFM	Cubic Feet per Minute
CKT.	Circuit
COND.	Conductor
Conn.	Connection
CP	Control Panel
CPT	Control Power Transformer
CT	Current Transformer
CU.	Copper
DC	Direct Current
Deg.	Degree
Disc.	Disconnect
DO	Draw Out
DPST	Double Pole Single Throw
EMT	Electric Metallic Tubing
E.O.	Electrically Operated
^{o}F	Degrees Fahrenheit
FLA	Full Load Amperes
FHP	Fractional Horsepower
FT.	Feet
FVNR	Full Voltage Non-Reversing
GFI (GFIC)	Ground Fault Interrupting
gnd.(GD.)	Ground
hp.	Horsepower
hr.	Hour
IEEE	Institute of Electrical and Electronic Engineers
in.	Inches
JB	Junction Box
KV	Kilovolt
KVA	Kilo-Volt-Amps
KW	Kilowatts
LCP	Local Control Panel
LED	Light Emitting Diode

max.	Maximum
MCB	Main Circuit Breaker
MCC	Motor Control Center
MCP	Motor Circuit Protector
min.	Minimum
MLO	Main Lugs Only
N.	Neutral
NEC	National Electric Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NIC.	Not in Contract
NF	Non Fused
No.	Number
ph	Phase
OCU	Odor Control Unit
OL	Overload
OSHA	Occupational Safety and Health Act
PB	Pullbox
Ph.	Phase
PNL	Panelboard
PR	Pair
PWR	Power
PF	Power Factor
Pri	Primary
psi	Pounds Per Square Inch
PT	Potential Transformer
PVC	Polyvinyl Chloride
RLA	Running Load Amps
RMS	Root-Means-Square
RPM	Revolutions Per Minute
Recept.	Receptacle
RTD	Resistance Temperature Device
RVNR	Reduced Voltage Non-Reversing
SCA	Short Circuit Amps
SCC	Short Circuit Current
SCCR	Short Circuit Current Rating
Sec.	Secondary
S/N	Solid Neutral
SPST	Single Pole Single Throw
SSRV	Solid State Reduced Voltage
SW.	Switch
SWBD	Switchboard
SWGR	Switchgear
TEFC	Totally Enclosed Fan Cooled
TSP	Twisted Shielded Pair
TYP	Typical
Temp.	Temperature
UL	Underwriters Laboratories
UNO	Unless Noted Otherwise

V	Volt
VFD	Variable Frequency Drive
WP	Weatherproof
XFMR	Transformer

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

D. Seal all openings, sleeves, penetration and slots as specified in Section 26 05 33.

3.02 INSTALLATION

A. Any work not installed according to the Drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Owner, the damaged unit(s) or systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied and all cost associated with replacement shall be borne by the Contractor.

C. Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

D. Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted at no additional cost to the Owner.

E. All “LB” type fitting hardware to be stainless steel or brass. All junction box hardware to be aluminum or stainless steel only.

3.03 MANUFACTURERS SERVICE

A. Provide manufacturer's services for testing and start-up of all major electrical equipment: VFDs, ATS, Gensets, Switchgear, Etc.

B. Testing and startup shall not be combined with training. Testing and start-up time shall not be used for manufacturer’s warranty repairs.

C. The manufacturers of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:

1. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on-site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "as-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity.
2. The Field Service Engineers shall provide engineering support during the energization and check-out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the manufacturer's performance specifications.
3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with manufacturer's test specifications.
4. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The reports after review by the Contractor shall be submitted to the Engineer.

3.04 TRAINING

A. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

B. Provide detailed O&M manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

C. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance including trouble-shooting of each system.

D. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule. The training shall be conducted with record "as-built" drawings sufficient for each class member.

E. The Contractor shall submit an overview of the proposed training plan. This

overview shall include, for each course proposed:

1. An overview of the training plan.
2. Course title and objectives.
3. Recommended types of attendees.
4. Course Content - A topical outline.
5. Course Format - Lecture, laboratory demonstration, etc.
6. Schedule of training courses including dates, duration and locations of each class.

3.05 WARRANTY

A. The work under this Division shall include a two-year warranty. This warranty shall be by the Contractor to the Owner for any defective workmanship or material that has been furnished under this Contract at no cost to the Owner for a period of two years from the date of substantial completion of the System. This guarantee shall not include light bulbs or batteries in service after six months from date of Substantial Completion of the System.

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE WIRES AND CABLES

PART 1 – GENERAL

1.01 REFERENCED STANDARDS

A. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI):

B. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.

C. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.

D. National Electrical Manufacturers Association/Insulated Cable Engineers Association
(NEMA/ICEA): WC 57/S-73-532, Standard for Control Cables: WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

E. National Fire Protection Association NFPA-70, National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL44): Standard for Safety Thermoset-Insulated Wires and Cables; (UL83): Standard for Safety Thermoplastic-Insulated Wires and Cables; UL467 Standard for Safety Grounding and Bonding Equipment. UL486A Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors; UL 486C, Standard for Safety Splicing Wire Connections. UL510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

1.02 DEFINITIONS

A. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2 or thermoplastic insulated THHN and THWN;

B. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

C. Instrumentation Cable (Analog signal cable): Multiple conductor, insulated, twisted Pair/Triad, with individual Pair/Triad shield and outer overall shield and outer sheath. Used for the transmission of low current (e.g., 4-20mA DC) using No. 18 AWG conductors. Common Types, TSP: Twisted shielded pair, TST: Twisted shielded triad.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 16, AWG. With overall shield where specified. Type SIS and MTW approved for use in the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers;

otherwise type XHHW-2.

E. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger, Rated XHHW-2. No. 12-6 AWG, Rated THHN or THWN.

F. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc. Common Types: Ethernet UTP-unshielded twisted pair.

1.03 SUBMITTALS

A. Submit cut sheets on all major types of wires and cables including splicing tape, and terminating/splicing lugs, conductor identification systems and connectors and cable sleeves. Submit sample of all instrumentation and control cable. Sample shall be a minimum of 24" with exterior sheath clearly marked.

B. Submit sample of all cable identification systems products.

C. Submit conduit schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 – PRODUCTS

2.01 POWER CONDUCTORS

A. Branch circuits and feeder conductors for all three phase electric power shall be stranded copper type XHHW-2 cross-link polyethylene (XLP) insulation and derated to 75 degrees Centigrade for #8 AWG and larger. No. 12-6 AWG, shall be type THHN or THWN, thermoplastic insulation and derated to 75 degrees Centigrade. No aluminum wiring shall be permitted. Wire shall be in accordance to NEC and minimum No. 12, except that branch "homeruns" over 50 ft. in length shall be minimum No. 10 for 120/208V circuits. All branch lighting circuits serving HID and Fluorescent fixtures shall be minimum #10 with each circuit provided with a separate neutral. All wire shall be manufactured in the USA.

B. Motor leads from variable frequency drives to driven motor shall be shielded VFD drive cable for all VFD motors. Provide flexible VFD shielded drive cables, 3 Class-I conductor cable plus 3 trisectional green insulated ground wires. Provide electrostatic shielding of tinned copper braided shield with aluminum-polyester laminated tape shielding system. Cross-linked polyethylene insulation system and neoprene or PVC outer jacket, type TC cable as manufactured by Service Wire or equal. Shielded VFD motor cables require increased conduit sizes over standard wire installations. Contractor to verify conduit sizes.

C. Taps and Splices:

1. All power wiring taps and splices in No. 8 or smaller wire shall be fastened together by means of terminal strips except within lighting fixtures and wiring devices where conformance to NEC practices will be acceptable (Twist/screw on type connectors). All taps and splices in wire larger than No. 8 shall be made with compression type connectors and taped to provide insulation equal to wire. Tape shall be heavy duty, flame retardant and

weather resistant vinyl electrical tape, minimum 7 mil premium grade with an operating temperature of 0 degree F. to 220 degree F. Provide tape meeting UL 510 and CSA standard C22.2.

2. All taps and splices in manholes or in ground pull boxes, etc. shall be approved by the engineer on a case by case basis; be made with high press long barrel double crimp compression type connectors and covered with Raychem heavy wall cable sleeves (type CTE or WCS) with type "S" sealant coating. Install sleeve kits as per manufacturer's installation instructions.

D. Color Coding:

1. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel except for the wire markings.

2. Unless otherwise approved, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green with yellow strips. Nominal Voltage: 120/208V, Phase A -black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C -yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above. In existing or expansion projects, comply with existing color coding established within the facility.

2.02 INSTRUMENTATION AND CONTROL CABLE

A. Multiconductor and Multi pair Process instrumentation cable shall be #18 AWG stranded, twisted pair, 600 V, (XLP) cross link polyethylene insulated, aluminum tape pair shielding, cross link polyethylene or chlorinated polyethylene (CPE) overall sheathed and shielded, type TC instrument cable as manufactured by the American Insulated Wire Co., Belden Wire Co. or equal.

B. Multiconductor control cable shall be #16 AWG, tinned in control panels, stranded, 600V, (XLP) cross link polyethylene insulated or polyolefin, with cross link polyethylene or chlorinated polyethylene (CPE or Hypalon) overall sheathed type TC control cable except for control cable into and out of VFD cabinets. Multiconductor control cable into and out of VFD cabinets shall be as indicated above and in addition include an aluminum polyester tape overall shield and drain wire. As a contractor alternate to shielded control cable into and out of VFD cabinets, provide twisted shielded instrument cable as specified above. Contractor to provide increased conduit size as required if instrument cable alternate is used into and out of VFD cabinets.

C. Connections:

1. All conductor connections shall be on terminal strips including all spare conductors. Provide terminal strips in all cabinets; motor control centers; etc.

2. All connections of stranded wire to screw terminals shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks. The stranded wire ferrule is to be crimped to all stranded wire using a crimping tool specifically approved for crimping the size and type of ferrule.
3. All conductors shall be marked with heat shrink type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing with all connections shown and described as to color code, number assigned to connection function of conductor and destination.
4. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
5. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
6. Cabinets: All cabinets shall be labeled with an engraved plastic laminate label riveted to the door for NEMA 1 enclosures only, labels shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable.
7. No splices shall be made within a conduit run or in manholes.

D. All plant control system field wiring shall be labeled per the instrumentation and control contractor loop drawings from the field device, through the intermediate cabinets, to the PLC cabinet. The labeling system shall be consistent throughout the loop and follow the standard tag designation: PLC#-Rack#-Slot#-Point# (example PLC1-R2-S3-P4).

E. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel run of power conduit and instrumentation or control conduit. This separation can be reduced to 8" if metallic grounded separation is provided.

2.03 INDUSTRIAL ETHERNET MEDIA CABLE

A. Multiconductor and Multi pair Data Signal cable shall be TIA 5638B Cat 5e, #22 AWG solid, twisted pair, 600V, PVC insulated, aluminum tape pair shielding, thermoplastic elastomer (TPE) overall sheathed and shielded, industrial Ethernet cable as manufactured by the Allen Bradley 1585-C8HB or equal. Option to provide premolded RJ45 patchcords Allen Bradley 1585D and 1585J is acceptable at contractor’s option.

B. Connections:
1. All conductor connections shall be to RJ45 and M12 compatible jacks.
2. All conductors shall be marked with mylar wrap type "Brady" labels. Identification labels shall be permanent type and be machine printed. All terminal block terminations shall be labeled. The inside portion of the terminal cabinet doors shall display a protected terminal cabinet drawing

with all connections shown and described as to color code, number assigned to connection function of conductor and destination.

3. Wire shall be guided within terminal cabinets by cable supports. All conductors shall be neatly led to terminations.
4. Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
5. No splices shall be made within a conduit run or in manholes.

2.04 CAT6 ETHERNET MEDIA CABLE

A. Category 6 Unshielded Twisted Pair (UTP), UL listed, and third party verified to comply with TIA/EIA 568 C Category 6 requirements. Suitable for high-speed network applications including gigabit Ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket. Cable shall withstand a bend radius of 1 inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking. Manufacturer and Product: Belden; 7852A. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.

2.05 MISC ACCESSORIES

A. Tape:
1. General Purpose, Flame Retardant: 7 mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5 mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing: 30 mil, elastomer. Manufacturers and Products: 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.

PART 3 – EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer’s recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer’s recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding **18** inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

3.02 SPARE CONDUCTORS

A. All runs of Multi pair Process instrumentation cable and multi conductor Control cable shall have a minimum of 2 spare conductors per conduit.

B. All branch circuit feeders of #3 and smaller shall have 2 spare conductors pulled in per circuit.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The terms “connect”, “ground” and “bond” are used interchangeably in this specification and have the same meaning.

B. This section specifies general grounding and bonding requirements of electrical equipment operations and to provide a low impedance path for possible ground fault currents.

C. “Grounding electrode system” refers to all electrodes required by NEC, as well as including made, supplementary, perimeter counterpoise ground, lightning protection system grounding electrodes.

1.02 RELATED WORK

A. Section 26 05 02, Basic Electrical Material and Methods: General electrical requirements.

B. Section 26 05 11, Special Electrical Requirements

C. Section 26 05 19, Low Voltage Wires and Cables

D. Section 26 41 00 Lightning Protection Systems

1.03 SUBMITTALS

A. Submit in accordance with Section 26 05 02, Basic Electrical Materials and Methods

B. Shop Drawings:
   1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
   2. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

C. Test Reports: Provide certified test reports of ground resistance.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Project Engineer:
   1. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 APPLICABLE PUBLICATIONS – Latest Edition

A. American Society for Testing and Materials (ASTM)

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

C. Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

D. National Fire Protection Association (NFPA)

E. National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
   1. Thermoset-Insulated Wires and Cables
   2. Thermoplastic-Insulated Wires and Cables
   3. Grounding and Bonding Equipment
   4. Wire Connectors

PART 2 – PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be UL 83 insulated stranded copper,. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.

B. Bonding conductors shall be ASTM B8 bare stranded copper.

C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.02 SPLICES AND TERMINATION COMPONENTS

A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.03 GROUND CONNECTIONS

A. Above Grade:
   1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lock washers.
   2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

PART 3 – EXECUTION

3.01 GENERAL

A. Ground in accordance with the NEC, as shown on drawings, and as hereinafter specified.

B. System Grounding:
   1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
   2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

C. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 GROUNDING CONNECTIONS

A. Make grounding connections that are below grade by exothermic weld. Make grounding connections that are above grade but are otherwise normally inaccessible (poured columns, within walls) with exothermic weld.

3.04 SECONDARY EQUIPMENT AND CIRCUITS

A. Transformers:
   1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
   2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the ground bar at the service equipment.

B. Conduit Systems:
   1. Ground all metallic conduit systems. All conduit systems shall contain an equipment grounding conductor (except service entrance with grounded neutral). Ground conductor shall be bonded to metallic conduit systems at the entrance and exit from the conduit.

C. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
   3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

D. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.

E. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.05 CORROSION INHIBITORS

A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.06 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.07 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 2 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the owner. Final tests shall assure that this requirement is met.

B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided. Document with test results for approval and include approved test results in the O&M Manual.

C. Below-grade connections shall be visually inspected by the Project Engineer prior to backfilling. Provide ground inspection wells at all ground rod locations.

3.08 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth, not less than 20 feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make above grade accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, drill rock then install rod. Backfill with flowable fill or concrete mix. Obtain the necessary permits if required for drilling.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. The work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc, and fastening hardware for supporting electrical work. Furnish and install all supports, hangers and inserts required to mount fixtures, conduit, cables, pull boxes and other equipment furnished under this Division. All supporting devices and hardware exterior of buildings or interior of structures except in air conditioned spaces shall be stainless steel. Aluminum and nonmetallic supports (fiberglass) and hardware will be reviewed by the Engineer on a case-by-case basis.

B. All items shall be supported from the structural portion of the building. Supports and hangers shall be of a type approved by Underwriters' Laboratories. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

C. The Contractor shall furnish and install all sleeves that may be required for openings through floors, wall etc. Where plans call for conduit to be run exposed, the Contractor shall furnish and install all inserts and clamps for the supporting of conduit. If the Contractor does not properly install all sleeves and inserts required, contractor to provide cutting and patching to the satisfaction of the Engineer.

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
   1. Section 26 05 33 – Conduit Systems

1.03 SUBMITTALS: PRODUCT DATA

A. Provide data for support channel.

1.04 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Support Channel: Stainless steel throughout except galvanized steel in conditioned interior areas.

B. Hardware: Stainless steel throughout

C. Minimum sized threaded rod for supports shall be 3/8”.

D. Conduit clamps, straps, supports, etc., shall be stainless steel or aluminum. One-hole straps shall be heavy duty type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All steel conduits shall be securely fastened in place on maximum of 6-foot intervals; all PVC conduits shall be securely fastened in place on maximum of 3 foot intervals vertically and 2 foot intervals horizontally. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by two-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.

B. On concrete or masonry construction, use "Tapcon" type fasteners. For brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head screws shall be used. An electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. Steel members shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from stainless steel, or approved substitution.

C. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only). Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.

D. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not drill structural steel members unless approved by the engineer.

E. Fabricate supports from 316 stainless steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall.

F. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

SECTION 26 05 33

CONDUIT SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description of System: This Section includes requirements for raceways, fittings, boxes, enclosures, and cabinets for electrical, instrumentation and control system wiring.

B. Heavy wall PVC (Schedule 80) shall be used for all raceways direct buried without concrete encasement protection. Conduits in concrete encasement use Schedule 40-PVC. Above ground in areas subject to chemical degradation (chemical storage, chemical feeder rooms, chlorine rooms, odor control and scrubber area, etc) use Schedule 80-PVC. Use aluminum conduit for exposed above grade interior area. Electrical Metallic Tubing shall be used within air-conditioned spaces and in electrical rooms for power and for instrumentation and control conduits. Use rigid aluminum conduit above grade on exterior of buildings and in above grade interior wet locations. Where PVC conduit penetrates a floor from underground or in a slab; a black mastic coated rigid aluminum conduit elbow shall be used for all conduits.

C. Minimum conduit size for all systems shall be 3/4". All conduits shall be U.L. listed and labeled. Conduit sizes shown on the drawings are to aid the contractor in bidding only; the contractor is responsible for conduit sizes as required by NEC fill tables but do not provide smaller conduits than indicated. The contractor is responsible to coordinate the required conduit sizes and conductor quantities for all control and instrumentation system conduit and wiring with the controls subcontractor prior to installation.

D. Provide stainless steel or non-metallic conduit supports and type 316 stainless steel hardware in all areas except air-conditioned spaces.

1.02 SUBMITTALS

A. Product Data:
   1. Product data shall be submitted on:
      a. Conduit, raceways, wireways.
      b. Conduit fittings, boxes, enclosures and cabinets.
      c. Surface metal raceway
      d. Conduit Schedule identifying conduit tag numbers, locations the conduit connects and the wire count.

PART 2 - PRODUCTS

2.01 ELECTRIC METALLIC TUBING

A. Electric metallic tubing (thin wall) shall meet Federal EMT Specifications WW-C-563 ANSI C80.3 and UL 797 with chromated and lacquered protective layer

2.02 FLEXIBLE CONDUIT

A. Flexible, Nonmetallic, Liquid-Tight Conduit: Type B
   1. Material: PVC core with fused flexible PVC jacket. UL 1660 listed for:
      a. Dry Conditions: 80 degrees C insulated conductors.
      b. Wet Conditions: 60 degrees C insulated conductors.
   2. Manufacturers and Products:
      a. Carlon; Carflex or X Flex.;
      b T & B; Xtraflex LTC or EFC.

2.04 PVC CONDUIT

A. PVC conduit shall be composed of High Impact Virgin homopolymer, PVC (polyvinyl chloride C-200 Compound), and shall conform to industry standards, and be UL 651 listed in accordance with Article 347 of National Electrical Code for underground, concrete encasement and or direct sunlight exposed use and NEMA standard TC-2. Materials must have tensile strength of 55 PSI, at 70oF, flexural strength of 11,000 PSI, compression strength of 8600 PSI. Manufacturer shall have five years' extruding PVC experience. Consistent with requirements provide PVC conduit products by one of the following manufacturers:
   1. Carlon
   2. Cantex
   3. J.M. Plastics
   4. Queen City Plastics

2.06 RIGID ALUMINUM CONDUIT

A. Provide Rigid Aluminum Conduit of 6063 alloy in temper designation T-1. The fittings are of the same alloy. Provide threaded Rigid Aluminum Conduit to Underwriters Laboratories U.L. 6A, “Standard for Electrical Rigid Metal Conduit and manufactured to ANSI C80.5.

B. Provide threaded aluminum conduit fittings, of 6063 alloy, cast copper free aluminum with integral insulated throat as manufactured by Allied, OZ Gedney, T&B, Crouse-Hinds, Killark or Appleton.

C. Provide supplementary corrosion protection for aluminum conduit imbedded in concrete or in contact with soil. Where aluminum conduits are in contact with or penetrate concrete, coast conduit with asphaltic or bitumastic type coating.

2.07 CONDUIT FITTINGS

A. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

B. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

C. Fittings for EMT: Steel compression type.

D. Fittings, surface boxes and conduit bodies for Rigid Aluminum Conduit shall be heavy cast aluminum with external raised hubs and mounting lugs;- Appleton, Crouse Hinds or approved substitution. Cover plates cast aluminum. Zinc die cast not acceptable.

E. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.

F. Conduit expansion fittings shall be malleable iron, and shall be hot dipped galvanized inside and outside. These fittings shall have a four-inch expansion chamber to allow approximately two-inch movement parallel to conduit run in either direction from normal. They shall have factory-installed packing and internal tinned copper braid packing to serve as an emergency bonding jumper. Unless the fitting used is listed by Underwriters' Laboratories for use "without external bonding jumpers", an external copper bonding jumper shall be installed with each expansion fitting with one end clamped on each conduit entering fitting.

G. Flexible, Nonmetallic, Liquid-Tight Conduit shall meet requirements of UL 514B with High strength plastic body, complete with lock nut, O-ring seal, threaded ferrule, sealing ring. Threaded ferrule designed to ensure high mechanical pullout strength and watertight seal. Manufacturer, Carlon; Type LN or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All raceways shall be run in neat and workmanlike manner and shall be properly supported in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners except for PVC conduit installed in exterior locations. PVC conduit installed in exterior locations shall be supported at two foot intervals. Supporting conduit and boxes with wire is not approved. All raceways except those from surface-mounted switches, outlet boxes or panels shall be run concealed from view. Exposed raceways shall be supported with clamp fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry. Rigid steel box connections shall be made with double locknuts and bushings. Where PVC penetrates a floor from underground or in slab, a black mastic coated aluminum conduit elbow shall be used on all conduits. All individual bare copper ground conductors (i.e. service, transformer, or lightning protection grounds) shall be installed in PVC conduit, not metal conduit. This does not apply to bare copper ground conductors run with feeders (as specified in this section). Conduits shall be run parallel to building walls wherever possible, exposed or concealed, and shall be grouped in workmanlike fashion. Crisscrossing of conduits shall be minimized.

B. All raceways runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

C. All raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.

D. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.

E. All raceways shall be run from outlet to outlet exactly as shown on the drawings, unless permission is granted to alter arrangement shown. If permission is granted arrangement shall be marked on field set of drawings as previously specified.

F. All underground raceways (with exception of raceways installed under floor slab) shall be installed in accordance with Section 300-5 of the NEC except that the minimum cover for any conduit shall be two feet. Included under this Section shall be the responsibility for verifying finished lines in areas where raceways will be installed underground before the grading is complete.

G. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.

H. Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade or terminated in a manhole. Marker shall be 6" round X 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

I. All conduit stubbed above floor shall be separated with plastic interlocking spacers manufactured specifically for this purpose, or shall be strapped to Kindorf channel supported by conduit driven into ground or tied to steel.

J. Raceways which do not have conductors furnished under this Division 26 Electrical of the specifications shall be left with an approved nylon pullcord in raceway.

K. Rigid Metallic Conduit, electrical metallic tubing, flexible steel conduit and PVC conduit shall be manufactured within the United States.

L. All connections to motors or other vibrating equipment (except dry type transformers) or at other locations where required shall be made with not less than 12" nor more than 20” of flexible liquid-tight nonmetallic conduit, using special type of connectors with strain relief fittings at both terminations of conduit. Flex connectors shall have insulated throat and shall be T & B 3100 Series or approved substitution. Use angle connectors wherever necessary to relieve angle strain on flex conduit. Connections to dry type transformers shall be made with flexible conduit. Typical length of flex conduit shall be limited to 20” unless specifically approved by the engineer.

M. PVC joints shall be solvent welded. Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings. Installation of PVC conduit shall be in accordance with manufacturer's recommendations. PVC conduit shall not be used to support fixture or equipment. Field bends shall be made with approved hotbox. Heating with flame and hand held heat guns are prohibited.

N. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete structure; on one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints; in each conduit run which mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit run above ground which is more than fifty feet long and interval between expansion fittings in such a runs shall not be greater than 100 feet for steel conduit and 50 feet for PVC conduit.

O. Electric metallic tubing (thin wall), where installed inside air-conditioned buildings above grade only, shall be joined with steel fittings and steel compression connectors.

P. Conduit installations on roofs shall be kept to a bare minimum. Where required, conduit shall be rigid aluminum conduit, including couplings. Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Supports to be fastened to roof using roofing adhesive as approved by roofing contractor.

Q. Underground cable identification: bury a continuous, pre-printed, bright colored metalized plastic (electronically traceable) ribbon cable marker with each underground conduit (or group of conduits), regardless of whether conduits are in ductbanks. Locate directly over conduits, 6" to 8" below finished grade. Delete this requirement under building slabs.

R. Provide for separation of instrumentation, control and power conductors. Provide a minimum of 24" inch separation for parallel runs of power conduit to instrumentation or control conduit with either conduit being PVC or Aluminum. This separation can be reduced to 8" if metallic grounded separation is provided (steel conduit).

U. Duct seal all conduit entrances. Foam seal is not acceptable.

V. All conduit runs shall have (1) spare conduits installed in the run sized to match the largest conduit in the run.

W. All conduit penetration into control panel cabinets shall be accomplished utilizing aluminum or stainless steel Myers Hubs consistent with the conduit type utilized.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS & DUCTBANKS

PART 1 - GENERAL

1.01 Provide underground duct banks for power and lighting feeders; instrumentation and control systems as shown or as specified herein; from point of service switchgear or equipment to the point of distribution or equipment served.

1.02 SUBMITTALS

A. Submit shop drawings or cut sheets on

1. Conduit
2. Fittings
3. Conduit Separators
4. PVC solvent
5. Precast concrete manholes
6. Composite handholes
7. Cable lubricants

1.03 DESCRIPTION OF ASSEMBLY

A. Underground duct banks shall be multiple individual conduits encased in reinforced concrete as indicated on the drawings. Conduits within building or structural foundations and protected by a concrete slab above them do not require encasement (except provide encasement or flowable fill under electrical and pump room slabs). The conduit shall be of plastic (PVC sch 40 for concrete encasement and Sch80 without concrete encasement), unless indicated or specified otherwise. The conduit used shall not be smaller than 4 inches in diameter, inside, unless otherwise noted. The concrete encasement surrounding the duct bank shall be rectangular in cross-section, having a minimum concrete thickness of three inches around all conduits. All concrete encased duct banks shall be steel reinforced as detailed. Power distribution conduits shall be separated by a minimum dimension of four inches and not less than 7.5" center to center. Power conduits shall be separated from low voltage instrumentation & control conduits by a minimum dimension of twenty-four inches.

B. The concrete work shall conform to Section on "Concrete". The top of the concrete envelope shall be not less than 24 inches below grade unless otherwise indicated. Concrete shall be installed in a continuous pour to eliminate joints in the duct run. The duct bank sides shall be formed in place using suitable concrete form work or corrugated metal forms. Open trench pours will not be allowed.

C. Plastic conduit, fittings and joints shall not have been stored in the sun or weather, in any excessively heated space, or unevenly supported during storage. Use and installation shall be in accordance with the National Electrical Code requirements for the installation of non-metallic rigid conduit. Plastic conduit shall be protected against the direct rays of the sun prior to installation. Conduit shall be PVC schedule

40 manufactured by Carlon, Queen City Plastics, or approved substitution. Conduit shall be U.L. listed and conform to NEMA Standards for schedule 40 PVC conduit.

D. Trenches for duct banks shall be completely dry before setting conduits or pouring concrete. Provide well pointing as required if necessary to keep trench dry.

E. Wires and cables in manhole/handhole shall be placed on cable racks. Manhole/handhole shall be cleaned of all loose materials, dirt and debris immediately after completion of new work and shall be in a clean condition when project is completed. Cable racks shall be stainless steel or non metallic with stainless steel hardware, cable racks shall be complete with insulators. Racks shall be Underground Devices or approved substitution.

F. Back filling of trenches shall be in layers not more than 8 inches deep, and shall be thoroughly tamped. The first layer shall be earth or sand, free from particles that would be retained on a 1/4 inch sieve. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The back fill shall be level with adjacent surface, except that in sodded or paved areas, a space equal to the thickness of the sod or paving shall be left.

G. The surface disturbed during the installation of duct shall be restored to its original elevation and condition if not refinished in connection with site work.

H. All unused conduit openings shall be plugged or capped with a suitable device designed for the purpose; caulking compound shall not be used for plugging conduit openings.

I. One No. 2 bare solid tinned copper counterpoise shall be run above all duct banks and shall be run into all manholes/handholes and grounded to 5/8" X 20' driven ground rods. Counterpoise shall run into buildings and be grounded at each structures service ground.

J. All conduits entering a building or structure shall be sealed with duct seal.

PART - 2 PRODUCTS

2.01 DUCT BANK STRUCTURES

A. Precast Concrete Construction: Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and pullboxes.

1. General: Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated precast monolithicly and placed as a unit, or structures may be assembled sections, design and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
2. Construction: Structure top, bottom and wall shall be of a uniform thickness of not less than 4 inches. Quantity, size, and location of duct bank entrance windows shall be as required, and cast completely open by the precaster.

Size of windows shall exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 2 inches. Provide drain sumps for precast structures a minimum of 12 inches in diameter and 6 inches deep.

3. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M198, Type-B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

B. Precast Concrete manholes and pullboxes (handholes): ASTM C 478. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes and pullboxes. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Metal Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

C. Metal Frames and Covers: Shall be made of cast iron. Covers shall weight a minimum 100lb. Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Covers shall have raised letters of identification as indicated on the drawings. Covers shall have an approved antislip surface. Covers shall be rated AASHTO H20.

D. Pulling-In Irons: Shall be steel bars bent cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 6 inches above or below, and opposite the conduits entering the manhole or pullbox. Pulling-in irons shall project into the box approximately 4 inches. Iron shall be hot-dipped galvanized after fabrication.

E. Cable Racks: Rack arms and insulators, shall be sufficient to accommodate the cables. Racks in manhole and pullbox shall be spaced not more than 2 feet apart, and each box wall shall be provided with a minimum of two racks. The wall bracket shall be stainless steel or fiberglass. Slots for mounting cable rack arms shall be

spaced at 8-inch intervals. The cable rack arms shall be of stainless steel or fiberglass and shall be of removable type. Insulators shall be dry-process glazed porcelain. All metal fasteners and hardware portion of racks shall be stainless steel.

F. Grounding in manholes and pullboxes: Provide No. 6 AWG bare copper grounding pigtails on walls of each manhole and pullbox. The pigtails shall be exothermically welded to the reinforcing bars and shall extend at least 8 inches into box. Two pigtails shall be provided in each box.

G. Pull Wire: Plastic rope having a minimum tensile strength of 200 pounds in each empty duct. Leave a minimum of 24 inches of slack at each end of the pull wires.

H. Composite Handholes: Only where composite handholes are indicated on the drawings, use handholes, covers and boxes of polymer concrete as manufactured by Quazite Corporation. The material shall consist of aggregate bound together with a polyester resin and reinforced with continuous woven glass strands. The covers and boxes shall be designed to be installed flush to grade with cover fitting flush to the box and shall be capable of withstanding normal shipping and installation process without chipping, cracking or structural damage. All boxes shall be manufactured with the use of male/female molds to ensure a consistent wall thickness and structural strength and shall be stackable or extra depth. The boxes and covers shall have dimensions as indicated and shall be concrete gray in color. The cover logo shall be recessed into the cover and shall read INSTRUMENTATION or ELECTRIC as indicated. The composite covers shall be designed for a static vertical load of 8,000 pounds and shall be tested, in the box, to a static load of 12,000 pounds (1.5 safety factor). The test load shall be distributed over a 10 inch by 10 inch by 1 inch thick distribution plate located at the center of the cover. The maximum deflection at a load of 8,000 pounds shall not exceed 0.50 inches. The covers shall be skid resistant and have a minimum coefficient of friction of 0.50 on the top surface for the life of the cover. Coatings will not be provided. The permanent deflection of any surface shall not exceed 10% of the maximum allowable test load deflection. The lockdown mechanism shall be capable of withstanding a minimum torque of 30 foot-pounds. All inserts and fasteners shall be of stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION: conform to NFPA 70 and ANSI C2.

A. The top of the conduit shall be not less than 24 inches below grade, for low voltage conduits and 48 inches for high voltage ducts. Run conduit in straight lines except where a change of direction is necessary. Provide not less than 3 inches clearance from the conduit to each side of the trench. A minimum clearance of 2 1/2 inches shall be provided between adjacent conduits. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve.

B. Precast manhole and pullbox Installation: Commercial precast assembly shall be set on 6 inches of level, 90 percent compacted granular fill, 3/4-inch to 1-inch size, extending 12 inches beyond the manhole or pullbox on each side. Granular fill shall

be compacted by a minimum of four passes with a plate type vibrator.

C. Buried Warning and Identification Tape: Metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3-inch-minimum width, color coded as specified below for the intended utility and warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow or red: Electric power

Orange: Instrumentation and Control

D. Conduit Placement: Duct lines shall have a continuous slope downward toward manholes/handholes and away from buildings with a pitch of not less than 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends may be made up or one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

E. Termination and Cleaning of Conduit: Terminate conduits in end-bells where duct lines enter manholes and pullboxes. Separators shall be of precast concrete, high impact polystyrene, steel, or a combination of these. Stagger conduit joints by rows and layers to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand, and dirt with suitable conduit plugs. As each section of a duct line is completed, draw a non-flexible testing mandrel not less than 12 inches long with a diameter 1/4 inch less than inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush having the same diameter of the duct through the duct, until duct is clear of particles of earth, sand, and gravel; then immediately install end plugs.

F. Conduit Protection at Concrete Penetrations: Conduits which penetrate concrete (slabs, pavement, and walls) shall be galvanized rigid steel; protected by a PVC sheath at the penetration; PVC sheath shall be 40-mils thick conforming to NEMA RN 1, and shall extend from at least 2 inches below the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches above concrete).

G. Cable Pulling: Pull Cables down grade with the feed-in point at the manhole or pullbox or point of the highest elevation. Use flexible cable feeds to convey cables through box opening and into duct runs. Accumulate cable slack at each box where space permits by training cable around the interior to form one complete loop. Maintain minimum allowable bending radii in forming such loops.

H. Cable Lubricants: Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

I. Cable Pulling Tensions: Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

J. Installation of Cables in manholes and pullboxes and Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space opening for future cables, except as otherwise indicated for existing installations.

K. FIREPROOFING OF CABLES IN MANHOLES: All wire and cables in manholes shall be fireproofed. Strips of fireproofing tape approximately 1/16 inch thick by 3 inches wide shall be wrapped tightly around each cable spirally in one-half lapped wrapping, or in two butt-jointed wrappings with the second wrapping covering the joints in the first. The tape shall be applied with the coated side toward the cable, and shall extend one inch into the ducts. To prevent unraveling, the fireproofing (Arc-proofing) tape shall be random wrapped with tape conforming to type FGT of specification MIL-I-15126. The fireproofing (arc proofing) tape shall consist of a flexible, conformable fabric having one side coated with a flame-retardant, flexible, polymeric coating and/or a chlorinated elastomer. The tape shall not be less than 0.050 inch thick, and shall weigh not less than 2.5 pounds per square yard. The tape shall be non-corrosive to cable sheath, shall be self-extinguishing, and shall not support combustion. The tape shall not deteriorate when subjected to oil, water, gases, saltwater, sewage and fungus. The tape shall have a tensile strength of not less than 40 pounds per inch width, and when tested under USA Standard L14.184 cut strip method. Provide certification the product retains 65 percent of its original tensile strength for the following tests for 168 hours for each requirement;

1. Immersion in distilled water,
2. Immersion in 3 percent salt water,
3. Exposure to ultra-violet light (30-watt germicidal lamp),
4. Exposure to sunlight (Type S-1 sun lamp), and exposure to concentrated sewage.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

A. Provide materials and installation for the identification of electrical equipment, components, cables and wiring and safety signs.

B. Related Work Specified in Other Sections Includes:
Section 26 05 02-Basic Electrical Materials and Methods; Section 26 05 19 Low-Voltage Wires and Cables; Section 26 08 00Acceptance Testing Performance Verification and Section 26 29 13 Control Panels,

1.02 REFERENCES

A. Codes and standards incorporated within this Section are:
1. ANSIC2/NFPA70E National Electrical Safety Code (NESC)
2. ANSI Z535.1 Safety Color Code
3. ANSI Z535.2 Environmental and Facility Safety Signs
4. ANSI Z535.3 Criteria for Safety Symbols
5. OSHA Occupational Safety and Health Act: specification 1910.145, Standards for Accident Prevention, Signs and Tags

1.03 SUBMITTALS: Furnish all product submittals used.

A. Product Data and Information: Furnish manufacturer's catalog data for safety signs, nameplates, labels and markers.

B. Furnish manufacturer's instructions indicating application conditions and limitations of use, and storage, handling, protection, examination and installation of product.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
1. W. H. Brady Company
2. Seton
3. Thomas & Betts A.
4. Approved Equal

2.02 MATERIALS

A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.

B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with white letters on Black background with lettering etched through the outer covering and fastened with corrosion resistant stainless steel screws. Do not use mounting cement for fastening nameplates.
   1. Provide nameplates with 1-inch high lettering for main breakers, automatic transfer switches, panelboards, transformers, VFD's, control panels and disconnect switches.
   2. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor. Submersible motor nameplates to be affixed to equipment disconnect.
   3. Provide approved directories of circuits with typewritten designations of each branch circuit in each panelboard.
   4. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.

2.03 WIRE MARKERS: Identify wire bundles and each individual wire.

A. Wire bundles: Provide a permanent waterproof brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".

B. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger

C. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

E. Write-On Tags: Polyester tag, 0.015-inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable: Marker for Tags: Permanent, waterproof, black-ink marker recommended by tag manufacturer.

F. Manufacturers and Products:
   1. Sleeve: Raychem; Type D SCE or ZH SCE. Brady, Type 3PS.
   2. Heat Bond Marker: Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive. Self-laminating protective shield over text. Machine printed black text. Manufacturer 3M Co.; Type SCS HB.
   3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
   4. Tie-On Cable Marker Tags: Chemical-resistant white tag. Size: 1/2 inch by 2 inches. Manufacturer and Product: Raychem; Type CM SCE.

2.04 SAFETY SIGNS: Provide safety signs in accordance with OSHA standards meeting the requirements of ANSI C2, ANSI Z535.1, ANSI Z535.2 and ANSI Z535.3. Comply with NFPA 70 and 29 CFR 1910.145

A. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils

with red and black letters and graphics on a white background.

B. Size: Provide 7-inch by 10-inch signs or smaller if larger size cannot be applied.

C. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.

D. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

E. All receptacles and switches shall be identified on the inside of the cover plate by circuit number and panelboard.

F. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

G. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing, and with colors, legend, and size required for application and with 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

2.05 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch. Identification plates shall be furnished for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, pilot lights, disconnect switches, manual starting switches, magnetic starters, and all miscellaneous controls, switches and enclosures.

B. Process control devices and pilot lights shall have identification plates. Identification plates shall be furnished for all line-voltage enclosed-circuit breakers; the plates shall identify the equipment served, voltage, phase(s), and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

C. Identification plates shall be three-layer white-black-white, engraved to show black letters on a white background. Letters shall be uppercase. Identification plates 1-1/2 inches high and smaller shall be 1/16 inch thick with engraved lettering 1/8 inch high. Identification plates larger than 1-1/2 inches high shall be 1/8 inch thick with engraved lettering not less than 3/16 inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled:

D. Provide nameplates of minimum letter height as follows: Panelboards, switchboards, safety switches and motor control centers: 1/4-inch, identify panel name; 1/8-inch, identify voltage, phase, number of wires, and source.

E. Safety color coding for identification of warning signs shall conform to NEMA Z 535. Red identification plates reading CAUTION: 480/277 VOLTS shall be provided in

switch and outlet boxes containing 277-or 480-volt circuits. An identification plate marked DANGER: 480 VOLTS shall be provided on the outside of 480-volt enclosures. Identification plate shall use white lettering on a red laminated plastic.

F. Any equipment with externally powered wiring shall be marked with a laminated plastic name plate having 3/16-inch-high white letters on a red background as follows: DANGER – EXTERNAL VOLTAGE SOURCE.

G. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying equipment in building, and the area served by each.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant stainless steel screws. Labels to be consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual designations. Warning Labels for Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

B. Install laminated nameplates identifying, each electrical equipment enclosure and Individual equipment and devices. The following items shall be equipped with nameplates: All motors; motor starters, motor-control centers, pushbutton stations, control panels, time switches, disconnect switches, panelboards, circuit breakers, contactors, recorders, transmitters, instruments or relays in separate enclosures, thermostats, photocells, power receptacles, switches controlling equipment or receptacles, switches controlling lighting fixtures where the fixtures are not located within the same space as the controlling switch, termination cabinets, manholes and pull boxes, instrumentation and control terminal cabinets, pull boxes manholes and cabinets. Special electrical systems shall be identified at junction and pull boxes, terminal cabinets and equipment racks.

C. Electrical contractor is responsible for nameplates on electrical equipment supplied by other divisions and installed and wired by electrical including all instrumentation and controls equipment. A portion of existing equipment affected by this contract shall also receive nameplates as determined by the engineer.

D. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

E. Nameplates shall adequately identify the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 277/480V, 3-phase, 4-wire". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine. Equipment Requiring Workspace Clearance shall be labeled According to NFPA 70 applied to door or cover of equipment.

F. Label all disconnects with nameplates as well as the location from which they are fed.

G. Rework or reuse of existing equipment will require new identification tags for some existing equipment.

H. Wire Markers: Identify each individual wire with identification tags as follows:
1. Wire identification markers: Provide wire identification markers on each wire at all termination points.
a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings
b. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.
c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
2. Provide oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.
3. All wires whether spare or used shall be tagged.
4. Mark wire at both ends.

I. Raceway Tags
1. Provide raceway tags to identify origin and destination of conduit. Install tags at each terminus and at midpoint of run. Provide tags at minimum intervals of every 50 feet of above grade raceway except where concealed in walls. Provide 316 stainless steel tags and stainless steel straps for attachment.
2. Tag numbers to match that submitted on approved conduit schedule.

J. Safety Signs: Provide safety signs as follows or as shown:
1. Wording: "DANGER -ELECTRICAL EQUIPMENT, AUTHORIZED PERSONNEL ONLY" Location: On the outside door of all electrical equipment rooms or areas. On the outside door of all electrical equipment cabinets.
2. Wording: "DANGER -POWERED FROM MORE THAN ONE SOURCE" Location: Outside all equipment that operates from more than one power source; ATS, PLCs, Main Tie Main switchgear/MCCs, etc.
3. Wording: "NOTICE -KEEP DOOR CLOSED" Location: On all doors with another safety sign installed.
4. Wording: "CAUTION -CONTROLS & INTERLOCKS POWERED FROM MULTIPLE SOURCES". Location: On all control panel doors, MCCs I&C terminal cabinets, etc.

K. Create and submit conduit schedule. Schedule to identify conduit tag numbers, the location the conduit connects and the wire count.

END OF SECTION

SECTION 26 05 70

WIRING DEVICES

PART 1 – GENERAL

1.01 SCOPE

A. The Work of this Section shall consist of furnishing all labor, materials, and equipment necessary for installation of wiring devices and plates.

1.02 REFERENCES

A. The latest edition of the following codes or standards shall apply to the design and fabrication of the products and equipment to be supplied under this contract.
   1. NEC (NFPA 70) National Electrical Code
   2. NETA International Electrical Testing Association - Acceptance Testing Specifications
   3. NEMA 250 - Enclosure for Electrical Equipment (1,000 Volts Maximum)
   4. Local Building Codes and Standards
   5. UL 1449 3rd edition Standard for Surge Protection Devices
   6. UL 498 Standard for Safety Attachment Plugs and Receptacles

1.03 SUBMITTALS

A. Furnish submittals in accordance with Section 26 05 02 Special Electrical Requirements.

B. Shop Drawings: Complete catalog cuts of switches, receptacles, enclosures, covers, and appurtenances, marked to clearly identify proposed materials

C. Documentation showing that proposed materials comply with the requirements of NEC and U.L.

1.04 TESTING

A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 05 11.

B. Test each receptacle for polarity and ground integrity with a standard receptacle tester.

C. Test GFCI receptacle for correct tripping operation with tester.

PART 2 – PRODUCTS

2.01 SNAP SWITCHES

A. Unless otherwise specified, each snap switch (flush tumbler-toggle) shall be of the Specification grade, heavy-duty type for mounting in a single-gang spacing,

fully rated 20 amperes, minimum, at 120-277 VAC, conforming to minimum requirements of the latest revision of the UL.

B. Switches shall operate in any position and shall be fully enclosed cup type with entire body molded phenolic or melamine. Fiber, paper of similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts. Brass contact arm.

C. Switches for hazardous locations shall be factory sealed, rated at 20 amperes, 120-277 VAC, capable of controlling 100 percent tungsten filament, fluorescent and HID lamp loads.

2.02 RECEPTACLES

A. Industrial or Hospital Grade: receptacles shall be in accordance with NEMA Publications and UL Listings. Receptacles shall be rated for 125VAC, 20 amperes, shall be polarized 3 wire type for use with 3 wire cord with grounded lead and 1 designated stud shall be permanently grounded to the conduit system (NEMA 5-20R). Receptacles shall also be fire-resistant, with nylon top (face) and bodies and bases with metal plaster ears (integral with the supporting member).

B. Provide single or duplex receptacles as shown or noted on drawings, and ivory color unless otherwise noted, with triple wipe or equivalent brass alloy power contacts for each prong. Approved manufacturers are Hubbell, Cooper, Pass & Seymour, or Leviton.

C. All receptacles shall be grounding type with a green-colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper in accordance with NEC, Article 250. Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.

D. GFCI: Ground-fault circuit interrupting receptacles (GFCI's) shall be installed at the locations indicated and as required by the NEC. GFCI's shall be duplex, Industrial or Hospital grade, tripping at 5 mA. Ratings shall be 125 V, 20 amperes, NEMA WD-1, Configuration 5-20R, capable of interrupting 5,000 amperes without damage.

E. Provide GFCI receptacles where shown and as required. Feed-through type GFCI's serving standard receptacles will not be permitted.

F. Pedestal type boxes for receptacles shall be cast iron 3/4 inch N.P.T. tapped flanged inlet; double gang, meeting UL Standard 514.

G. Special purpose receptacles shall have ratings and number of poles as indicated or required for anticipated purpose. Matching plug with cord-grip features shall be provided with each special-purpose receptacle.

H. Receptacles for hazardous locations shall be single gang receptacles with spring door. Receptacles shall have a factory sealed chamber. The receptacles shall have a delayed action feature requiring the plug to be inserted in the receptacle and rotated before the electrical connection is made. The receptacle shall not

work with non-hazardous rated plugs. One plug shall be furnished with each receptacle. The receptacles shall be rated for 20 amps at 125 VAC.

I. SPD Receptacles: Transient voltage surge suppressing receptacles provided with a filtering capacitor for 7 to 1 average noise reduction and Two-way protection for line equipment. Response time less than 1 nanosecond for un-mounted Metal Oxide Varistor (MOV); Overcurrent protection; Thermal protection; Varistor with voltage capabilities of 150V RMS

J. Outdoor mounted Receptacles shall be corrosion resistant and shall in addition to meeting the requirements of general-purpose receptacle have Nickel coated metal parts. Manufacturer; Hubbell Bryant; 20A rated HBL53CM62 Series or equal.

K. Outdoor mounted Receptacles shall be furnished with aluminum weatherproof while in use covers.

2.03 SWITCH, MOTOR RATED: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection. UL 508 listed. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Minimum General Purpose Rating: 30 amperes, 600V ac. Manufacturer: Cooper Arrow Hart; Hubbell Bryant: HBL78 Series; Leviton.

2.04 PLUG CAPS & CORDS: Provide and install a matching plug cap and properly sized cord for equipment items noted on the drawings.

2.05 DEVICE PLATES

A. Provide device plates for each switch, receptacle, signal and telephone outlet, and special purpose outlet. Do not use sectional gang plates for multi-gang boxes. All Plates shall be of stainless steel.

PART 3 – EXECUTION

3.01 GENERAL: Perform work in accordance with the National Electrical Code.

3.02 CONNECTION: Rigidly attach wiring devices in accordance with National Electrical Code. Coordinate installation avoiding interference with other equipment.

3.03 GROUNDING: Ground all devices, including switches and receptacles, in accordance with NEC, ART 250.

A. Ground switches and associated metal plates through switch mounting yoke, outlet box, and raceway system.

B. Ground flush receptacles and their metal plates through grounding jumper connections to outlet box and grounding system.

END OF SECTION

SECTION 26 05 73

SHORT CIRCUIT & COORDINATION STUDY & ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.01 GENERAL SCOPE

A. Provide the services of a recognized corporately and financially independent firm for the purpose of performing electrical studies and reports on all new electrical equipment supplied in this contract and on existing equipment as herein specified. It is the intent of these specifications that the study firm work in direct communication with the engineer of record with frequent updates as the work progresses. The study firm shall provide all material, equipment, labor and technical supervision required to perform the studies and reports.

B. Provide a short circuit, coordination and arc-flash study for entire electrical system. Provide a single final electrical study report incorporating the short circuit, coordination and arc flash study. The final document shall become part of the operation and maintenance manuals for the facility. The report shall be submitted on 8.5" X 11" paper bound with all field data in appendix form. Drawings within the testing report shall be on 11" X 17" paper folded to 8.5" X 11" and drawn with a computer aided design (CAD) package. The computer aided design package shall be Autocad or converted to Autocad. All adjustable breakers shall be fitted with a sticker indicating the coordination values for the equipment.

C. Provide a short circuit, coordination and arc-flash study from the Generator and Utility Service primary OCP to all points downstream. Provide system studies in latest release of SKM Power Systems software. Provide CD-Rom electronic version of SKM Power Systems software data files bound in study report for future use by owner. The electrical system studies shall be signed and sealed by a Florida registered electrical engineer. The signing engineer shall verify all documentation and record drawings. The signing engineer shall meet at the site with the electrical design engineer during the information gathering phase and after system evaluation to discuss remedial changes necessary for code compliance. The remedial work study changes shall be incorporated within the electrical studies at no additional cost to the owner.

1.02 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
   2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
   3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
   4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
   5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit

Breakers Used in Industrial and Commercial Power Systems.

6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):
   1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
   3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
   5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)
   1. NFPA 70 - National Electrical Code, latest edition
   2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.03 QUALIFICATIONS

A. The study firm shall be regularly engaged in the study of electrical equipment devices, installations, and systems. The lead technical person shall be a electrical professional engineer in the state of Florida.

B. The following study firms are provided for information only and other qualified companies will be considered by the County:
   1. Emerson Electrical Reliability Services, Inc. (239)-693-7100
   2. Industrial Electrical Testing, Inc. (904) 260-8378
   3. Crews Electrical Testing, Inc. (904) 880-8686

PART 2 - PRODUCT

2.01 SHORT-CIRCUIT ANALYSIS AND COORDINATION STUDY for all new electrical equipment. Provide an integrated complete study for the total electrical system.

A. Data Collection: Study Firm shall furnish all field data as required by the power system studies. All data shall be verified on site by the signing engineer. The study firm shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Data may require combination to include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents and site visits.

D. Include fault contribution of existing motors in the study, with motors < 10 hp

grouped together. The testing firm shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.02 Provide a current and complete short-circuit study, equipment interrupting or withstand evaluation, and a protective device coordination study for the electrical distribution system.

A. The studies shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

B. The studies shall be submitted to the project electrical engineer prior to granting final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.

C. The study shall be in accordance with applicable ANSI and IEEE Standards. The study input shall include the utility company's short circuit single and three phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.

D. Short circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.

E. An equipment evaluation study shall be performed to determine the adequacy of new and existing circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the available fault currents. Any problem areas or inadequacies in the existing equipment shall be documented back to the project engineer with recommended remedial actions. The study firm shall coordinate with the supplier of the new equipment to assure all specifications of the new equipment meet or exceed the ratings required by the study at no additional cost to the owner.

F. A protective device coordination study shall be performed to select or to check the selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings. The coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down to and including each motor control center and/or panelboard. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.

G. The time current characteristics of the specified protective devices shall be plotted on appropriate log-log paper. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays of fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves, and fuse curves. The coordination plots shall indicate the types of protective

devices selected, proposed relay taps, time dial and instantaneous trip settings, ANSI transformer magnetizing inrush and withstand curves per ANSI C37.91, cable damage curves, symmetrical and asymmetrical fault currents. All requirements of the current National Electric Code shall be adhered to. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate the coordination achieved to each utility main breaker, primary feeder breaker, unit substation primary protective device rated or more. There shall be a maximum of four protective devices per plot.

H. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system. Discrepancies, problem areas, or inadequacies shall be coordinated with the equipment suppliers and resolved with in the scope of the project and at no additional cost to the owner.

I. The results of the power system study shall be summarized in a final report and made part of the operation and maintenance manuals. The report shall include the following sections;
   1. Description, purpose, basis written scope, and a single line diagram of the portion of the power system which is included within the scope of study.
   2. Tabulations of circuit breaker, fuse and other equipment ratings versus calculated short circuit duties, and commentary regarding same.
   3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection and commentary regarding same.
   4. Fault current tabulations including a definition of terms and a guide for interpretation.

2.03 The contractors certified study firm shall be responsible for setting the breakers. Each breaker shall be fitted with an engraved tag or permanent vinyl label indicating the breaker name and the settings listed: Adjustable pickups and time delays (long time, short time, ground); Adjustable time-current characteristic; Adjustable instantaneous pickup; Recommendations shall incorporate revised settings to mitigate excessive arc flash hazard.

2.04 ARC FLASH EVALUATION

A. Provide an investigation to quantify the arc-flash hazard to which workers could be exposed to throughout the facility. Establish arc-flash intensity data for all electrical equipment where there may be an occasion to open doors, remove covers or work on the electrical equipment in such a way that workers are exposed to energized conductors.

B. Provide a safety policy to include procedures and information regarding the arc flash data developed for the site. Provide a written recommendation for PPE equipment following the simplified approach to PPE defined in NFPA 70E Annex H. The site safety manual to include procedures and methods related to energized work, PPE standards, and the arc-flash data developed in the analysis.

C. Provide arc flash evaluations in conformance to the latest edition of IEEE Std. 1584- *IEEE Guide for Performing Arc-Flash Hazard Calculations* and NFPA 70- *National Electrical Code* and NFPA 70E-*Standard for Electrical Safety in the Workplace.* The arc flash study shall be performed using computer software that uses methods based on IEEE Std. 1584. The software used must be capable of modeling all protective devices at the site and any mitigation devices used to limit the incident energy. The software used must have the capability of modeling user defined PPE descriptions and ATPV values as well as limiting the maximum clearing time where engineering judgment deems it prudent.

D. The study firm shall collect all data required for the arc flash evaluation. The existing settings and equipment types and ratings shall be field verified. Any data that should be determined to be unverifiable (due to safety or operational concern) shall be identified to the engineer and alternate means to determine the data shall be used.

E. Where the calculations determine that the breaker settings result in arc flash hazard of category three, four or with incident energy levels (>40 cal/cm^2), the study engineer shall provide recommended breaker settings or other mitigation recommendations to reduce the incident energy to the lowest level and where energized work is capable of being performed. The study firm shall document the recommended changes and provide time-current curves indicating the coordination that reflects the recommended settings. Where main switchgear incorporates fully compartmentalized breakers and insulated bus, analyze utility main and genset main breaker compartments separate from feeder breaker compartments.

F. Provide color coded labels per ANSI Z535.4; Orange=Warning, Red=Danger. Provide arc flash hazard/risk category 0-2 with an incident energy of 0-8cal/cm2 equipment with Orange “Warning” Labels. Provide arc flash hazard/risk category 3-4 with an incident energy of 8-40cal/cm2 equipment with Orange “Warning” Labels. Provide Red “Danger” labels with the words “Energized Work Prohibited” in areas of extreme hazard above 40cal/cm2. Provide labels as approved by the engineer consistent with utility standards and in accordance with the simplified PPE approach defined in NFPA 70E, Annex H.

G. Provide permanent labels for each electrical enclosure or equipment where workers could be exposed to energized conductors. Provide die-cut 4" x 6" labels with preprinted headers. Organize safety information in approved order to communicate quickly, clearly and accurately. Provide Die-cut labels made from industrial grade indoor/outdoor vinyl, providing a long label life. Labels shall not include study firm information. Label layout shall be approved by the project engineer. Provide orange Warning and red Danger labels for category 0-2, 3-4 and above incident energy categories. Study firm shall supervise installation of labels and provide a statement in the project report that the labels are approved as installed. These labels shall comply with the requirements of NFPA 70E and include at least the following information:

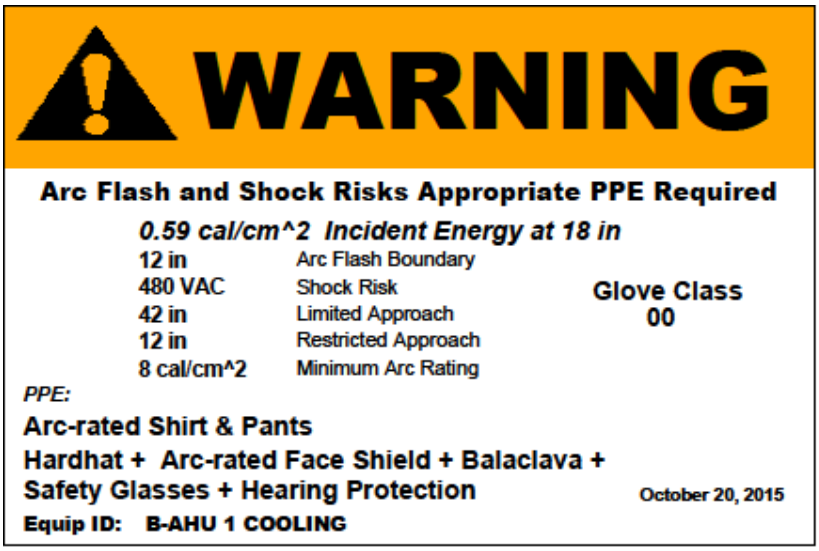
- Voltage (phase to phase).
- Flash Protection Boundary (inches).
- Incident Energy at the working distance (cal/cm^2).
- PPE Class and Description (Including glove rating).

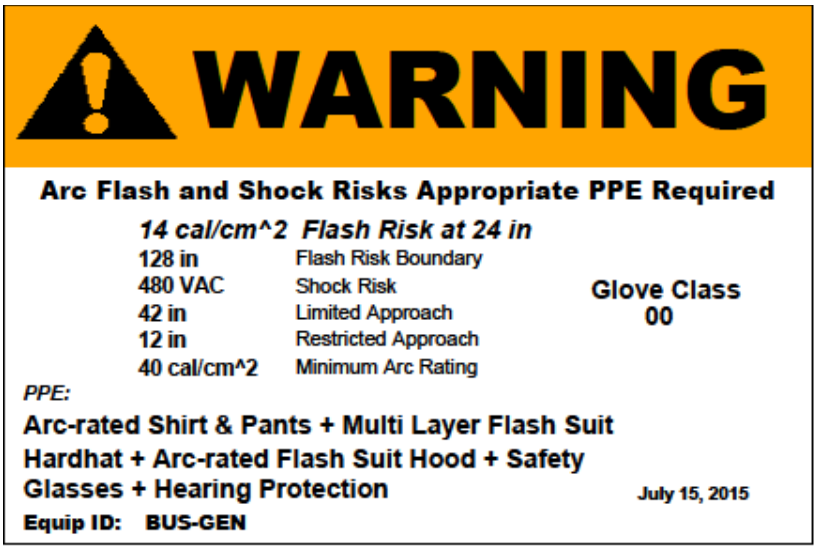
- Restricted Approach Boundary (inches).
- Limited Shock Approach Boundary (inches).
- Prohibited Shock Approach Boundary (inches).
- Location Identification

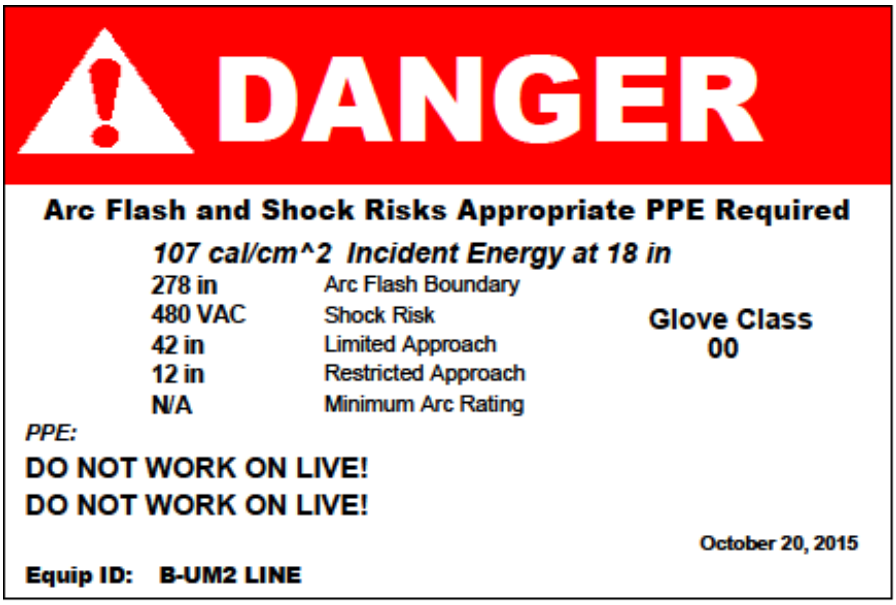
H. Provide a comprehensive report that includes the basis for and results of numerical assessments. The report shall include any significant conclusions and recommendations for corrective or mitigative action as appropriate. In addition, the report shall include the following:

- Summary of project.
- Description of system and equipment included in the assessment.
- Identification of the methods or software used.
- Date work was performed.
- Identification of the person that performed the assessment.
- Tabular data indicating; the incident energy and required PPE for all locations evaluated.
- Detailed datasheets for each location studied.
- Tabular data of recommended settings changes.
- Time-current curves for the locations with recommended settings changes.
- A one-line diagram of the computer model.

I. Sample Arc Flash Labels:







END OF SECTION

SECTION 26 08 00

ACCEPTANCE TESTING AND PERFORMANCE VERIFICATION

PART 1 - GENERAL

1.01 GENERAL SCOPE

A. The Contractor shall engage the services of a recognized corporately and financially independent testing firm for the purpose of performing inspections and tests on all new electrical equipment supplied in this contract and on existing modified equipment as herein specified. All tests shall be documented. It is the intent of these Specifications that the testing firm work in direct communication with the engineer of record with frequent testing data updates as the work progresses.

B. The testing firm shall provide all material, equipment, labor and technical supervision to perform such tests and inspections. Qualified professional engineering staff shall supervise testing.

C. It is the purpose of these tests to assure that all tested electrical equipment, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications. Tests shall be performed with and in cooperation with certification tests performed by switchgear and generator manufacturer. The testing contractor shall be an integral part in assuring the coordinated testing and startup of the power system. The tests and inspections shall determine suitability for energization.

D. An itemized description of existing equipment (wellfield equipment) to be inspected and tested is as follows:
   1. Provide testing of existing feeders that are relocated, extended or disturbed in any way.
   2. Provide testing of existing breakers that are re-fed, relocated, re-cabled or disturbed in any way.

E. The above electrical testing shall be used in the development of the final testing report encompassing all new and existing electrical equipment; submitted with the operation and maintenance manuals prior to substantial completion of the project. The testing report shall be submitted on 8.5-inch by 11-inch paper bound with all field test data in appendix form plus an electronic copy in Adobe PDF format. All tested breakers shall be fitted with a sticker indicating the testing firm, date and technician performing the test.

1.02 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and test shall be in accordance with the following codes and standards except as provided otherwise herein:
   1. National Electrical Manufacturer's Association – NEMA.
   2. American Society for Testing and Materials – ASTM.

3. Institute of Electrical and Electronic Engineers – IEEE.
4. International Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1991.
5. American National Standards Institute - ANSI C2: National Electrical Safety Code.
6. State and local codes and ordinances.
7. Insulated Cable Engineers Association – ICEA.
8. Association of Edison Illuminating Companies – AEIC.
9. Occupational Safety and Health Administration – OSHA.
10. National Fire Protection Association – NFPA.
    a. ANSI/NFPA 70: National Electrical Code.
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance.
    c. NFPA70E: Standard for Electrical Safety in the Workplace.
    d. ANSI/NFPA 780: Lightning Protection Code.
    e. ANSI/NFPA 101: Life Safety Code.

B. All inspections and test shall utilize the following references:
1. Project design Specifications.
2. Project design Drawings.
3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.03 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, supplier, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The following testing firms are provided for information only and other qualified companies will be considered by the County:
1. Emerson Electrical Reliability Services, Inc.
2. Industrial Electrical Testing, Inc.
3. Electric Power Systems.
4. Circuit Breaker Sales & Service.

1.04 DIVISION OF RESPONSIBILITY

A. The Contractor shall perform routine insulation-resistance, continuity, and rotation test for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The Contractor shall supply a suitable and stable source of electrical power to each test Site.

C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling. However the testing firm shall visit the Site a minimum of once a week to perform

coordination duties required and make reports to the engineer of the installation progress.

D. The testing firm shall notify the engineer prior to commencement of any testing.

E. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.

F. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

G. Safety and Precautions:
   1. Safety practices shall include, but are not limited to, the following requirements:
      a. Occupational Safety and Health Act.
      b. Accident Prevention Manual for Industrial Operations, National Safety council.
      c. Applicable state and local safety operating procedures.
      d. Owner's safety practices.
      e. National Fire Protection Association - NFPA 70E-2009.
      f. American National Standards for Personnel Protection.
   2. All test shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.
   3. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

1.05 SUITABILITY OF TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition.

B. Digital multimeters used shall be RMS sensing when the variable be measured contains harmonics or dc offset or any deviation from a pure sine wave. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of 2 percent of the scale used.

PART 2 - INSPECTION AND TEST PROCEDURES

2.01 SWITCHGEAR, SWITCHBOARD AND PANELBOARD ASSEMBLIES

A. Visual and Mechanical Inspection:
   1. Inspect for physical, electrical, and mechanical condition.
   2. Compare equipment nameplate information with latest one-line diagram.
   3. Check for proper anchorage, required are clearances, physical damage and proper alignment.
   4. Inspect all doors, panels, and sections for paint, dents, scratches, fit and missing hardware.
   5. Verify that fuse and/or circuit breaker sizes and types correspond to Drawings.
   6. Verify that current and potential transformer ratios correspond to drawings. Inspect all bus connections for high resistance.

7. Check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels. Inspect shipping splits for mechanical connection assuring adequate surface contact.
8. Test all electrical and mechanical interlock systems for proper operation and sequencing. Closure attempt shall be made on locked open devices. Opening attempt shall be made on locked closed devices. Key exchange shall be made with devices operated in off normal positions.
9. Clean entire switchgear using manufacturer's approved methods and materials.
10. Inspect insulators for evidence of physical damage or contaminated surfaces.
11. Verify proper barrier and shutter installation and operation.
12. Lubrication: Verify appropriate contact lubricant on moving current carrying parts. Verify appropriate lubrication on moving and sliding surfaces.
13. Exercise all active components.
14. Inspect all mechanical indicating devices for proper operation.

B. Electrical Tests:
1. Perform tests on all instrument transformers.
2. Perform ground resistance tests.
3. Perform insulation resistance on each bus section, phase-to-phase and phase-to-ground for three (3) minutes. Test voltages and minimum resistances shall be in accordance with NETA recommendations.
4. Perform low ohm resistance test on ground bonding & shipping splits with ductor tester (Digital low ohm resistance meter) to insure connection is a low resistance connection. Test from one fixed bus to adjacent fixed bus through the shipping split connector to measure both connection points. Microhm values shall not vary more than 50 percent from other phase readings and meet the manufactures published data based on bus size, ampacities and material.
5. Perform an overpotential test on each bus section, each phase-to-ground, for three (3) minutes at values indicated in ANSI/IEEE C37.20.2. or manufacturer's recommended potential.
6. Perform insulation-resistance test on control wiring except where connected to solid state components.
7. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.
8. Perform secondary voltage energization test on all control power circuits and potential circuits as detailed in this specification. Check voltages levels at each point on terminal boards and at each terminal on devices.
9. Perform current injection tests on the entire current circuit in each section of switchgear. Perform current test by primary injection where possible; secondary injection if not.
10. Determine accuracy of all meters and calibrate watt-hour meters. Verify multipliers.
11. Perform phasing check on double-ended switchgear to ensure proper bus phasing from each source.
12. Control Power Transformers - Dry Type:

a. Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
b. Verify proper primary and secondary fuse ratings or circuit breakers.
c. Verify proper interlock function and contact operation.
d. Perform insulation-resistance test. Perform measurements from winding-to-winding and windings-to-ground.
e. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check potential at all devices. Verify proper secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

13. Potential Transformer Circuits:
a. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check for proper potential at all devices.
b. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

C. Test Values: Verify Bolt-torque values, Insulation resistance, overpotential levels in conformance to NETA standards or specified by manufacturer.

2.02 CABLES - LOW VOLTAGE - 600V MAXIMUM (ALL CABLES EXCEPT 20 AND 30AMP LIGHTING AND RECEPTACLE CIRCUITS).

A. Visual and Mechanical Inspection:
1. Inspect cables for physical damage and proper connection in accordance with Drawings.
2. Test cable mechanical connections to manufacturer's recommended values or NETA Standards using a calibrated torque wrench.
3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests:
1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1,000-volts dc for 3 minutes.
2. Perform continuity test to insure proper cable connection.
3. Test Values; Evaluate results by comparison with cables of same length and type. Minimum acceptable value shall be no less than 50 megohms for new feeders; 5megohms for existing reused, renovated, rerouted or extended feeders.

2.03 CIRCUIT BREAKERS (ALL BREAKERS EXCEPT 20AMP LIGHTING AND RECEPTACLE BREAKERS; TEST ALL GFCI BREAKERS)

A. Circuit Breakers - Low Voltage insulated case/molded case:
1. Visual and Mechanical Inspection:
a. Check circuit breaker for proper mounting and compare

nameplate data to drawings and specifications.

b. Operate circuit breaker to ensure smooth operation.

c. Inspect case for cracks or other defects.

d. Check tightness of connections using calibrated torque wrench. Refer to manufacturer's instructions or NETA standards for proper torque levels.

2. Electrical Tests:

a. Perform a contact-resistance test.

b. Perform an insulation-resistance test at 1,000-volts dc from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase.

c. Determine long-time minimum pickup current by primary current injection where practical.

d. Perform long-time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time.

e. Determine short-time pickup and delay by primary current injection, if applicable.

f. Determine ground-fault pickup and time delay by primary current injection, if applicable.

g. Determine instantaneous pickup current by primary injection using run-up or pulse method.

3. Test Values:

a. Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.

b. Insulation resistance shall not be less than 100 megohms.

c. Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.

d. All trip times shall fall within NETA Standards. Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.

e. Instantaneous pickup values shall be within NETA standards.

2.04 METERING AND INSTRUMENTATION

A. Visual and Mechanical Inspection:

1. Examine all devices for broken parts, shipping damage and tightness of connections.

2. Verify that meter types, scales and connections are in accordance with Drawings and Specifications.

B. Electrical Tests:

1. Determine accuracy of meters at 25/50/75/100 percent of full scale.

2. Calibrate watt-hour meters to one-half percent (0.5%).

3. Verify all instrument multipliers.

4. Verify calibration of all instrumentation is accurate to the operator interface terminals.

2.05 GROUNDING SYSTEMS: (PROVIDE FOR NEW AND UPGRADED GROUNDING SYSTEMS)

A. Visual and Mechanical Inspection:

B. Inspect ground systems for compliance with Drawings and Specifications.

C. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System." Instrumentation utilized shall be as Approved by NETA Standards and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten. In large ground grid systems where adequate pole distance is not practical provide Tagg Slope technique or the intersecting curves method (Ref. Nos. 40 and 41 in IEEE Std. 81.) of calculating system resistance.

D. Equipment Grounds: Utilize two-point method of IEEE Standard 81. Measure between equipment ground being tested and known low-impedance grounding electrode of system:
   1. Lightning protection ground system test values within the ground system should be 5 ohms or less tested with a clamp on ground test instrument. Down conductor tests at grade level should be 2 ohms or less. Investigate high resistance connections and correct readings above these limits.
   2. The main ground electrode system impedance-to-ground should be no greater than one (1) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

2.06 GROUND-FAULT SYSTEMS

A. Visual and Mechanical Inspection:
   1. Inspect for physical damage and compliance with Drawings and Specifications.
   2. Inspect neutral main bonding connection to assure:
      a. Zero-sequence sensing system is grounded.
      b. Ground-strap sensing systems are grounded through sensing device.
      c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
      d. Grounded conductor (neutral) is solidly grounded.
   3. Inspect control power transformer to ensure adequate capacity for system.
   4. Manually operate monitor panels (if present) for: Trip test; No trip test; Non-automatic reset.
   5. Record proper operation and test sequence.
   6. Set pick-up and time-delay settings in accordance with the settings provided by the manufacturer.

B. Electrical Tests:
   1. Measure system neutral insulation resistance to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral

insulation resistance and replace link.

2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.
3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameter:

1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferable one (1) megohm or greater.
2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
3. Relay pickup value shall be within 10 percent of setting and in no case greater than 1,200A.

2.07 MOTORS (1 hp and Greater)

A. Visual and Mechanical Inspection:

1. Inspect for physical damage.
2. Inspect for proper anchorage, mounting, grounding, connection and lubrication.
3. When applicable, perform special tests as air gap spacing and pedestal alignment.

B. Electrical Tests - Induction Motors:

1. Perform insulation resistance tests in accordance with ANSI/IEEE Standard 43.
2. Motors 200 hp and Less - Test duration shall be for one minute with resistances tabulated at 30 and 60 seconds and calculate the dielectric absorption ratio. Motors larger than 200 hp perform tests for ten minutes and calculate polarization index. Minimum acceptable polarization index for Class B or F insulated motors shall be 2.0.
3. Perform insulation resistance test on pedestal per manufacturer instructions.
4. Perform insulation resistance test on surge protection device in accordance with this Specification.
5. Check that the motor space heater circuit is in proper operating conduction.
6. Check all protective devices in accordance with other sections of these Specifications.
7. Perform a rotation test to ensure proper shaft direction if the motor has been disconnected.
8. Measure running current and evaluate relative to load conditions and nameplate full load amperes. Verify proper overload relays.

2.08 MOTOR CONTROL (ALL MOTORS)

A. Visual and Mechanical Inspection:
   1. Inspect for physical damage, proper anchorage, and grounding.
   2. Inspect equipment for compliance with drawings and specifications.
   3. Motor-running protection
      a. Compare overload heater rating with motor full-load current rating to verify proper sizing.
      b. If motor-running protection is provided by fuses, verify proper rating considering motor characteristics and power-factor correction capacitors if applicable. Check tightness of bolted connections using calibrated torque wrench.

B. Electrical Tests:
   1. Insulation tests:
      a. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for three (3) minutes. Test voltage shall be in accordance with NETA Standards.
      b. Measure insulation resistance of each starter section phase-to-phase and phase-to-ground with the starter contacts closed and the protective device open. Test voltage shall be in accordance with NETA Standards.
      c. Measure insulation resistance of each control circuit with respect to ground.
   2. Test motor overload units by injecting current through overload unit and monitoring trip time at three hundred percent (300%) of motor full-load current.
   3. Three phase power unbalance: Run motor at full load steady state conditions and take current readings on all three leads. Roll the motor leads maintaining the proper rotation and take motor current readings on all three possible hook-ups. Choose the least unbalance hookup for each motor. The maximum acceptable unbalance is 10 percent at full load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If on the three possible hook ups, the leg of "greatest unbalance" (furthest from the average) stays on the same power lead then most of the unbalance is being caused by the power source. However, if the leg of greatest unbalance moves on each of the hookups with a particular motor lead, the primary source of unbalance is on the motor side of the starter. Check for damaged cable, leaking splices, poor connections, or faulty motor winding.

2.09 TRANSFORMERS - DRY TYPE TRANSFORMERS - SMALL DRY TYPE, AIR-COOLED (600 VOLT AND BELOW)

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test. Perform test verification for impedance.

D. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

2.10 THERMOGRAPHIC SURVEY (PROVIDE FOR ALL NEW OR MODIFIED SWITCHGEAR, BUS DUCTS, TRANSFORMERS, POINTS OF POWER CONNECTION EQUAL TO OR GREATER THAN 30AMPS, MCC'S AND DISTRIBUTION CENTERS)

A. Visual and Mechanical:
   1. Remove all necessary covers prior to scanning.
   2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned:
   1. All new and existing equipment with ratings of 30 amps or more.

C. Provide report indicating the following:
   1. Problem area (location of "hot spot").
   2. Temperature rise between "hot spot" and normal or reference area.
   3. Cause of heat rise.
   4. Phase unbalance, if present.
   5. Areas scanned.

D. Test Parameters:
   1. Scanning distribution system with ability to detect 1^{o}C between subject area and reference at 30^{o}C.
   2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
   3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.
   4. Provide photographs and/or the thermogram of the deficient area as seem on the imaging system.

2.11 LOW VOLTAGE SURGE SUPPRESSORS

A. Visual and mechanical inspection:
   1. Verify suppressors are installed with minimum length leads to the protected equipment. Verify connections to bus.
   2. Verify ground connections to ground bus.

B. Electrical tests:
   1. Test clamping voltage and verify meets specified ratings; test in accordance with ANSI C62.33 section 4.4 and 4.7.

2.12 LOW VOLTAGE AIR SWITCHES (DISCONNECT SWITCHES, MANUAL AND AUTOMATIC TRANSFER SWITCHES)

A. Visual and mechanical inspection:
   1. Compare equipment nameplate data with drawings and specs.
   2. Inspection for mechanical and physical damage. Cleaning of interior, insulators, arc chutes.
   3. Testing of mechanical operator. Cleaning and lubrication of contacts and

mechanism, as applicable.

4. Verification of contact alignment and wipe. Verify phase barrier insulation.
5. Inspect anchorage, alignment, grounding, and required clearances.
6. Documentation of fuse and types are in accordance with drawings, short circuit studies and coordination study.
7. Verification of tightness of accessible bolted electrical connections by calibrated torque-wrench method.
8. Verification of presence of expulsion-limiting devices on all holders having expulsion-type elements.
9. Verification of interlocking systems for proper operation and sequencing.
10. Verify proper lubrication on current carrying and moving sliding parts.

B. Electrical tests:

1. Contact resistance testing across each switch blade and fuse holder.
2. Measurement of fuse resistance.
3. Insulation resistance testing on each pole, phase-to-phase and phase-to-ground with switch closed and across each open pole for one minute.
4. ac or dc overpotential testing phase-to-phase and phase-to-ground.
5. Verification of proper space heater operation.

END OF SECTION

SECTION 26 24 20

ELECTRIC MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials, installation and testing of induction motors and applies to motors which are provided as part of equipment specified in other sections. Contractor shall furnish motors in conformance to this section and with the individual specification sections of the driven equipment for a complete and operable system. It shall be the contractor's responsibility to bring to the attention of the engineer any conflict between this section and the driven equipment section for engineer's resolution prior to purchase; in general most stringent best quality governs.

B. Motors which are an integral part of standard manufactured driven equipment (submersible pumps, motor valve operators) may be exempt from this specification where necessary and required by the manufacturer of the equipment.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 29 23 Variable Frequency Drives
B. Section 26 08 00 Acceptance Testing & Performance Verification

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Show complete nameplate data, horsepower, current, voltage, phase, and frequency ratings, NEMA design, Frame Size, starting code letter or locked rotor KVA, efficiency and power factor, winding insulation class and treatment, rated ambient temperature, service factor, mounting arrangements, size and location of conduit entry, location and size of grounding lug, and coatings.

C. Submit guaranteed full load efficiency.

1.04 FACTORY TESTS

A. Tests shall comply with NEMA Standard MG1-12.51 and MG 1-23.46.

B. For high efficiency motors, provide certified test results of percent efficiency and power factor data at full, 75% and 50% load.

C. Test thermally protected motors in accordance with NEMA Standard MG 1 winding temperature and trip current tests.

1.05 CONTROLLER COORDINATION

A. Where motor controllers are furnished, provide reviewed shop drawings to the controller manufacturer for coordination and sizing of the controller.

1.06 QUALITY ASSURANCE

A. NEMA Compliance: Unless otherwise indicated, comply with NEMA standard MG 1.

B. U.L. Listing: Motors for applications in hazardous locations shall bear the U.L. label listing its use in accordance with NEC.

C. ANSI/IEEE 112; Test Procedures for polyphase induction motors.

PART 2 – PRODUCTS

2.01 GENERAL MOTOR DESIGN REQUIREMENTS

A. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

B. Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4

200	95.8	96.2	95.8

C. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, alternating current motors shall be single speed, non-reversing, squirrel cage induction motors, NEMA design B. Motors 15 horsepower and larger shall be NEMA starting code F or G. Motors smaller than 15 horsepower may be manufacturers' standard starting characteristics. Stator windings shall be copper.

D. The connected load (maximum horsepower required) of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

E. Connection box shall be cast metal with gaskets between the box and housing and between the box and cover. Provide a grounding terminal in the connection box.

F. Open drip-proof and weather-protected motors shall have a service factor of 1.15. Inverter Duty (VFD) rated motors shall have a service factor of 1.15 for sine wave power and 1.0 for inverter power. Totally enclosed fan cooled motors shall have a service factor of 1.15.

G. Unless otherwise noted, motors shall be rated for continuous duty at an ambient temperature of 40°C and at an altitude of 3,300 feet. High ambient Motors shall be rated for continuous duty at an ambient temperature of 65°C. Motors shall have 120-volt heating elements.

H. Non-submersible Motors shall have 120-volt heating elements.

I. Open dripproof and weather-protected motors 7.5 HP and larger shall have stainless steel screens over openings.

J. Motors installed in hazardous areas shall be Totally enclosed, explosion proof, suitable for use in Class 1, Division I, Group D hazardous locations, with UL label.

K. Provide motors with a guaranteed maximum noise level of 90dBA, measured at three feet from the motor surface per IEEE 85, when running at no-load connected to sine wave power.

L. Unless otherwise noted, motors shall be premium efficiency type. The efficiency shall be determined by IEEE 112 method B using sine wave power for motors up to 300 horsepower and method F for motors above 300 horsepower. Efficiency shall be listed on the nameplate in accordance with NEMA MG 1 12.53.

M. As a minimum all motors shall have manufacturer's standard tropical protection. Motors in wet locations shall be moisture sealed. Motors with form-wound coils shall have vacuum-pressure impregnated windings.

N. Motors designated to be Totally Enclosed Fan Cooled (TEFC) shall be rated for IEEE-841-2001 standards or Coro-duty where listed in pump sections of

specifications. TEFC motors shall be premium efficient, all cast iron including conduit box and fan cover guard, with stainless steel nameplate and plated hardware, with internal bearing caps and an inpro/seal on the drive end. Motor finishes shall be rated for 250hour salt spray. TEFC motors shall have a 5 year warranty.

O. In addition to nameplate information required by NEMA Standard MG 1-10.37 through 39, show on the nameplate the bearing numbers for both bearings, efficiency, power factor at full load and the maximum recommended kVAR of power capacitors to result in a 90 percent power factor. Provide all motors with stainless steel nameplates.

P. Equip all motors with thermal protection in accordance with NEMA Standard MG 1. Control leads shall be color-coded, brought out to the motor conduit box or a separate terminal box for connection.

1. Provide three series connected, thermal switches, one in each winding. Provide normally closed and normally open switches as shown on the electrical elementary drawings. Where not shown provide normally closed switches.

2.02 BEARINGS

A. Bearings for standard duty motors shall be rated for a minimum of 24,000 hours (B-10 rating); Heavy duty specified motors bearings shall be rated for a minimum of 40,000 hours (B-10 rating). Where unspecified provide bearings with B-10 ratings as follows: Less than 50hp provide 24,000hr B-10 rating; 50hp to 200hp provide B-10 rating of 40,000hr; greater than 200hp provide B-10 rating of 100,000hr.

B. Bearings shall be ball or roller anti-friction type. Fractional horsepower through 2 horsepower motors shall be furnished with life time lubricated bearings. Horizontal motors larger than 2 horsepower shall be furnished with relubricatable ball bearings.

C. Vertical Motors

1. Vertical motors shall be designed for vertical operation and shall have thrust bearings with a rated B-10 life of 40,000 hours as defined by Anti-Friction Bearing Manufacturers Association (AFBMA).

2. Thrust bearings for motors 75 horsepower and larger shall be oil lubricated. Guide bearings may be anti-friction, grease lubricated or oil lubricated.

3. Equip grease lubricated bearings with fittings in each bearing housing. Fittings shall be accessible without removal of any covers or guards. Provide drains to prevent over-lubrication.

D. Equip motors with a non-reversing ratchet as required or as indicated.

E. Bearing Protection

1. Provide bearing protection from shaft currents for all motors 20hp or greater and driven by variable frequency drives. The device shall divert shaft currents to ground or insulate the shaft so currents will not flow through bearings. The device shall be maintenance free. Provide current diverter seal equal to Inpro-Seal type CDR.

2.03 INSULATION AND TEMPERATURE RISE

A. Unless otherwise noted, provide Class F insulation limited to Class B temperature rise at unity service factor.

B. All motors indicated to be heavy duty motors in the individual equipment specifications of the contract documents shall be provided with minimum Class "H" insulation system limited to Class "B" temperature rise at unity service factor.

2.04 VOLTAGE

A. Generally provide alternating current motors 1/2 horsepower and smaller at 115 volts single phase 60 Hz, and motors 3/4 horsepower and larger at 460 volts three phase 60 Hz. Contractor shall coordinate exact requirements.

2.05 COATING

A. Do not coat cast aluminum frame motors.

B. Motors housed within equipment enclosures, such as exhaust fans, air handling units, and air conditioners, may have factory's standard prime and finish coats.

C. Coat cast-iron frame motors. Apply prime coat at the factory which shall be compatible with field applied finish coats.

D. Field apply finish coat(s) specified in the applicable equipment section.

2.06 INVERTER DUTY RATED MOTORS

A. Inverter duty rated motors (variable frequency drive (VFD) controlled motors) shall have a nameplate that states "SUITABLE FOR VFD APPLICATION". VFD motors shall not have a critical vibration frequency within the operating range of the VFD. Provide VFD rated motors with special balance option. Provide balance to .0005in for high thrust and 3600rpm motors; .0010in for all other motors.

B. Except where noted, the motor features defined by this specification shall be in addition to any mechanical and electrical feature defined in the fixed speed motor section.

C. Motor insulation shall be an "Inverter Grade" system designed to meet the voltage spike limits defined by NEMA MG1, Part 31, 1993. The insulation system must include the use of High Dielectric magnet wire which exceeds the dielectric withstand levels provided by double film or heavy film magnet wire. Complete insulation of the slot, cell and phase groups is required. The system shall be

rated for class F rise or better. The winding insulation system shall be equal to Phelps Dodge Thermaleze Quantum Shield. The system shall exhibit an insulation pulse endurance life expectancy of 150% at 60HZ when compared to typical heavy film insulation systems. The system shall exhibit an insulation pulse endurance life expectancy from fast rise time IGBT inverters of 100% at a 2.0KHZ carrier frequency.

D. Motors shall be capable of operating at 1.0 service factor on Inverter Power. Nameplate Sinewave service factor shall be 1.15 or greater.

E. Motor temperature rise shall not exceed class F insulation limits, with 115C allowable winding hot spot temperature, when operated on Inverter Power across its nameplate speed and torque envelope. Sinewave temperature rise shall be class F or better.

F. The 2 pole 4 pole 6 pole 8 pole motors shall be capable of operating a Variable Torque centrifugal pump load from base speed down to 10% of base speed. Motor shall be nameplated for 6-60 Hertz operation. Hazardous location motors may be nameplated 10-60 Hertz.

G. Stator core designs shall be of high rigidity with reinforced end turn construction to minimize mechanical fatigue of the winding, and to reduce resonant noise. Single dip and bake cycles are not acceptable.

H. Winding thermal protection, utilizing normally closed contacts (or normally open where shown on the electrical drawings) shall be sized to match the maximum safe operating temperature of the insulation system. Hazardous location motors shall have winding thermal protection sized as required to meet U.L. or as auxiliary devices where not required by U.L.

I. Maximized copper content shall be utilized to achieve high motor efficiency and thermal transfer. Table 1 lists the minimum NEMA nominal efficiency levels that must be nameplated on the motor. Low loss electrical steel shall be utilized in the stator and rotor core assemblies.

J. Nameplate data for adjustable speed operation shall be stamped on a stainless steel data plate and permanently attached to the motor frame. The minimum amount of adjustable speed data shall include:
   1. Application Type - Variable Torque and/or Constant HP.
   2. Maximum approved continuous HP.
   3. Approved speed range.
   4. Typical motor volts per hertz.
   5. S.F. on inverter power.

PART 3 – EXECUTION

3.01 STORAGE

A. Protect motors from exposure of elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

B. Unless protected by manufacturer's packing, upon delivery, carefully wrap each motor in three layers of 8-mil minimum polyethylene. Secure the wrap with adhesive tape to minimize the entrance of moisture. For base mounted motors, wrap the entire assembly.

3.02 FIELD OPERATING TESTS

A. Run each motor with its control as nearly as possible under operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.

B. Record current in each phase of each motor 1 horsepower and larger and include in the maintenance manual. Repair or replace motor or driven equipment if current exceeds motor nameplate value.

END OF SECTION

SECTION 26 27 13

ELECTRIC SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION OF SYSTEM

A. The Electrical Utility Company will provide the electrical service of the characteristics as shown on the Drawings. This Contractor's work will begin where the Utility Company's work ends.

B. The Contractor shall furnish all labor, materials, etc., necessary for a complete approved electrical service as required for this project, including inspection and approval by the Utility and local Inspection Departments (if any) and inform the Engineer prior to energizing power lines.

C. This Contractor shall notify the Utility Company in writing, with two copies to the Engineer, no later than ten (10) days after signing contracts as to when this Contractor anticipates the building power service will be required.

D. The contractor is responsible for complete application, coordination, and scheduling of the electrical service with FPL. Contractor is required to complete all service applications and deliver to County project manager to acquire proper signatures.

1.02. CONSTRUCTION FACILITIES

A. The facilities and equipment required to provide all electrical power for construction, lighting and balancing and testing consumed prior to final acceptance of the project shall be provided under this section of the specifications. All wiring, outlets and other work required to provide this power at the site and within the building for all trades shall be arranged for, furnished and installed under this section of the specifications including any fee, charge or cost due the utility company for temporary power installation or hook-ups.

B. Facilities shall be furnished in a neat and safe manner in compliance with governing codes, good working practices and OSHA regulations.

1.03. UNDERGROUND ELECTRICAL SERVICE

A. Furnish and install underground service from power company pad-mount transformers or pole base handholes to main service equipment. Seal conduit with duct-seal where entering building.

B. The underground service shall comply with all the requirements of the NEC, local Utility Company and local enforcing authority.

1.04. UTILITY COMPANY FEES, CHARGES AND COSTS

A. It is the contractor's responsibility to contact the required Utility Company to determine if any fees, charges or costs will be due the Utility Company, as required by the Utility Company for temporary power, installations, hook-ups, etc. This fee, charge or cost shall be turned over to the County Project manager for payment.

1.05 SUBMITTALS

A. Submit product data on:
   1. Aluminum Meter base and CT, UTB and STB cabinet if applicable.
   2. Copy of Contractors notice to FPL
   3. Copy of Contractors transmittal of FPL invoice to County

PART 2 – PRODUCTS

2.01 METERING

A. Meter bases shall be furnished and installed by this contractor. Provide aluminum meter bases. Metering bases and conduits must be installed in accordance with the Utility Company requirements.

B. FP&L requirements. Work to be completed under this section shall be in accordance with FP&L documentation and standards.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 26 28 11

CIRCUIT BREAKERS AND FUSIBLE SWITCHES – LOW VOLTAGE

PART 1 – GENERAL(NOT USED)

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Provide Cutler Hammer or Square-D circuit breakers to match equipment provided. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.

2.02 MOLDED CASE CIRCUIT BREAKERS – 800 A AND BELOW

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

D. Circuit breakers 400ampere frame and below shall be have thermal-magnetic trip units and inverse time-current characteristics.

E. Circuit breakers 800ampere through 1200-ampere frame shall have microprocessor-based rms sensing trip units.

2.03 QUICK-MAKE/QUICK-BREAK FUSIBLE SWITCHES

A. Protective devices shall be quick-make/quick-break fusible switches. Fusible switches 30 amperes through 600 amperes frames shall be furnished with rejection Class “R” or “J” type fuse clips unless otherwise scheduled. Fusible switches 800 amperes through 1200 amperes shall be furnished with Class L fuse clips. Switches shall incorporate safety cover interlocks to prevent opening the cover with the switch in the ON position or prevent placing the switch in the ON position with the cover open. Provide defeater for authorized personnel. Handles shall have provisions for padlocking and shall clearly indicate the ON or OFF position. Front cover doors shall be padlockable in the closed position.

PART 3 – EXECUTION(NOT USED)

END OF SECTION

SECTION 26 29 13

CONTROL PANELS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish all labor, equipment, and materials for control panels as indicated on the drawings and specified herein. The panel supplier shall be a UL listed panel shop and all panels shall be UL-508 certified and labeled.

B. Control panel equipment shall be coordinated to provide all the specified control as indicate in the elementary diagrams or specified herein.

C. The Contractor shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other sections of the Contract Documents that are an integral part of the plant control systems. This interfacing shall be incorporated in the detailed systems drawings and data sections to be submitted by the contractor prior to rough-in work.

1.02 SUBMITTALS

A. The contractor shall submit to the Engineer for approval complete shop drawings, wiring diagrams, data, and operation and maintenance manuals of all equipment to be furnished under this section.

B. Coordination and Shop Drawings: Prepare and submit coordination drawings for installation of products and materials fabricated. Coordination and shop drawings shall be prepared using a computer aided drafting system compatible with Autodesk AutoCAD version 2014 or greater. Coordination and shop drawings shall be submitted on hard copy and electronic CD-Rom (dwg) format.

1. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Diagrams shall show all component and panel terminal board identification numbers, and external wire and cable numbers. Note, this diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, pull boxes, etc.). Diagrams' device designations, and symbols shall be in accordance with NEMA ICS 1-101.
2. Panel Wiring Diagrams: Elementary diagrams shall be similar to those diagrams shown in the drawings, but with the addition of all auxiliary devices such as additional relays, alarms, fuses, lights, fans, heaters, etc.
3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, tag numbers and PLC I/O identification (address) numbers. Wiring diagrams shall show all circuits individually; no common diagrams shall be allowed.
4. Submit arrangement and construction drawings for consoles, control panels, and for other special enclosed assemblies for field installation. Include dimensions, identification of all components, preparation and finish data, nameplates, enough other details to define the style and

overall appearance of the assembly and a finish treatment. Drawings shall show the location of all front panel mounted devices to scale, and shall include a panel legend and a bill of materials. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends and annunciator inscriptions. The bill of materials shall list all devices mounted within the panel that are not listed in the panel legend, and shall include the tag number, description, manufacturer and complete model number for each device.

5. Submit installation, mounting, and anchoring details for all components.

C. Operation, Maintenance and Repair Manuals
   1. Submit operation and maintenance manuals.

D. Panel Record Drawings
   1. Provide one set of laminated approved panel record drawings inside each control panel.
   2. Include one loose set of laminated approved panel record drawing inside of each control panel door data pocket.

1.03 CODES AND STANDARDS

A. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards
   1. Instrumentation: Instrument Society of America (ISA).
   2. National Electrical Code (NEC).
   3. Wiring: ISA S5.3 and S5.4, latest issue.
   4. Control Panels and equipment: NEMA, UL and ANSI.
   5. Control Logic: Joint Industrial Council (JIC).
   6. UL508A and UL508A-SB

PART 2 - PRODUCTS

2.01 GENERAL

A. Control panels shall be UL508A/SB compliant. Control panels with resident voltages greater than 120V shall be marked with a short circuit current rating (SCCR). The SCCR shall be equal to or more than the short circuit current available at the panel line terminals and in no case be less than 10,000A SCCR. The panel designer shall verify the available short circuit required.

B. The electrical control equipment shall be mounted within a pad-lockable NEMA Type 4X wall mount for exterior installation locations and freestanding for interior installation locations, dead-front enclosure constructed of not less than 304 stainless steel powder coated white and shall be equipped with a 3-point latch with all hardware and exterior components construction of 300 series stainless steel (except control panels in air conditioned spaces and electrical room may be NEMA 1 painted steel). Provide data pocket. The enclosure shall be powder coated white. Bottom entry ONLY of cables shall be permitted. The enclosure shall be fitted with legs to allow conduit entry into the bottom of the enclosure. Flat bottom enclosures set on concrete pads with open window cutting of

enclosure bottom for conduits is strictly prohibited. The enclosure shall be equipped with sunshields for exterior installation locations, an inner dead front door and shall incorporate a removable, aluminum or stainless steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Utilize stainless steel threaded standoffs welded to exterior of control panel to secure sunshields. All hardware shall be stainless steel. Provide safety hardware to hold the door in an open position.

C. Components: All motor branch circuit breakers; motor starters and DIN rail mounted control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.

D. A circuit breaker shall be provided on each control panel as a means of disconnecting power to the control panel. The circuit breaker operating handle shall be installed on the right side of the cabinet not in the door. The door shall be interlocked from opening when the circuit breaker is in the on position. Do not provide door interlock for lift stations. The circuit breaker operating handle shall have an interlock defeat mechanism for qualified personnel to gain access to the panel without shutting off power.

E. Control transformers shall be installed where shown to provide 120VAC and 24VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The transformer secondary shall be grounded on one leg.

F. All control panel wiring shall be identified at both ends with type written heat shrinkable wire markers with the numbering system shown on the control submittal drawings.
   1. Control wiring shall be stranded tinned copper, minimum size #16 AWG (except for shielded instrumentation cable may be #18 AWG), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation.
   2. Wire shall be guided within control and terminal cabinets by cable supports (duct). Instrumentation and control field cables on the unprotected side of SPD devices within the cabinet shall not run in parallel to the cables on the protected side of the SPD device. Separate cable supports (duct) will be provided.
   3. All conductors shall be neatly led to terminations. All connections of stranded wire to screw type terminal blocks shall be by insulated spade lugs, crimp fastened to wire. Provide stranded wire crimp ferrules for all stranded wire connections not requiring spade lugs for screw type terminal blocks.

G. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed using an epoxy process. Nameplates shall be laminated plastic, engraved white letters with a black background. List the manufacturer of the control panel cabinet and the control panel builder.

H. Corrosion Inhibitor Emitter: Provide an industrial corrosion inhibitor emitter on all exterior mounted control panels that will protect internal components of the

control panel from corrosion one year. Provide a year supply of spare emitters, for each control panel.

I. Terminal strips shall be provided for all signals as indicated on the drawings plus all spare conductors as specified. Terminal strips shall be switch type with integral fuses equal to Allen Bradley 1492-H6. Wiring from the control panel to the terminal strips shall be factory installed. All spare conductors shall be terminated and identified. All terminals over 200V phase to phase shall be covered with approved plastic shields.

J. RELAYS

1. Control circuit switching shall be accomplished with relays. These relays, for interfacing and control applications, shall be the compact general purpose plug-in type having low coil inrush and holding current characteristics. An LED status-indicating light shall be provided with each relay. Contact arrangements shall be as noted or shown, and shall be rated for not less than 10 amperes at 120V ac or 28V dc. Coil voltage shall be as noted or shown. Non-latching relays shall have a single coil. Latching relays shall have two coils, unlatching being accomplished by energizing one coil, and latching being accomplished by energizing the other coil. Relays shall have plain plastic dust covers, test buttons, and mounting sockets with screw terminals and holddown springs. Relays shall be UL recognized. Relays shall be Square D, Allen Bradley, Omron or approved equal.
2. Time on delay functions shall be accomplished with Square-D 9050JCK60V20 timer relays. Provide RK electronics CFB24D-7-2M relay for time off delay applications. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status-indicating light shall be provided with each relay. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Time delay rangeability shall be at least 10:1. Operating voltage shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Operating temperature shall be -20 degrees F to 165 degrees F. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Amerace Corp., Control Products Division, Agastat Series 7000, Cutler-Hammer Series D87, Square D, Allen Bradley, Omron or approved equal.
3. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and the terminals are readily accessible.

K. Panel Operating Controls and Instruments

1. All operating controls and instruments shall be securely mounted on the interior deadfront as detailed on panel enclosure drawings. All controls and instruments shall be clearly labeled to indicate function.
2. Indicator lamps shall be 30mm LED full voltage push to test type and mounted in NEMA 4X (800H) modules, as manufactured by Allen Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from

the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, push to test industrial type with screwed on prismatic glass lenses in colors as shown, and shall have factory engraved legend plates. LED's shall be high illumination type (5ma at 130V ac).

3. Selector switches shall be 30mm heavy-duty, oiltight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Units with up to four selection positions shall be Allen Bradley 800H, Square D Type K, Cutler-Hammer Type T, or equal.
4. 22mm devices are not acceptable.

L. Process Meters
1. Provide digital programmable process meters with a loop powered display designed for a 4-20MA current loop. Provide minimum 0.5" high, 4-1/2" digit LED display to indicate amplitude of current in the current loop. In general, a loop current of 4ma corresponds to a display indication of 0 percent and a loop current of 20ma corresponds to a display indication of 100 percent. The meter shall be provided with programmable internal scaling adjustment. Provide units with NEMA-4X faceplate rating constructed of silicone coated Lexan and gasketed for NEMA 4 requirements; circuit boards coated for moisture resistance. Provide panel meters for each analog process variable; Pressure, level and flow as indicated equal to Yokogawa, Red Lion, or equal.

M. Phase Monitors
1. Provide ATC Diversified and or Macromatic.

N. Uninterruptable Power Supply (UPS)
1. Provide 24VDC input, 12/24VDC dual output UPS. Puls UB10.241 UPS, no equal.

PART 3 - EXECUTION

3.01 MOUNTING OF EQUIPMENT AND ACCESSORIES

A. Install and mount equipment in accordance with the Contract Documents, and installation detailed shop drawings. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock and vibration; and freedom from interference with other equipment, piping, and electrical work.

B. Mount local equipment in cabinets or existing panels as specified. Mount associated terminals on a common panel or rack; all terminals over 200V phase to phase shall be covered with plastic shields.

C. Provide services of panel manufacturer to test the completed system after

installation to assure that all components are operating within the specified range and all interlocks are functioning properly. Panel manufacturer shall certify functional operation and calibration in written startup report. Perform field tests on all completed control assemblies to demonstrate conformance to specifications and functional compatibility.

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 FURNISHING OF EQUIPMENT

A. Unless specifically noted otherwise, variable frequency motor drives for all equipment requiring them shall be furnished under this section. The drive manufacturer shall furnish all required controls as specified herein and as functionally required by the instrumentation and controls section.

B. The manufacturer shall be Square D Altivar 660 or Ativar 320 Process Drive series. No equal.

C. Provide Altivar 660 drives with necessary modifications to provide a two second power loss ride through.

D. Provide all drives with conventional analog and digital control interface for control. Provide Ethernet TCP/IP network communications for monitoring to the plant control system for Altivar 660 VFD's.

E. Provide equipment purchased from the manufacturer's representative authorized to represent the manufacturer in the project's territory, Lee County Florida.

F. The manufacturer shall factory fabricate the drive cabinets to match the plan lineup and available space indicated

1.02 DESCRIPTION OF SYSTEM

A. Factory-assembled, metal-enclosed VFD motor control units for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place. Where shown on drawings, furnish and install VFD units in freestanding NEMA 12 gasketed, ventilated and filtered motor control cabinets as herein specified. The motor control shall be supplied from a 3-phase, 3-wire 60 cycle power system as shown. A U.L. label shall be provided on each Section indicating compliance with UL Standards. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ETL, UL, ANSI, and NEMA.

B. VFD Motor Control Units shall include all protective devices and equipment as listed on drawings or as included in these specifications, with necessary interconnections, instrumentation, and control wiring.

C. The VFD manufacturer shall be responsible for providing a system for the specific installation intended, including considerations of conductor distances from the drive to the motor. Each VFD drive shall include an output dv/dt filter system within the VFD cabinet to limit voltage peak and voltage rise time at the motor terminals. The filters must limit the voltage rise time and voltage peak at the motor terminals to those required by NEMA MG1-1993, Section IV, Part 30 with voltage peak less than 1000 volts and rise time greater than 2

microseconds.

1.03 QUALITY ASSURANCE

A. Reference Standards:
1. American National Standard Institute (ANSI):
a. ANSI Y32.2-1975, Graphic Symbols for Electrical and Electronic Diagrams.
b. ANSI Z55.1-1967 (R1973) Gray finishes for Industrial Apparatus and Equipment.

2. National Electrical Manufacturers Association (NEMA):
a. NEMA ICS-1, 2, 3, 4, 5, 6, controls and systems.

3. National Fire Protection Association (NFPA):
a. NFPA 70-2008, National Electric Code (NEC).
b. NFPA-70E-2009 Standard for Electrical Safety in the Workplace.

4. Underwriters' Laboratories, Incorporated (UL):
a. UL Electrical Construction Materials List, motor controllers motor-control centers (NJAV), (HJOT) and (NLDX).

1.04 SUBMITTALS

A. Product Data:
1. Layouts showing concrete pad dimensions, conduit entrance and available space, bus duct connections, electrical ratings, nameplate nomenclature, and single-line diagrams in accordance with ANSI Y32.2 indicating connections and controls with numbered terminals.
2. Frame sizes and Interrupting Capacity of unit.
3. Horsepower rating and rated voltage of unit.
4. Manufacturer's written recommendation for storage and protection, installation instructions and field test requirements.
5. Manufacturer's instructions for tightening bus connections, performing cleaning, and operating and maintaining motor control unit.
6. Submit written verification that overall dimensions are within the maximum dimensions indicated on plans.
7. Submit manufacturer’s recommended spare parts list.

B. Shop Drawings:
1. Complete master wiring diagrams, elementary schematics and control schematics shall be submitted for approval before proceeding with manufacture. Suitable outline drawings shall be furnished as part of this submittal. Standard or typical pre-printed sheets or drawings simply marked to indicate applicability to this contract will not be acceptable. Shop drawings shall be job specific.
2. A complete drawing indicating each point of interface with the process control system and the type of signal provided or accepted at each point.
3. A complete drive programmer’s manual.
4. A drawing showing the layout of the VFD local control panel indicating every device mounted on the door with complete identification.
5. Provide shop drawings on 11" X 17" paper and drawn with a computer aided design (CAD) package. The computer aided design package shall

be Autocad or converted to Autocad format. Submittals shall include hard copy and CD-ROM media electronic copies (dwg format).

1.05 WARRANTY

A. The equipment manufacturer shall provide a two year warranty from initial startup and demonstration of the complete automatic controlled drive pump system to the engineer. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship. In the event the equipment fails to perform as specified, the equipment manufacturer shall promptly repair or replace the defective equipment without any costs to the owner (including labor, transportation, handling and shipment costs). Warranty shall not cover damage to the equipment caused by external sources and operator errors; however the units shall be protected from power line surges and electrical fault conditions and therefore the warranty shall apply to power line transient surge, ground faults, line to line faults, EMI and RFI interference and other external electrical disturbance caused damage.

B. The VFD manufacturer shall maintain as part of a national network, engineering service facilities within 150 miles of the project to provide start-up service, emergency service calls, repair work, and service contracts.

1.06 SPARE PARTS

A. Provide spare parts as follows: one set of all fuse types, one each type relay, SPD, Phase Monitor, 2 sets of replacement filters, one complete set of VFD inverter fans and VFD enclosure fans, one set of pilot lights (LED type), one of each type thermal module or switch. In addition provide circuit boards for: Gate Interface Board, PreCharge Board, Power Interface Board, Control Board, Power Module, Heatsink Fan, HIM module. Provide one spare of all I/O and dual port Ethernet/IP DLR communications boards.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide 75hp and above VFD's as manufactured by Square D Altivar 660 Process Drive series with clean power drive. Provide 20hp and below VFD's as manufactured by Square D Altivar 320 Process Drive series with clean power drive. Provide clean power controller utilizing a front end MTE Matrix broadband filter with harmonic cancellation techniques. The VFD shall contain a built in cut-out circuit to automatically take the filter offline on low power loads. Provide Ethernet communications capability. Provide hard wired control where shown on the drawings.

B. The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a three-step operation. Adjustable Current Source VFDs are not acceptable. IGBT type Transistors shall be used in the inverter section. GTOs and SCRs are not acceptable. The VFDs shall be current regulated. VFDs permitting instantaneous over current trips other than for output short circuit are not acceptable.

C. All VFDs shall utilize a vector torque control strategy to regulate motor flux to

optimize motor torque without the need for encoders. VFDs requiring voltage, dwell and current adjustments to achieve improved torque control are not acceptable.

D. The manufacturer shall supply variable frequency drives compatible with the pump motors for operation of these motors at motor full load amps. The drives shall vary the output frequency from minimum to maximum pump speed typically 6-60hz.

E. The drive shall be of sufficient capacity and provide a quality of output waveform so as to achieve full rated and continuous output of the pump motor. All drives shall be factory built-up units complete with all necessary and specified components, as hereinafter defined, which shall be supplied by the drive manufacturer as a unit. Each built-up drive shall be tested by the drive manufacturer prior to shipment from the factory and a certificate of the test provided.

2.02 ENVIRONMENTAL CONDITIONS

A. The drive shall accept plant power nominal AC voltage of 480V AC +10% -10%, 3 phase, 60 Hertz $\pm$ 3%.

B. The operating ambient condition shall have a temperature range of 0 to 40 degrees Celsius with a relative humidity of up to 95% (non-condensing).

2.03 CONSTRUCTION TECHNIQUES

A. The drive shall be of modular design to provide for ease and speed of maintenance including removal of modules, with one maintenance technician.

B. All components shall be mounted in a NEMA type 12, gasketed, ventilated and filtered enclosure properly sized to dissipate the heat generated by the power electronics for the MPS 6600 VFDs, a NEMA type 1 enclosure will be provided for LS 616 & LS – 617 VFDs which shall be housed in an custom fabricated Pump Control Panel. The enclosure shall be painted with corrosion resistant coatings with finish paint of ANSI 49 Gray. Ether top or bottom entry of cables shall be permitted.

C. The DC bus shall be filtered by series inductor & capacitors to provide ripple free dc.

D. Circuit breakers. The operating mechanism shall be designed so that the door can be padlocked in the "Off" position. Protection for the VFD's power circuit shall be provided by use of circuit breakers and type "J" input fuses.

E. The drive shall meet any one of the following standards; CSA, ETL, UL.

F. All VFD's must be tested/run under load until rated operating temperatures is achieved.

G. Provide VFDs with shock hazard shielding methods for all exposed terminals, bus bars and termination points. The low voltage terminals, buss bars, lugs etc. shall be physically guarded, insulated and/or isolated to insure safety to maintenance personnel and for reduced arc flash hazard.

H. Provide VFDs with approved ventilation air filter frame mounting and hardware

assemblies.

I. The VFD shall be furnished with a diagnostic indicator to show low bus/line and high bus/line voltage conditions, timed current overload and inverter output fault. Drive ready and Drive run status indication shall be standard.

2.04 ACCESSORIES

A. The Altivar 660 unit shall include an incoming, UL listed, circuit breaker. A three position switch (hand-off-auto) mounted on the controller door provides manual selection of local or auto control. The "Hand" position allows manual local keypad run/stop and speed control of the VFD; the speed control shall be via a keypad mounted on the door calibrated from 0-100% speed. The door of the VFD cabinet shall contain but not be limited to the following devices:

1. Key Pad and alpha numeric displays providing programming and manual control of the drive.
2. VFD fault indicating light.
3. Hand auto switch.
4. Power On indicating light.
5. VFD Run indicating light.
6. Motor High Temperature indicating light.
7. Process parameter control indicating light (Ex: Low Level shutdown).

B. The Altivar 320 unit shall include a dial and escape button mounted on the unit drive to navigate the menus and set drive speed control calibrated from 0-100% speed. The unit shall contain but not be limited to the following devices:

1. Integrated Alpha numeric displays providing programming and manual control of the drive.
2. VFD fault indicating light.
3. VFD Run indicating light.

C. Provide 24Vdc logic module and 24Vdc power supply within the drive to hold the drive logic active during power interruptions.

2.05 OPERATING CHARACTERISTICS

A. The variable frequency drive shall convert single or 3 phase, 60 Hertz input power to an adjustable frequency and voltage (from 6 Hertz to 60 Hertz with a frequency stability of +/- 1% of setting) for controlling the speed of AC induction motors. The converter will be of the voltage source design using current controlled PWM techniques. The input power factor of the drive shall be a minimum of .95 at all speeds and loads.

B. The output voltage shall vary proportionally with the output frequency to maintain a constant volts/Hertz value up to nominal frequency. Above nominal frequency, the output voltage shall remain constant.

C. The modulating control scheme shall closely approximate actual sine wave current throughout the speed range of the drive. The regulator shall be fully digital with microprocessor control of frequency, voltage, and current. The frequency resolution of the drive shall be .01 Hertz. All drive adjustments and custom programming shall

be capable of being stored in a non-volatile memory (EEPROM).

D. Current limit. A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 115%.

E. The power unit's logic common shall be at ground potential.

F. Short circuit and ground fault protection. The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding without damage to the VFD, short circuits at 480V plus 10% (528V). Opening of the VFD's input and/or output line switches during drive operation shall not result in damage to the drive.

G. The VFD shall be capable of providing 110% motor name plate service factor current for one minute. The VFD shall include an instantaneous overcurrent trip. The VFD shall not restart after electronic overcurrent trip until manually reset. Except for overcurrent, the drive will first attempt to restart on the inverter up to a maximum of three times on "Auto-Restart" before faulting out and waiting for operator reset.

H. Altivar 660 Power loss ride-through. The VFD shall be capable of continued operation during an intermittent loss of power for 2.0 second (120 cycles). The essential drive and pump relay logic integrated within the drive shall be powered through the 24VDC VFD power source during the power interruption for the 2 second duration. The VFD drive will resume normal operation within 0.5sec if power is reapplied during the 2 second ride through duration.

I. Auto restart after power outage. The VFD shall be capable of starting into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor in the preset method of starting.

J. Transient and surge voltage protection. Transient and surge voltage protection shall be provided through use of Metal Oxide Varistors (MOV's) and phase-to-ground filter capacitors.

K. Auto restart after fault. The VFD shall automatically attempt to restart after a malfunction or an interruption of power. If the drive reaches the limit of restarts without successfully restarting and running for 90 seconds, the restart circuit shall lockout and drop out the fault relay. Two Form C contacts shall be provided.

L. Motor overload protection. Provide electronic motor overload and single phase protection integral to the inverter.

M. Frequency jump points: Provide (3) selectable frequency jump points in 1.0hz increments, to be used to avoid critical resonance frequencies of the mechanical system.

N. Application programming dedicated to pumps.

1. The VFD shall provide Pump Control & Monitoring Functions for

Centrifugal pump characteristics and configurations.

a. Pump monitoring function in order to define data relevant for pump (acceleration, low speed, high speed, etc.)
b. Application Units function in order to define units used in applications.
c. Pump Cyclic Start Protection in order to protect the pump against too many restarts in a dedicated time period.
d. Multi-pump functions.

2. The VFD shall provide Pump Protection Functions
   a. Anti-Jam function in order to remove automatically clogging substances from the pump impellers.
   b. Pipe Cleaning function in order to start pump regularly to avoid sedimentation in pump impeller
   c. Cavitation Pump Protection
   d. Inlet protection in order to avoid system dry running.
3. The VFD shall provide Application control functions
   a. Stop and Go function in order to reduce consumption of VFD in case of pump inoperation.
   b. Pipe Fill function in order to manage a smooth control during pipe filling and to lessen the effects of water hammer.
   c. Sleep wake-up function in order to manage periods of the application when process demand is low and when it is not needed.
   d. Low demand function in order to define periods of the application when process demand is low in order to save energy.
4. The VFD shall provide Pump curve input to help optimize pump performance.
   a. Input and storage of the pump characteristics including 5 points of the pump curve.
   b. A best efficiency point (BEP) function in order to run in optimum conditions and detect deviation from this point.

2.06 CONTROLS

A. Provide an operator panel with a detachable UL Type 12/IP65 rated bi-color backlit graphical user interface terminal with keypad and capacitive wheel for monitoring, annunciation, and configuration for Altivar 660 VFD. The graphical display shall change to a red backlit color when an alarm occurs. The display provides indication of any selected drive functions; speed, load, motor volts, motor amps, diagnostic information, programming functions, etc. The keypad provides a means of programming and manually controlling the drive. Programming only keypads are not acceptable. The key pad shall be used to input the following setup adjustments:

1. Minimum speed, 1 to 85%
2. Maximum speed, 50 to 100%
3. Linear accel, 2-25 seconds
4. Maximum output voltage, adjustable
5. Volts/Hertz, adjustable.
6. Local setpoint reference.
7. Current Limit Setpoint.
8. Selectable carrier frequencies, V/Hz, and critical frequency avoidance lockout.
9. Multiple attempt restarts

B. Remote Controls: The VFD drives shall be hardwired to the plant control system as detailed on the single line drawing. The Ativar 660 VFD drives shall have a dedicated Ethernet connection to the plant control system with all parameters within the drive accessible to the control system. As a minimum provide the following inputs and outputs for remote operator control from the plant computer system.

1. Drive Digital inputs
   a. Start/Stop
   b. Drive Reset
2. Drive Digital outputs
   a. VFD in remote and Ready.
   b. Drive running
   c. VFD internal fault.
   d. VFD external fault
3. Analog inputs/outputs
   a. Motor speed feedback output
   b. Remote speed Setpoint input

C. Internal Control Wiring: Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine area to receive motor-control units to assure adequate clearance for motor control unit installation. Check that concrete pads are level and free of irregularities for motor control centers.

B. All workmanship utilized in the manufacture and installation of this system shall be of the highest quality and performed in a manner which is consistent with all accepted practices for industrial controls.

C. The supplier shall construct and verify proper operation of the assembled system under simulated conditions with motors of similar characteristics; before shipment to the site.

3.02 INSTALLATION

A. Install motor control units in accordance with manufacturer's written instructions, and NEC.

B. The installing contractor shall guarantee that installation of the system is in accordance with the manufacturer's instructions.

3.03 START UP SUPERVISION AND TRAINING

A. The system supplier shall provide a factory trained and authorized service technician to inspect all final connections and check the system prior to start-up of the pump drive system. The service technician shall coordinate with the systems integrator for complete functional check-out of the system. The factory authorized person shall provide written certification that the installation meets or exceeds all

factory recommendations for proper operation.

B. Copies of the Operating and Maintenance manuals shall be prepared specifically for this installation and shall include all required specification sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

C. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for training to instruct representatives of the owner and the Engineer in proper operation and maintenance. Training subjects shall include, operator training, system repair, maintenance and detailed software training. Training shall be conducted after system startup, testing, and control tuning procedures are complete, and before final completion. If there are difficulties in operation of the equipment due to the installation or fabrication, additional instruction days shall be provided as deemed necessary by the engineer and at no cost to the owner.

END OF SECTION

SECTION 26 36 13

SAFETY SWITCHES AND DISCONNECTS

PART 1 – GENERAL (NOT USED)

PART 2 – PRODUCTS

2.01 GENERAL

A. All single throw disconnect switches and double throw manual transfer switches shall be heavy-duty horsepower rated type. Safety switches shall be rated for the available fault current where installed. Provide enclosed molded case switch type disconnects where required to meet high available fault current areas (above 10kaic). Switches shall be fusible only where required to meet equipment nameplate requirements.

B. Switches shall be 240V rated on systems up to and including 120/208V and 600V rated on higher voltage systems. All switches for motors shall be horsepower rated. All switches shall be NEMA 4X stainless steel enclosure except switches mounted in air-conditioned spaces. As an alternate to NEMA 4X stainless steel enclosures provide polyglass enclosures for 30amp (10hp) switches in the chemical areas equal to Hubbell Circuit-Lock.

C. Provide and install lugs on disconnect switch as required to accept conductors called for on drawings.

D. Provide Switches with an externally operated handle; quick make quick break mechanism; the handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be lockable in the "off" position with a padlock. Switches shall have arch suppressors, pin hinges and be horsepower rated at 600 volts.

E. Double throw non-fused safety switches may be used for manual power transfer where shown on the drawings and in areas up to 10,000A available short circuit current. In areas above 10k amps use double throw molded case manual transfer switches rated for the available fault currents.

2.02 SUBMITTALS

A. Submit product data on all major types of disconnects.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All three phase motors shall be provided with field mounted disconnects if they are not mounted within site of the three phase feeder breaker or control device they are wired from.

B. With the safety switch in the open position, both the motor heater and power circuits shall be open as well.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTIVE DEVICES (SPDs)

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection should be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

A. Section 26 29 13 - Control Panels

B. Section 26 24 16 – Panelboards

C. Section 40 95 13 - Instrumentation and Controls Systems

1.03 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

B. ANSI/IEEE C62.41.1-2002 – Guide on surge environment in low-voltage (1000 V and less) AC power circuits.

C. ANSI/IEEE C62.41.2-2002 – Recommended practice on characterization of surges in low-voltage (1000 V and less) AC power circuits.

D. ANSI/IEEE C62.45-2002 – Recommended practice on surge testing for equipment connected low-voltage (1000 V and less) AC power circuits.

1.04 SUBMITTALS

A. The following information shall be submitted to the Engineer:
   1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL).

2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:
1. Descriptive bulletins
2. Product sheets

C. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed and shall incorporate all changes made during the manufacturing process

1.05 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

1.07 MANUFACTURERS

A. Eaton / Cutler-Hammer products

B. SquareD by Schneider Electric: Surgelogic

C. EDCO

D. Erico

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

PART 2 – PRODUCTS

2.01 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.

6. SHORT CIRCUIT CURRENT RATING (SCCR): Per NEC 286.6, the short circuit current rating of the SPD shall be equal to or greater than the available short circuit current at the point where installed

7. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	2500

Modes	240D	480D	600D
L-L; L-G	1200	2000	2500

8. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment. The equipment shall be fully tested and certified to the following UL standards:

   UL 67 = Panelboards
   UL 845 = Motor Control Centers
   UL 857 = Busway
   UL 891 = Switchboards
   UL 1558 = Low Voltage Switchgear

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
      i. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
   b. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location.
   c. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed.
5. Remote Status Monitor: The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

6. Overcurrent Protection
   a. The SPD shall be designed in a way that it will take itself off-line before any damaging external effects to the suppressor or surroundings will occur.

2.02 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	240kA	120 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.03 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards.
   1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
   2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
   3. The panelboard shall be capable of re-energizing upon removal of the SPD.
   4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
   5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
   6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.04 ENCLOSURES

A. All enclosed equipment mounted for indoor application shall be NEMA 1 general purpose enclosures. Provide NEMA 4X enclosures for all outdoor applications.

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4X – Constructed of stainless steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, splashing water, and hose directed water).

2.05 POWER SUPPRESSORS FOR ELECTRONIC EQUIPMENT

A. Each item of electronic equipment provided under this contract and connected by

line cord or direct wired to the building electrical system shall be provided with a three-stage single or multi-phase hybrid suppressor. Fusing shall be provided which removes the protective elements from the circuit upon failure. Visual indication or loss of output power shall be used to notify the user of device failure.

B. Suppressors shall be rated for a minimum of 125% of their continuous electrical load. Suppressors for cord connected equipment shall be equipped with standard NEMA cordsets one of which includes a molded grounding receptacle and the other, a molded grounding plug. Suppressor shall be installed in series with the power cord for the protected equipment. Where several items of equipment are grouped within the same cluster of equipment, one suppressor may be used in conjunction with properly sized grounding plugstrip to serve the equipment.

C. Suppressors for direct wired equipment shall be identical in internal design to the unit described for cord connected applications, however, protected screw terminals suitable for termination of solid copper wire shall be used for wiring terminations. One suppressor may be used to support several equipment cabinets provided all cabinets are located within the same equipment cluster and the maximum connected load shall not exceed eighty percent of the rated suppressor capacity.

D. Suppressors shall be constructed with a phenolic non-flammable exterior housing with provisions for mounting to the interior of equipment racks, cabinets, or to the exterior of free-standing equipment. Suppressors shall be constructed as three-stage devices. The first stage shall include a high-energy varistor clamp between line and neutral and from neutral to ground. The second stage shall consist of series air-core inductor installed in the line conductor(s) to properly coordinate the action of the first and third stages. The third, fast acting, hard clamping stage shall consist of a network of silicon avalanche bipolar surge suppression diodes between the neutral and line conductor(s).

E. Minimum suppressor performance characteristics shall be as follows:
1. Maximum single impulse line-to-neutral current withstand: 15,000 Amperes (8 x 20 us waveform)
2. Maximum single impulse neutral-to-ground current withstand: 10,000 Amperes (8 x 20 us waveform)
3. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 1200 occurrences
4. Pulse lifetime rating for 200 Ampere (8 x 20 us waveform): 10,000 occurrences
5. Worst case response time: Five Nanoseconds
6. Worst case (Maximum Single Impulse Current Conditions) clamping voltage: 400% of nominal phase-to-ground RMS voltage.
7. Initial breakdown voltage: 200% of nominal phase-to-ground RMS voltage.

2.06 SUPPRESSORS FOR CONDUCTOR PAIR PROTECTION

A. Suppression devices for conductor pair protection shall be provided in single-

circuit pluggable packages suitable for the circuitry to be protected. Units for protection of data circuits which utilize standard connector configurations shall be equipped with connectors which install in series with the data cable to the protected equipment. Units intended for use with multiple wiring pairs shall be equipped with accessory terminal blocks or strips suitable for the type of wiring being used. Single pair units shall be configured as encapsulated units with wire leads or screw-terminal wiring terminations. Suppressors installed outside of terminal or equipment cabinets (except at designated terminal boards) shall be provided with a housing to afford physical protection for the surge suppression modules.

B. Suppression for each pair shall consist of a three-element gas tube first stage, an isolating element in series with each conductor of the pair, and a silicon avalanche second stage. Second stage clamping shall be provided across the pair for differential mode protection and from each side of the pair to ground for common mode protection. Resistive limiting elements may be used on low current circuits where the effect of voltage drop across the series resistance has no effect on circuit operation. Inductive series elements shall be used on higher current circuits to effectively pass direct or low frequency alternating currents while limiting passage of fast risetime surge waveforms. Silicon avalanche devices shall be designed for surge suppressor applications and shall be polarized or bipolar as appropriate for each circuit.

C. Minimum performance criteria (each circuit) shall be as follows:
   1. Maximum single impulse conductor-to-ground or conductor to conductor current withstand: 10,000 Amperes (8 x 20 us waveform)
   2. Pulse lifetime rating Category B worst case current waveform (8 x 20 us @ 3000 Amperes): 10 occurrences
   3. Pulse lifetime rating for 100 Ampere (10 x 1000 us waveform): 1,000 occurrences
   4. Worst case response time: Five Nanoseconds
   5. Worst case (Maximum Single Impulse Current) clamping voltage: 200% of normal operating voltage amplitude and polarized or bipolar as appropriate for each circuit type.
   6. Initial breakdown voltage: 150 percent of normal operating voltage peak amplitude plus or minus five percent.
   7. Capacitance: Capacitance for DC or low frequency lines shall not exceed 2000 picofarads measured line to line or line to ground at the rated diode breakdown voltage. Suppressors intended for use on high frequency or high baud rate circuits shall be designed for use on such lines. Capacitance of such units shall be equated to equivalent cable feet based on the type of cabling used for the particular circuit. The sum of equivalent cable feet for suppressors and actual cable footage shall not exceed manufacturers recommended maximum values for the system on which these devices are installed.
   8. Circuit compensation: Any additional circuit compensation (gain or equalization) required to compensate for the insertion of surge suppression devices shall be provided as part of this contract.

PART 3 - EXECUTION

3.01 BONDING AND GROUNDING CONDUCTORS AND MATERIALS

A. Conductors utilized for surge suppressor bonding shall be a minimum of #6 AWG solid insulated copper unless otherwise specified.

B. Ground bus or strip material shall be copper, a minimum of 26 gauge in thickness and three inches wide unless otherwise specified. Bus materials may be secured to surfaces with an appropriate mastic material or mechanical fasteners. Bus connections shall be bolted or brazed and reinforced as necessary on thin bus material to provide a permanent and secure connection.

C. Unless otherwise specified, all surge suppression grounding electrodes shall be 5/8" diameter copperweld rods, twenty feet in length.

D. Connectors, splices, and other fittings used to interconnect grounding conductors, bond to equipment or ground bars, shall comply with requirements of the National Electric Code and be approved by Underwriters Laboratories for the purpose.

E. Connectors and fittings for grounding and bonding conductors shall be of the compression or set-screw type in above grade locations. Connections below grade shall be exothermically welded or brazed.

F. Bonding connections between electrically dissimilar metals shall be made using exothermic welds or using bi-metal connectors designed to prevent galvanic corrosion.

3.02 SEGREGATION OF WIRING

A. All system wiring shall be classified into protected and non-protected categories. Wiring on the exposed side of suppression devices shall be considered unprotected. Surge suppressor grounding and bonding conductors shall also fall into this category.

B. All wiring between surge suppressors and protected equipment shall be considered protected. Isolated circuitry exempted from surge suppression requirements in part one of this section shall also be considered protected.

C. A minimum of three inches of separation shall be provided between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards and other locations. In no case shall protected and unprotected wiring be bundled together or routed through the same conduit. Where bundles of protected and unprotected wiring cross, such crossings shall be made at right angles.

3.03 INSTALLATION OF SUPPRESSORS

A. Suppressors shall be installed as close as practical to the equipment to be protected consistent with available space. Where space permits and no code restrictions apply, suppressors may be installed within the same cabinet as the protected equipment. Suppressors installed in this manner shall utilize the

equipment chassis as a medium for bonding of their ground terminals. Bonding jumpers not exceeding two inches in length shall be installed between the chassis and suppressor ground terminals. Bolted connections with star washers shall be used to insure electrical and mechanical integrity of connections to the equipment chassis.

B. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be consistent with recommended industry practices for the system on which these devices are installed.

C. Bonding between ground terminals for power and signal line suppressors serving a particular item or cluster of equipment shall be kept as short as possible. Where practical, suppressors shall be installed in a common location for the cluster with their ground terminals bonded closely together. For installations requiring separation between the various suppressor grounds and equipment chassis within an equipment cluster, the following table shall be used to determine bonding conductor requirements (distances are measured between most distant suppressor or chassis grounds):

BONDING DISTANCE	MATERIAL
0 - 10 feet	#6 AWG Bare Copper (Solid)
10- 25 feet	1-1/2" Copper Strip 26ga. Min.
25- 50 feet	3" Copper Strip 26ga. Min.
Over 50 feet	6" Copper Strip 26ga. Min.

Care shall be exercised to avoid connection of incidental grounds to the bonding bus system.

D. Where terminal cabinets are used to house surge suppressors, painted steel backboards shall be used to serve as a low impedance ground plane for bonding surge suppressor leads together. Terminal boards used for the same purpose shall be laminated with a single sheet of 14 ga. galvanized steel to serve as a ground plane for suppressors. Suppressors with ground terminals not inherently bonded to the ground plane through their mounting shall be bonded to this plane using a two-inch maximum length of #12AWG copper wire and suitable lug. Ground planes and backboards shall be drilled to accept self tapping screws, any paint in the area of the bond shall be removed and star washers shall be used.

E. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG bare copper conductors and approved connections unless otherwise noted.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year replacement warranty from the date of shipment against any SPD part failure in material or workmanship when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description of System
1. Light fixtures furnished under this Division shall be furnished complete with lamps and all necessary trim and mounting hardware, and installed as shown on the drawings.
2. Light fixtures shall be neatly and firmly mounted, using standard supports for outlets and fixtures. See special mounting requirements as detailed on the drawings.
3. Lamps shall be included in the system guarantee for a period of ninety (90) days after final acceptance of the building.

1.02 CODES

A. The WORK of this Section shall comply with the current editions of the following codes
1. National Electrical Code (NEC), NFPA 70
2. Florida Building Code (FBC)

1.03 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section
1. UL Underwriters Laboratories
2. CBM Certified Ballast Manufacturer's Association

1.04 SUBMITTALS

A. Shop Drawings and manufacturers data shall be submitted for the following items
1. Luminaire data shall show full-size cross sections. Indicate finished dimensions, metal thickness, U.L. Label, finish, lens/louver thickness and materials.
2. Show mounting details, including hung ceiling construction.
3. Indicate type of ballast and manufacturers and ballast quantity and location. Include information as to power factor, input watts and ballast factor.
4. Indicate lamps to be utilized and quantity.
5. Include a complete listing of all luminaries on a single sheet. This listing shall contain the luminaire type, manufacturer’s catalog number, applied voltage, lamps, ballast type and luminaire quantities.
6. The Engineer reserves the right to require submittal of a complete sample fixture for any fixture type.
7. For exterior post/pole mounted light fixtures, clearly indicate hand hole and lightning protection ground lug mounted to post/pole at hand hole inside post/pole.

8. Signed and sealed shop drawings and calculations shall be submitted for all exterior pole mounted fixtures. The seal must be of a registered professional engineer certifying that the foundation and pole/fixture assembly meets or exceeds the wind load criteria of the most current Florida Building Code. The foundation details shown on the plans are for bidding purposes only; the contractor shall provide the foundation and pole assembly necessary for compliance as submitted at no additional cost to owner.
9. Product data shall be submitted showing manufacturer's written recommendations for storage and protection, and installation instructions.

PART 2 – PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Luminaires
1. Acceptable manufacturers are listed in the lighting fixture schedule shown on the Drawings.
2. The designations indicated on the lighting fixture schedule are a design series reference (not necessarily a complete catalog number) and do not necessarily represent the number, size, voltage, wattage, type of lamp, ballast, finish trim, ceiling type, mounting hardware of special requirements as specified hereinafter on as required by the particular installation(s) and code. Contractor shall verify these requirements and order fixtures as required to give proper installation per the contract documents and per codes.

B. Ballasts
1. It is preferred that all ballasts shall be of the same manufacturer. Every effort shall be made to eliminate ballasts from multiple manufacturers. Ballasts within luminaires of a given type must however be of the same manufacturer. Multiple manufacturers will not be permitted.
2. Approved Manufacturers:
    a. Motorola
    b. Advance Transformer Co.
    c. Magnetek
    d. General Electric

C. Lamps
1. All lamps shall be of the same manufacturer. Multiple manufacturers are not permitted.
2. Approved Manufacturers:
    a. General Electric
    b. Philips
    c. Osram Sylvania

2.02 MATERIALS

A. All lighting fixtures mounted outdoors subject to dampness and insects shall have gasketing material between lens door and frame to completely seal interior of fixture. Knockouts and holes in fixtures housing shall be closed and sealed. All fixtures

shall be complete with lamps, shielding brackets, concrete bases, anchor bolts, and all necessary fittings and accessories for a complete installation.

B. Plastic Lenses and diffusers:
   1. Virgin acrylic unless otherwise noted. Install and leave with no finger prints or dirt marks on the lens or diffuser. Lenses shall be provided on all recessed metal halide luminaires.
   2. Minimum unpenetrated thickness for Parabolic or conical element diffuser: 0.085 inch.
   3. Minimum nominal thickness: 0.125 inch.

C. Parabolic Luminaire Care: Parabolic luminaires to be installed with mylar cover over louvers. Cover shall be U.L. listed for temporary lighting. Upon completion of work, remove mylar cover with white gloves and blow clean reflectors.

D. Finish: Porcelain or baked enamel finish matte white on interiors with minimum tested reflectance of 90 percent matte white finish or as specified in visible exterior. Thoroughly clean base metal and painted after fabrication.

E. Sockets: Incandescent lamp sockets - porcelain housings over copper screw shells, with medium base sockets rated at 660 watts and 250 volts. Insulating joint in pull chains. Fluorescent lampholder - white, rotor lock, heat-resistant plastic rated 660 watts and 600 volts. Fluorescent industrial sockets - heavy-duty, multi-socket, metal-clad, spring-loaded. Provide heavy-duty sockets for H.I.D. luminaires where mounted less than 8'-0" AFF.

F. Luminaire Wiring: Minimum individual luminaire wiring - number 18 gauge with insulation at rated operating temperature of 105 degrees Centigrade or higher. Terminate wiring for recessed luminaires, except fluorescent units, in an external splice box.

G. Ballasts
   1. Ballasts for F32T8 lamps shall be:
      a. High frequency solid state electronic.
      b. Electronic Program start
      c. 50 F minimum starting temperature unless otherwise noted
      d. Minimum 1.15 ballast factor
      e. Maximum total harmonic distortion (THD) less than 10%
      f. High power factor, minimum 95 %
      g. Sound rated A
   2. High-power factor (over 90 percent). Certified Ballast Manufacturers' Certification, ballast case temperature not to exceed 90 degrees Centigrade during normal operation in 30 degrees Centigrade ambient temperature. Ballast voltage: 120 or 277 volts, as required by circuiting. Ballast shall be provided with the best sound rating available.
   3. Built-in self-resetting thermal actuated device will remove ballast from line when excessive ballast temperature is reached. U.L. Class P, CBM certified 100% output.
   4. The conductors between ballasts and lampholders shall have an approved insulation for 1,000 volts. This includes conductors to and from remote ballasts.

5. High-intensity discharge ballasts shall be constant wattage autotransformer type with built-in thermal protection, minimum power factor of 80%. 12" min. leads.
6. Provide ballasts with voltage characteristics to match that of all related circuitry indicated on the Drawings. No extra compensation will be allowed for failure to properly coordinate ballast voltage with circuitry.
7. Ballasts for control of lamps in one housing or fixture unit may control lamps of an adjoining unit, except as otherwise noted.
8. Guarantee ballast for one full year and one year prorated as per standard manufacturer's warranty against defects for a period of 2 years. Guarantee to include replacing defective ballast with new ballast.
9. Provide dimming ballasts as shown on the drawing for fixtures controlled by individual dimming or dimming systems.
10. LED drivers for interior luminaires shall employ an auto resetting thermal management system to turn off the LED array when normal operating temperatures are exceeded. Exterior drivers shall employ a step reduction circuit to reduce lumen output in order to maintain proper operating temperatures, but will not allow an “off” condition for thermal management.

H. Lamps
1. Provide a complete set of new lamps in each fixture.
2. Unless noted otherwise lamps must conform to the following:
    a. Fluorescent: T-8, 41k color. Minimum of 80 CRI and 3100 lumens.
    b. Incandescent: "A" lamps to be inside frosted rated at 130 volts.
    c. Compact Fluorescent: triple Twin tube, 4-pin
    d. HID: Metal Halide, clear, universal base, open rated.
    e. LED: Minimum of 50,000 hrs life at no less than 70% initial lumen rating. 40k color. Minimum of 80 CRI. Color variation shall not exceed a 3 step MacAdam ellipse.

I. Luminaires installed recessed in a metal pan ceiling shall have a flange type trim to overlap abutment of adjacent pans.

J. Where utilized as raceways, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary.

K. Where ceiling mounted fixtures are called for in the Light Fixture Schedule and on the drawings, this contractor shall provide fixture trims and supports as required to match type of ceiling system which will be furnished. No ceiling fixtures shall be ordered until the Ceiling System Installer has given written approval of the method and location of fixture hanging and fixture type. Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Clips identified for use with the type of ceiling frame member(s) and fixture(s) shall also be permitted. Where fixtures are supported by the suspended ceiling system; the ceiling system shall have a minimum (2) opposite corners tied to structure at each fixture location; this contractor shall be responsible for doing this work or for having the ceiling contractor perform it. All supports shall meet current FBC standards.

L. All exterior post/pole mounted light fixtures shall have a hand hole at the base, lightning protection in hand hole and ground conductor connected to ground rod at base. Hand hole shall provide easy access to light fixture fusing and lightning

protection ground lug. Lightning protection ground lug shall be provided inside post/pole, electrically in contact with pole, for connection to ground rod. Provide and install ground wire from ground lug to ground rod, concealing ground wire through post/pole base. Anchor bolts to be galvanized.

M. All interior and exterior light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels. All labels shall be concealed within the body of the fixture and/or luminaire. No manufacturers name or logo shall appear on the exterior of any light fixtures unless approved in writing by engineer.

N. All light fixtures shall adhere to U.L. Test Standard #1571 and Section #410-65C of the National Electric Code. All manufacturers shall provide the required thermal protection as required.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install luminaires in mechanical and unfinished areas after ductwork and piping installation. Adjust fixture locations to provide the best lighting for equipment access and service locations. Locate fixtures 8 feet 6 inches above floor, or at suitable locations within space on walls but not lower than 7'-0" AFF.

B. The Contractor shall protect luminaires from damage during installation of same and up to time of final acceptance. Any broken luminaires, glassware, plastics, lamps, etc., must be replaced by the Contractor with new parts, without any additional expense to the Owner.

C. The contractor shall verify prior to ordering fixtures that each fixture scheduled has correct type trim and support arrangement for the proposed ceiling construction.

D. Install all fixtures in accordance with manufacturer's written instructions and the NEC.

E. Pendant mounted units shall comply with the following:
   1. Each stem shall have a brass or steel swivel or other self-aligning device of type approved by the Engineer. The entire luminaire mounting (hickey, aligner, swivel, stem, etc.) shall be submitted to and approved by the Engineer before installation.
   2. An insulated malleable iron bushing shall be placed at luminaire end of stem through which wire passes.
   3. A pendant support using an approved sliding clevis bracket which firmly grips an indentation in rigid sides of the wiring channel will be acceptable.
   4. Connections between outlet boxes and luminaires shall be by means of approved flexible raceways. The application of raceways directly between luminaires is unacceptable.

F. Where luminaires are mounted upon surface-mounted outlet boxes in surface mounted conduit runs, this Contractor shall furnish and install a luminaire canopy

sufficiently deep to permit exposed conduits to pass through. Canopy shall have proper openings cut by luminaire manufacturer through which conduits may pass. Submit sample of canopy for approval before installation.

G. Ceiling surface mounted fluorescent fixtures installed in exposed ceiling areas are to be suspended from ceiling structure with all-thread rods and 1-1/2”x1-1/2” Kindorf channels, full length of fixture/row. Mount outlet box at structure with flexible connection to fixture.

H. Ducseal shall be installed to seal all conduits entering exterior light fixtures from underground.

I. Install exit light as indicated on the drawings but not higher than 10'0" AFF. Size and color of lettering shall comply with local codes.

J. Outdoor lighting shall be aimed in periods of darkness in front of the owner/engineer.

3.02 COORDINATION WITH AMBIENT CONDITIONS

A. The Contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions which will exist when the luminaires are installed. No extra compensation will be permitted for failure to coordinate the luminaires with their ambient conditions. These areas of coordination include but are not limited to the following:

1. Wet location labels
2. Damp location labels
3. Low temperature ballasts
4. Dimming ballasts
5. Very low heat rise ballasts
6. Explosion proof
7. Plenums and air handling spaces
8. Fire rated ceilings
9. Low density ceilings
10. Insulated ceilings

3.03 CLEAN-UP

A. Luminaires:

1. Clean free from dust and dirt. Wash lens and glassware using cleaner such as “Windex” and dry with absorbent paper. Clean plastic per manufacturer’s recommendations; do not wipe. Lenses which are kept in original containers until immediately prior to final inspection may not require cleaning. Clean “Alzak” aluminum surfaces (reflectors, fixture cones and the like) per mfr’s recommendations being careful to remove finger prints and smudges.
2. It is the contractor’s responsibility to remove any U.L. labels or manufacturer’s labels from areas of fixture exposed to view and relocate label to non-obtrusive area on fixture.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for clearing of all areas within the Contract limits and other areas shown, including work designated in permits and other agreements, in accordance with the requirements of Division 1.

B. Related Work Specified in Other Sections Includes:

1. Section 02 40 00 - Demolition
2. Section 31 23 16 - Excavation - Earth and Rock
3. Section 31 23 23 - Backfilling
4. Section 32 92 00 – Lawn Restoration

1.2 DEFINITIONS

A. Clearing: Clearing is the removal from the ground surface and disposal, within the designated areas, of trees, brush, shrubs, down timber, decayed wood, other vegetation, rubbish and debris as well as the removal of fences.

B. Grubbing: Grubbing is the removal and disposal of all stumps, buried logs, roots larger than 1-1/2 inches, matted roots and organic materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TREE REMOVAL

A. Tree Removal Within Property Limits: Remove trees and shrubs within the property limits, unless otherwise indicated.

1. Remove trees and shrubs to avoid damage to trees and shrubs designated to remain.

2. Grub and remove tree stumps and shrubs felled within the property limits to an authorized disposal site. Fill depressions created by such removal with material suitable for backfill as specified in Section 31 23 23.

B. Tree Removal Outside Property Limits: Do not cut or damage trees outside the property limits unless shown to be removed or unless written permission has been obtained from the property owner. Furnish three copies of the written permission before removal operations commence.

C. If the landowner desires the timber or small trees, the CONTRACTOR shall cut and neatly pile it in 4 ft. lengths for removal by the OWNER; otherwise, the CONTRACTOR shall dispose of it by hauling it away from the project site.

3.2 TREES AND SHRUBS TO BE SAVED

A. Protection: Protect trees and shrubs within the construction site that are so delineated or are marked in the field to be saved from defacement, injury and destruction.

1. Work within the limits of the tree drip line with extreme care using either hand tools or equipment that will not cause damage to trees.

a. Do not disturb or cut roots unnecessarily. Do not cut roots 1-1/2 inches and larger unless approved.

b. Immediately backfill around tree roots after completion of construction in the vicinity of trees.

c. Do not operate any wheeled or tracked equipment within drip line.

2. Protect vegetation from damage caused by emissions from engine-powered equipment.

3. During working operations, protect the trunk, foliage and root system of all trees to be saved with boards or other guards placed as shown and as required to prevent damage, injury and defacement.

a. Do not pile excavated materials within the drip line or adjacent to the trunk of trees.

b. Do not allow runoff to accumulate around trunk of trees.

c. Do not fasten or attach ropes, cables, or guy wires to trees without permission. When such permission is granted, protect the tree before making fastening or attachments by providing burlap wrapping and softwood cleats.

d. The use of axes or climbing spurs for trimming will not be permitted.

e. Provide climbing ropes during trimming.

4. Remove shrubs to be saved, taking a sufficient earth ball with the roots to maintain the shrub.

a. Temporarily replant if required, and replace at the completion of construction in a condition equaling that which existed prior to removal.

b. Replace in kind if the transplant fails.

5. Have any tree and shrub repair performed by a tree surgeon properly licensed by the State of Florida and within 24 hours after damage occurred.

3.3 CLEARING AND GRUBBING

A. Clearing: Clear all items specified to the limits shown and remove cleared and grubbed materials from the site.

1. Do not start earthwork operations in areas where clearing and grubbing is not complete, except that stumps and large roots may be removed concurrent with excavation.

2. Comply with erosion, sediment control and storm management measures as specified in Division 1.

B. Grubbing: Clear and grub areas to be excavated, areas receiving less than 3 feet of fill and areas upon which structures are to be constructed.

1. Remove stumps and root mats in these areas to a depth of not less than 18 inches below the subgrade of sloped surfaces.

2. Fill all depressions made by the removal of stumps or roots with material suitable for backfill as specified in Section 31 23 23.

C. Limited Clearing: Clear areas receiving more than 3 feet of fill by cutting trees and shrubs as close as practical to the existing ground. Grubbing will not be required.

D. Dispose of all material and debris from the clearing and grubbing operation by hauling such material and debris away to an approved dump. The cost of disposal (including hauling) of cleared and grubbed material and debris shall be considered a subsidiary obligation of the Contractor; the cost of which shall be included in the prices bid for the various classes of work.

3.4 TOPSOIL

A. Stripping: Strip existing topsoil from areas that will be excavated or graded prior to commencement of excavating or grading and place in well-drained stockpiles in approved locations.

3.5 PRESERVATION OF DEVELOPED PRIVATE PROPERTY

A. The CONTRACTOR shall exercise extreme care to avoid unnecessary disturbance of developed private property along the route of the construction. Trees, shrubbery, gardens, lawns, and other landscaping, which in the opinion of the ENGINEER must be removed, shall be replaced and replanted to restore the construction easement to the condition existing prior to construction.

B. All soil preservation procedures and replanting operations shall be under the supervision of a nursery representative experienced in such operations.

C. Improvements to the land such as fences, walls, outbuildings, and other structures which of necessity must be removed, shall be replaced with equal quality materials and workmanship.

D. Clean up the construction site across developed private property directly after construction is completed upon approval of the ENGINEER.

E. Any commercial signs, disturbed or removed, shall be restored to their original condition within 24 hours.

3.6 PRESERVATION OF PUBLIC PROPERTY

A. The appropriate paragraphs of Articles 3.5 and 3.6 of these Specifications shall apply to the preservation and restoration of public lands, parks, rights-of-way, easements, and all other damaged areas.

END OF SECTION

SECTION 31 23 16

EXCAVATION - EARTH AND ROCK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for performing opencut excavations to the widths and depths necessary for constructing structures, pipelines and conduits including excavation of any material necessary for any purpose pertinent to the construction of the Work.

B. Related Work Specified In Other Sections Includes:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 31 10 00 - Site Clearing
3. Section 31 23 23 - Backfilling
4. Section 31 40 00 - Shoring, Sheeting and Bracing
5. Division 33 - Utilities

1.2 DEFINITIONS

A. Earth: "Earth" includes all materials which, in the opinion of the ENGINEER, do not require blasting, barring, wedging or special impact tools for their removal from their original beds, and removal of which can be completed using standard excavating equipment. Specifically excluded are all ledge and bedrock and boulders or pieces of masonry larger than one cubic yard in volume.

B. Rock: "Rock" includes all materials which, in the opinion of the ENGINEER, require blasting, barring, wedging and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Boulders or masonry larger than one cubic yard in volume are classed as rock excavation.

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Dewatering Excavation Plan: Develop an excavation dewatering plan that considers site ground and groundwater conditions, the type and arrangement of the equipment to be used and the proper method of groundwater disposal. Prepare the dewatering plan before beginning excavations below groundwater. Maintain one copy of the dewatering plan at the project site to be available for inspection while all dewatering operations are underway.

1.4 SITE CONDITIONS

A. Geotechnical Investigation: A geotechnical investigation and report for MPS 6600 site titled Proposed Waterway Estates Intermediate Pump Station was prepared for Florida Governmental Utility Authority (FGUA) dated January 31, 2011, and was referenced by the OWNER and ENGINEER in preparing the Contract Documents. McKim & Creed later subtracted Universal Engineering Sciences to conduct a geotechnical exploration on the soil conditions onsite.

1. The geotechnical investigation reports may be examined by the CONTRACTOR for whatever value it may be considered to be worth. However, this information is not guaranteed as to its accuracy or completeness.

2. The geotechnical investigation report is not part of the Contract Documents.

B. Actual Conditions: Make any geotechnical investigations deemed necessary to determine actual site conditions.

C. Underground Utilities: Locate and identify all existing underground utilities prior to the commencement of Work.

D. Quality and Quantity: Make any other investigations and determinations necessary to determine the quality and quantities of earth and rock and the methods to be used to excavate these materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL

A. Clearing: Clear open cut excavation sites of obstructions preparatory to excavation. Clearing in accordance with Section 31 10 00, includes removal and disposal of vegetation, trees, stumps, roots and bushes, except those specified to be protected during trench excavation.

B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in accordance with Section 31 40 00.

C. Safety: Whenever an excavation site or trench is left unattended by the CONTRACTOR or when an area is not within 100 feet of observation by the CONTRACTOR, the excavation site or trench shall be filled and/or, at the OWNER's discretion, protected by other means to prevent accidental or unauthorized entry. Such protection shall include barricades and other protection devices requested by

the ENGINEER or OWNER, including temporary fencing, snow fencing, or temporary "structure" tape. Such safety items shall not relieve the CONTRACTOR of any site safety requirements or liabilities established by Federal, State and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the general public.

D. Hazardous Materials: If encountered, take care of hazardous materials not specifically shown or noted in accordance with Section 01 57 00.

E. During excavation and any site work, storm water pollution prevention measures shall be taken to ensure that water quality criteria are not violated in the receiving water body and all state and local regulatory requirements are met.

3.2 STRUCTURE EXCAVATION

A. Excavation Size: Provide excavations of sufficient size and only of sufficient size to permit the Work to be economically and properly constructed in the manner and of the size specified.

B. Excavation Shape: Shape and dimension the bottom of the excavation in earth or rock to the shape and dimensions of the underside of the structure or drainage blanket wherever the nature of the excavated material permits.

C. Compaction: Before placing foundation slabs, footings or backfill, proof roll the bottom of the excavations to detect soft spots.

1. For accessible areas, proof roll with a ten wheel tandem axle dump truck loaded to at least 15 tons or similarly loaded construction equipment.

2. For small areas, proof roll with a smooth-faced steel roller filled with water or sand, or compact with a mechanical tamper.

3. Make one complete coverage, with overlap, of the area.

4. Overexcavate soft zones and replace with compacted select fill in accordance with Part 3, Section 3.9.

3.3 TRENCH EXCAVATION

A. Preparation: Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Unless shown or specified otherwise, preserve all trees and large shrubs. Hold damage to the root structure to a minimum. Small shrubs may be preserved or replaced with equivalent specimens.

B. Adequate Space: Keep the width of trenches to a minimum, however provide adequate space for workers to place, joint and backfill the pipe properly.

1. The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus 8-inches for unsheeted trench or 12 inches for sheeted trench.

   The maximum width of trench, measured at the top of the pipe, shall not exceed the outside pipe diameter plus 2 feet, unless otherwise shown on the drawing details or approved by the ENGINEER. Trench walls shall be maintained vertical from the bottom of the trench to a line measured one foot above the top of the pipe. From one foot above the top of the pipe to the surface the trench walls shall conform with OSHA Regulations.

2. In sheeted trenches, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.

3. Should the maximum trench widths specified above be exceeded without written approval, provide concrete cradle or encasement for the pipe as directed. No separate payment will be made for such concrete cradle or encasement.

C. Depth:

1. Excavate trenches to a minimum depth of 8 inches below the bottom of the pipe or the bottom of encasement for electrical ducts, unless otherwise shown, specified or directed, so that bedding material can be placed in the bottom of the trench and shaped to provide a continuous, firm bearing for duct encasement, pipe barrels and bells.

2. Standard trench grade shall be defined as the bottom surface of the utility to be constructed or placed within the trench. Trench grade for utilities in rock or other non-cushioning material shall be defined as additional undercuts backfilled with #57 stone compacted in 6-inch lifts, below the standard 8-inches minimum trench undercut. Excavation below trench grade that is not ordered in writing by the ENGINEER shall be backfilled to trench grade and compacted.

D. Unstable or Unsuitable Materials: If unstable or unsuitable material is exposed at the level of the bottom of the trench excavation, excavate the material in accordance with the subsection headed "Authorized Additional Excavation".

1. Material shall be removed for the full width of the trench and to the depth required to reach suitable foundation material.

2. When in the judgment of the ENGINEER the unstable or unsuitable material extends to an excessive depth, the ENGINEER may advise, in writing, the need for stabilization of the trench bottom with additional select fill material, crushed stone, washed shell, gravel mat or the need to provide firm support for the pipe or electrical duct by other suitable methods.

3. Crushed stone, washed shell and gravel shall be as specified in Section 31 23 23.

4. Payment for such trench stabilization will be made under the appropriate Contract Items or where no such items exist, as a change in the Work.

E. Length of Excavation: Keep the open excavated trench preceding the pipe or electrical duct laying operation and the unfilled trench, with pipe or duct in place, to a minimum length which causes the least disturbance. Provide ladders for a means of exit from the trench as required by applicable safety and health regulations.

F. Excavated Material: Excavated material to be used for backfill shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the Contractor shall be responsible for obtaining the sites to be used and shall maintain his operations to provide for natural drainage and not present an unsightly appearance.

G. Water: Allow no water to rise in the trench excavation until sufficient backfill has been placed to prevent pipe or duct flotation.

3.4 SHORT TUNNEL EXCAVATION

A. Short Tunnel Requirements: In some instances, trees, shrubs, utilities, sidewalks and other obstructions may be encountered, the proximity of which may be a hindrance to open cut trench excavation. In such cases, excavate by means of short tunnels in order to protect such obstructions against damage.

1. Construct the short tunnel by hand, auger or other approved method approximately 6 inches larger than the diameter of pipe bells or outer electrical duct encasement.

2. Consider such short tunnel work incidental to the construction of pipelines or conduits and all appurtenances. The need for short tunnels will not be grounds for additional payment.

3.5 EXCAVATION FOR JACKING AND AUGERING

A. Jacking and Augering Requirements: Allow adequate length in jacking pits to provide room for the jacking frame, the jacking head, the reaction blocks, the jacks, auger rig, and the jacking pipe. Provide sufficient pit width to allow ample working space on each side of the jacking frame. Allow sufficient pit depth such that the invert of the pipe, when placed on the guide frame, will be at the elevation desired for the completed line. Tightly sheet the pit and keep it dry at all times.

3.6 ROCK EXCAVATION

A. Rock Excavation: Excavate rock within the boundary lines and grades as shown, specified or required.

1. Rock removed from the excavation becomes the property of the CONTRACTOR. Transport and dispose of excavated rock at an off site disposal location. Obtain the off site disposal location.

2. Remove all shattered rock and loose pieces.

B. Structure Depths: For cast-in-place structures, excavate the rock only to the bottom of the structure, foundation slab, or drainage blanket.

C. Trench Width: Maintain a minimum clear width of the trench at the level of the top of the pipe of the outside diameter of the pipe barrel plus 4 feet, unless otherwise approved.

D. Trench Depth: For trench excavation in which pipelines or electrical ducts are to be placed, excavate the rock to a minimum depth of 8 inches below the bottom of the pipe or duct encasement. Provide a cushion of sand or suitable crushed rock. Refill the excavated space with pipe bedding material in accordance with Section 31 23 23. Include placing, compacting and shaping pipe bedding material in the appropriate Contract Items.

E. Manhole Depths: For manhole excavation, excavate the rock to a minimum depth of 8 inches below the bottom of the manhole base for pipelines 24 inches in diameter and larger and 6 inches below the bottom manhole base for pipelines less than 24 inches in diameter. Refill the excavated space with pipe bedding material in accordance with Section 31 23 23. Include placing, compacting and shaping pipe bedding material for manhole bases in the appropriate Contract Items.

F. Over-excavated Space: Refill the excavated space in rock below structures, pipelines, conduits and manholes, which exceeds the specified depths with 2,500 psi concrete, crushed stone, washed shell, or other material as directed. Include refilling of over-excavated space in rock as part of the rock excavation.

G. Other Requirements: Follow, where applicable, the requirements of the subsections on "Trench Excavation" and "Structure Excavation".

H. Payment: Rock excavation, including placing, compacting and shaping of the select fill material, will be paid for under the appropriate Contract Items or where no such items exist, as a change in the Work.

I. Blasting: Perform authorized blasting by authorized and qualified workers as approved as to the number, length, placing and direction, and loading of holes. Do not use charges which will make the excavation unduly large or irregular, nor shatter the rock upon or against which masonry is to be built, nor injure masonry or existing structures at the site or in the vicinity.

1. Cover each blast with a woven wire cable mat weighted with heavy timbers. Blasting will not be permitted within 25 feet of existing or of the completed pipeline or structure. Control blasts in tunnels so that the material surrounding the tunnel base proper is not loosened or displaced.

2. Discontinue blasting whenever it is determined that further blasting may injure or damage adjacent rock, masonry, utility lines, or other structures. In such cases, excavate the remaining rock by barring, wedging, or other approved methods.

3. Where sewers, gas, water, steam, or other utility ducts or lines, catch basin connections, or other structures have been exposed during excavation, adequately protect such structures from damage before proceeding with the blasting. Promptly repair any structure damaged by blasting at no addition to the Contract Price.

4. Take due precautions to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms or other sources of extraneous electricity.

5. Keep a sufficient quantity of explosives on hand to avoid delay to the Work on the site when rock excavation is in progress. At no time keep a quantity in excess of that which will be required for use within the following 12 hours.

6. Store, handle and use such explosives in conformity with all laws, ordinances, and regulations of the County or governing body governing the storage and use of explosives at the construction site.

7. Provide a magazine keeper to keep accurate daily records and account for each piece of explosive, detonator and equipment from time of delivery at the magazine until used or removed from the site. Abandon no explosives or blasting agents.

8. Take sole responsibility for the methods of handling, use, and storage of explosives and any damage to persons or property resulting therefrom. Approval of these methods or failure to order that blasting be discontinued does not relieve the CONTRACTOR of any of this responsibility.

3.7 FINISHED EXCAVATION

A. Finish: Provide a reasonably smooth finished surface for all excavations, which is uniformly compacted and free from irregular surface changes.

B. Finish Methods: Provide a degree of finish which is ordinarily obtainable from blade-grade operations, except as otherwise specified in Section 31 23 23.

3.8 PROTECTION

A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.

B. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.

C. It shall be the CONTRACTOR's responsibility to acquaint himself with all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, work shall be coordinated with the facility owner and performed so as to cause as little interference as possible with the service rendered by the facility disturbed. Facilities or structures damaged in the prosecution of the work shall be repaired and/or replaced immediately, in conformance with current standard practices of the industry, or according to the direction of the owner of such facility, at the CONTRACTOR's expense.

D. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Division 1.

3.9 AUTHORIZED ADDITIONAL EXCAVATION

A. Additional Excavation: Carry the excavation to such additional depth and width as authorized in writing, for the following reasons:

1. In case the materials encountered at the elevations shown are not suitable.

2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.

B. Refill Materials: Refill such excavated space with either authorized 2500 psi concrete or compacted select fill material, in compliance with the applicable provisions of Section 31 23 23.

C. Compaction: Where necessary, compact fill materials to avoid future settlement. As a minimum, unless otherwise specified or directed, backfill layers shall not exceed 6-inches in thickness for the full trench width and compaction shall equal 95% of maximum density, or 98% if under paved area of roadway, as determined by using ASTM D 1557. Compaction density tests shall be made at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.

D. Payment: Additional earth excavations so authorized and concrete or select fill materials authorized for filling such additional excavation and compaction of select fill materials will be paid for under the appropriate Contract Items or where no such items exist, as a change in the Work.

3.10 UNAUTHORIZED EXCAVATION

A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved in order to provide for the stability of the various structures.

B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with 2500 psi concrete or compacted select fill material, as approved.

C. Payment: Refill for unauthorized excavation will not be measured and no payment will be made therefor.

3.11 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.

B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.

C. Excess Materials: CONTRACTOR shall be responsible to transport and dispose of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off site disposal location secured by the CONTRACTOR.

3.12 REMOVAL OF WATER

A. Water Removal: At all times during the excavation period and until completion and acceptance of the WORK at final inspection, provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation or other parts of the WORK.

B. Dry Excavations: Keep the excavation dry.

C. Water Contact: Allow no water to rise over or come in contact with masonry and concrete until the concrete and mortar have attained a set and, in any event, not sooner than 12 hours after placing the masonry or concrete.

D. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.

E. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.

F. Sanitary Sewers: Discharge no water into sanitary sewers.

G. Storm Sewers: Discharge no water containing settleable solids into storm sewers.

H. Repair: Promptly repair any and all damage caused by dewatering the Work.

END OF SECTION

SECTION 31 23 23

BACKFILLING

PART 1 GENERAL

1.1 SUMMARY

A. General Requirements: Backfill all excavation to the original surface of the ground or to such other grades as may be shown or required. For areas to be covered by topsoil, leave or stop backfill (12) inches below the finished grade or as shown. Obtain approval for the time elapsing before backfilling against masonry structures. Remove from all backfill, any compressible, putrescible, or destructible rubbish and refuse and all lumber and braces from the excavated space before backfilling is started. Leave sheeting and bracing in place or remove as the work progresses.

B. Equipment Limitations: Do not permit construction equipment used to backfill to travel against and over cast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified providing the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.

C. Related Work Specified in Other Sections Includes:

1. Section 31 10 00 - Site Clearing
2. Section 31 23 16 - Excavation – Earth and Rock

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 1557 - Standard Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 in Drop

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL - GENERAL

A. General: Backfill with sound materials, free from waste, organic matter, rubbish, boggy or other unsuitable materials.

B. General Materials Requirements: Conform materials used for backfilling to the requirements specified. Follow common fill requirements whenever drainage or

select fill is not specified. Determine and obtain the approval of the appropriate test method where more than one compaction test method is specified.

C. Frozen Materials: Do not use frozen material for backfilling.

2.2 DRAINAGE FILL

A. Materials for Drainage Fill: Use clean gravel, crushed stone, or other suitable material conforming to the gradation specified for drainage fill. Clay and fine particles are unacceptable in drainage fill. Provide drainage fill of a grade between the following limits:

U.S. Standard Sieve	Percent Passing By Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	45-65
#4	5-15
#16	0-4

2.3 SELECT FILL

A. Materials for Select Fill: Use clean gravel, crushed stone, washed shell, or other granular or similar material as approved which can be readily and thoroughly compacted to 95 percent of the maximum dry density obtainable by ASTM D 1557.

1. Allowed Materials: Grade select fill between the following limits:

U.S. Standard Sieve	Percent Passing By Weight
2 inch	100
1-1/2 inch	90-100
1 inch	75-95
1/2 inch	45-70
#4	25-50
#10	15-40
#200	5-15

2. Unallowed Materials: Very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet are unacceptable as select fill.

2.4 COMMON FILL

A. Materials for Common Fill: Material from on-site excavation may be used as common fill provided that it can be readily compacted to 90 percent of the maximum dry density obtainable by ASTM D 1557, and does not contain unsuitable material. Select fill may be used as common fill at no change in the Contract Price.

B. Granular Materials On-Site: Granular on-site material, which is fairly well graded between the following limits may be used as granular common fill:

U.S. Standard Sieve	Percent Passing by Weight
3 inch	100
#10	50-100
#60	20-90
#200	0-20

C. Cohesive Materials On-Site: Cohesive site material may be used as common fill.

1. The gradation requirements do not apply to cohesive common fill.

2. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

D. Material Approval: All material used as common fill is subject to approval. If there is insufficient on-site material, import whatever additional off-site material is required which conforms to the specifications and at no additional cost.

2.5 Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.6 UTILITY PIPE BEDDING

A. Class A (special utility bedding). Should special bedding be required due to depth of cover, impact loadings or other conditions, Class A bedding shall be installed, as shown in Section 6 of the Lee County Utilities Operations Manual.

B. Class B (minimum utility bedding). The bottom of the trench shall be shaped to provide a firm bedding for the utility pipe. The utility shall be firmly bedded in undisturbed firm soil or hand shaped unyielding material. The bedding shall be shaped so that the pipe will be in continuous contact therewith for its full length and shall provide a minimum bottom segment support for the pipe equal to 0.3 times the outside diameter of the barrel.

PART 3 EXECUTION

3.1 ELECTRICAL DUCT AND PRECAST MANHOLE BEDDING

A. Bedding Compaction: Bed all electrical ducts and precast manholes in well graded, compacted, select fill conforming to the requirements except as otherwise shown, specified, or required. Extend electrical duct bedding a minimum of 6 inches below the bottom of the duct encasement for the full trench width. Compact bedding thickness no less than 6 inches for precast concrete manhole bases.

B. Concrete Work Mats: Cast cast-in-place manhole bases and other foundations for structures against a 2500 psi concrete work mat in clean and dry excavations, unless otherwise shown, specified or required.

C. Bedding Placement: Place select fill used for bedding beneath electrical ducts and precast manhole bases, in uniform layers not greater than 9 inches in loose thickness. Thoroughly compact in place with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

D. Use of Select Fill: Bed existing underground structures, tunnels, conduits and pipes crossing the excavation with compacted select fill material. Place bedding material under and around each existing underground structure, tunnel, conduit or pipe and extend underneath and on each side to a distance equal to the depth of the trench below the structure, tunnel, conduit or pipe.

3.2 PIPE BEDDING AND INITIAL BACKFILL

A. Hand Placement: Place select fill by hand for initial pipe backfill from top of bedding to 1 foot over top of pipes in uniform layers not greater than 6 inches in loose thickness. Tamp under pipe haunches and thoroughly compact in place the select fill with suitable mechanical or pneumatic tools to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Stone Placement: Do not place large stone fragments in the pipe bedding or backfill to 1 foot over the top of pipes, nor nearer than 2 feet at any point from any pipe, conduit or concrete wall.

C. Unallowed Materials: Pipe bedding containing very fine sand, uniformly graded sands and gravels, sand and silt, soft earth, or other materials that have a tendency to flow under pressure when wet is unacceptable.

3.3 BEDDING PLACEMENT AND BACKFILL FOR PIPE IN SHORT TUNNEL

A. Bed pipelines or electrical ducts placed in short tunnels in select fill or 2500 psi concrete. Completely fill the remainder of the annular space between the outside of the pipe wall and the tunnel wall with select fill, suitable job-excavated material, or 2500 psi concrete, as approved. Suitably support pipelines or ducts in short tunnels to permit placing of backfill suitably tamped in place.

3.4 TRENCH BACKFILL

A. General: Backfill material shall be clean earth fill composed of sand, clay and sand, sand and stone, crushed stone, or an approved combination thereof. Backfilling shall be accomplished under two specified requirements: First Lift, from trench grade to a point 12 inches above the top of the utility, and, Second Lift, from the top of the First Lift to the ground surface. Where thrust blocks, encasements, or other below-grade concrete work have been installed, backfilling shall not proceed until the concrete has obtained sufficient strength to support the backfill load.

B. First Lift: Fine material shall be carefully placed and tamped around the lower half of the utility. Backfilling shall be carefully continued in compacted and tested layers not exceeding 6 inches in thickness for the full trench width, until the fill is 12 inches above the top of the utility, using the best available material from the excavation, if approved. The material for these first layers of backfill shall be lowered to within 2 feet above the top of pipes before it is allowed to fall, unless the material is placed with approved devices that protect the pipes from impact. The "First Lift" shall be thoroughly compacted and tested before the "Second Lift" is placed. Unless otherwise specified, compaction shall equal 98% of maximum density, as determined by ASTM D 1557. The "First Lift" backfill shall exclude stones, or rock fragments larger than the following:

Pipe Type	(Greatest Dimension-Inches) Fragment Size (Inches)
Steel	2
Concrete	2
Ductile Iron	2
Plastic	1
Fiberglass	1

C. Second Lift: The remainder of the trench, above the "First Lift", shall be backfilled and tested in layers not exceeding 6 inches. The maximum dimension of a stone, rock, or pavement fragment shall be 6 inches. When trenches are cut in pavements or areas to be paved, compaction, as determined by ASTM D 1557, shall be equal to 98% of maximum density, with compaction in other areas not less than 95% of maximum density in unpaved portions of the Rights-of-Way or 90% of maximum density in other areas.

As an alternative, or if required under roadways, Flowable Fill may be substituted. If Flowable Fill is to be used, a fabric mesh shall be installed between the “first lift” and the Flowable Fill. Flowable Fill shall be in accordance with Section 4.7.AH of the Lee County Utilities Operations Manual.

D. Compaction Methods: The above specified compaction shall be accomplished using accepted standard methods (powered tampers, vibrators, etc.), with exception that the first two feet of backfilling over the pipe shall be compacted by hand-operated tamping devices. Flooding or puddling with water to consolidate backfill is not

acceptable, except where sand is the only material utilized and encountered and the operation has been approved by the OWNER.

E. Density Tests: Density tests for determination of the above specified compaction shall be made by an independent testing laboratory and certified by the Contractor's Florida Registered, PROFESSIONAL ENGINEER at the expense of the CONTRACTOR. Test locations will be determined by the OWNER but in any case, shall be spaced not more than 100 feet apart where the trench cut is continuous. If any test results are unsatisfactory, the CONTRACTOR shall re-excavate and re-compact the backfill at his expense until the desired compaction is obtained. Additional compaction tests shall be made to each site of an unsatisfactory test, as directed, to determine the extent of re-excavation and re-compaction if necessary.

Copies of all density test results shall be furnished on a regular basis by the PROFESSOINAL ENGINEER, to Lee County Utilities. Failure to furnish these results will result in the project not being recommended for acceptance by Lee County

F. Dropping of Material on Work: Do trench backfilling work in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance. Do not allow backfilling material from a bucket to fall directly on a structure or pipe and, in all cases, lower the bucket so that the shock of falling earth will not cause damage.

G. Distribution of Large Materials: Break lumps up and distribute any stones, pieces of crushed rock or lumps which cannot be readily broken up, throughout the mass so that all interstices are solidly filled with fine material.

3.5 STRUCTURE BACKFILL

A. Use of Select Fill: Use select fill underneath all structures, and adjacent to structures where pipes, connections, electrical ducts and structural foundations are to be located within this fill. Use select fill beneath all pavements, walkways, and railroad tracks, and extend to the bottom of pavement base course or ballast.

1. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.

2. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Use of Common Fill: Use common granular fill adjacent to structures in all areas not specified above, unless otherwise shown or specified. Select fill may be used in place of common granular fill at no additional cost.

1. Extend such backfill from the bottom of the excavation or top of bedding to the bottom of subgrade for lawns or lawn replacement, the top of previously existing ground surface or to such other grades as may be shown or required.

2. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.

3. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

C. Use of Clay: In unpaved areas adjacent to structures for the top 1 foot of fill directly under lawn subgrades use clay backfill placed in 6-inch lifts. Compact clay backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

1. Use clay having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

3.6 DRAINAGE BLANKET

A. Drainage Fill Placement: Provide a drainage blanket where shown consisting of drainage fill.

1. Place drainage fill underneath all structures and adjacent to structures where pipes, connections, electrical ducts and structural foundations located within this fill, in uniform layers not greater than 8 inches in loose thickness. Compact drainage fill with suitable mechanical or pneumatic equipment to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

2. Place drainage fill adjacent to structures in all areas not specified above in uniform layers not greater than 8 inches in loose thickness. Compact drainage fill with suitable mechanical or pneumatic equipment to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

3.7 EARTH EMBANKMENTS

A. Use of Cohesive Materials: Make all earth embankments of approved cohesive common fill material.

1. Place fill in uniform layers not greater than 10 inches in loose thickness. Compact in place with suitable approved mechanical equipment.

2. Compact earth embankments to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

3. Do not use cohesionless, granular material as earth embankment backfill, unless otherwise shown or required.

3.8 COMPACTION EQUIPMENT

A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.

1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use hand held pneumatic tampers elsewhere for compaction of cohesive fill material.

2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.

3. Do not use heavy compaction equipment over pipelines or other structures unless the depth of fill is sufficient to adequately distribute the load.

3.9 BORROW

A. Should there be insufficient material from the excavations to meet the requirements for fill material, borrow shall be obtained from pits secured and tested by the CONTRACTOR and approved by the OWNER. Copies of all test results shall be submitted to Lee County Utilities.

3.10 FINISH GRADING

A. Final Contours: Perform finish grading in accordance with the completed contour elevations and grades shown and blend into conformation with remaining natural ground surfaces.

1. Leave all finished grading surfaces smooth and firm to drain.

2. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.

B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

3.11 RESPONSIBILITY FOR AFTERSETTLEMENT

A. Aftersettlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

3.12 INSPECTION AND TESTING OF BACKFILLING

A. Sampling and Testing: Provide sampling, testing, and laboratory methods in accordance with the appropriate ASTM Standard Specification. Subject all backfill to these tests.

B. Compaction density tests shall be made at all such backfill areas with spacing not to exceed 100 feet apart and on each 6-inch compacted layer.

C. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating or sprinkling as needed and recompaction in place prior to placement of a new lift.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 31 40 00

SHORING, SHEETING AND BRACING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Work required for protection of an excavation or structure through shoring, sheeting, and bracing.

B. Related Work Specified in Other Sections Includes:

1. Section 31 23 16 - Excavation - Earth and Rock
2. Section 31 23 23 - Backfilling

1.2 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. CONTRACTOR's Submittals: All sheeting and bracing shall be the responsibility of the CONTRACTOR to retain qualified design services for these systems, and to be completed with strict adherence to OSHA Regulations. Submit complete design calculations and working drawings of proposed shoring, sheeting and bracing which have been prepared, signed and sealed by a Licensed Professional Engineer experienced in Structural Engineering and registered in the State of Florida, before starting excavation for jacking pits and structures. Use the soil pressure diagram shown for shoring, sheeting and bracing design. ENGINEER's review of calculations and working drawings will be limited to confirming that the design was prepared by a licensed professional engineer and that the soil pressure diagram shown was used.

1.3 REFERENCES

A. Design: Comply with all Federal and State laws and regulations applying to the design and construction of shoring, sheeting and bracing.

B. N.B.S. Building Science Series 127 "Recommended Technical Provisions for Construction Practice in Shoring and Sloping Trenches and Excavations.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Do work in accordance with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54), and the Florida Trench Safety Act. The

CONTRACTOR shall also observe 29 CFR 1910.46 OSHA's regulation for Confined Space Entry.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND MATERIALS

A. Material Recommendations: Use manufacturers and materials for shoring, sheeting and bracing as recommended by the Licensed Professional Engineer who designed the shoring, sheeting, and bracing.

PART 3 EXECUTION

3.1 SHORING, SHEETING AND BRACING INSTALLATION

A. General: Provide safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, to avoid delay to the work, all in accordance with applicable safety and health regulations. Properly shore, sheet, and brace all excavations which are not cut back to the proper slope and where shown. Meet the general trenching requirements of the applicable safety and health regulations for the minimum shoring, sheeting and bracing for trench excavations.

1. CONTRACTOR's Responsibility: Sole responsibility for the design, methods of installation, and adequacy of the shoring, sheeting and bracing.

B. Arrange shoring, sheeting and bracing so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.

C. If ENGINEER is of the opinion that at any point the shoring, sheeting or bracing are inadequate or unsuited for the purpose, resubmission of design calculations and working drawings for that point may be ordered, taking into consideration the observed field conditions. If the new calculations show the need for additional shoring, sheeting and bracing, it should be installed immediately.

D. Monitoring: Periodically monitor horizontal and vertical deflections of sheeting. Submit these measurements for review.

E. Accurately locate all underground utilities and take the required measures necessary to protect them from damage. All underground utilities shall be kept in service at all times as specified in Division 1.

F. Driven Sheeting: Drive tight sheet piling in that portion of any excavation in paved or surface streets City collector and arterial streets and in State and County highways below the intersection of a one-on-one slope line from the nearest face of the excavation to the edge of the existing pavement or surface.

G. Sheeting Depth: In general drive or place sheeting for pipelines to a depth at elevation equal to the top of the pipe as approved.

1. If it is necessary to drive sheeting below that elevation in order to obtain a dry trench or satisfactory working conditions, cut the sheeting off at the top of the pipe and leave in place sheeting below the top of the pipe.

2. Do not cut the sheeting until backfill has been placed and compacted to the top of the pipe.

H. Sheeting Removal: In general, remove sheeting and bracing above the top of the pipe as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures. Sheeting shall be removed as backfilling progresses so that the sides are always supported or when removal would not endanger the construction of adjacent structures. When required to eliminate excessive trench width or other damages, shoring or bracing shall be left in place and the top cut off at an elevation 2.5 feet below finished grade, unless otherwise directed.

1. Carefully fill voids left by the withdrawal of the sheeting by jetting, ramming or otherwise.

2. No separate payment will be made for filling of such voids.

I. Permission for Removal: Obtain permission before the removal of any shoring, sheeting or bracing. Retain the responsibility for injury to structures or to other property or persons from failure to leave such shoring, sheeting and bracing in place even though permission for removal has been obtained.

J. Preload internal braces to 50 percent of the design loads.

K. Proof test tie backs to 133 percent of the design loads and lock off tie backs at 75 percent of the design loads.

3.2 SHEETING LEFT IN PLACE FOR PROTECTION

A. Ordered Left in Place: In addition to sheeting specified or shown to be left in place, the ENGINEER may order, in writing, any or all other shoring, sheeting or bracing to be left in place for the purpose of preventing injury to the structures, pipelines or to other property or to persons.

1. Cutoff sheeting left in place at the elevation shown or ordered, but, in general, at least 2.5 feet below the final ground surface.

2. Drive up tight any bracing remaining in place.

B. Right to Order: Do not construe the right to order shoring, sheeting and bracing left in place as creating any obligation to issue such orders.

C. Payment: Shoring, sheeting and bracing left in place, by written order, will be paid for under the appropriate Contract Items or where no such items exist, as changes in the work.

END OF SECTION

SECTION 32 10 01

PAVEMENT REPAIR AND RESTORATION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and remove and replace pavements over trenches excavated for installation of pipelines as shown on the drawings and/or specified herein.

1.2 GENERAL

A. All damage, as a result of work under this project, done to existing pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipelines, conduits, drains, catch basins, or stabilized areas or driveways and including all obstructions not specifically named herein, shall be repaired in a manner satisfactory to the ENGINEER. Bid prices shall include the furnishing of all labor, materials, equipment, and incidentals necessary for the cutting, repair, and restoration of the damaged areas unless pay items for specific types of repair are included in the Bid Form.

B. Keep the surface of the backfilled area of excavation in a safe condition and level with the remaining pavement until the pavement is restored in the manner specified herein. All surface irregularities that are dangerous or obstructive to traffic are to be removed. The repair shall conform to applicable OWNER or State requirements for pavement repair and as described herein.

C. All materials and workmanship shall be first class, and nothing herein shall be construed as to relieve the CONTRACTOR from this responsibility. The OWNER reserves the right to require soil bearing or loading tests or materials tests, should the adequacy of the foundation or the quality of materials used be questionable. Costs of these tests shall be borne by the OWNER, if found acceptable; the costs of all failed tests shall be borne by the CONTRACTOR.

D. All street and road repair shall be made in accordance with the details indicated on the drawings and in accordance with the applicable requirements of these Specifications and meeting the permit requirements and approval of the governing Department of Transportation agencies.

E. Pavement or roadway surfaces cut or damaged shall be replaced by the CONTRACTOR in equal or better condition than the original, including stabilization, base course, surface course, curb and gutter or other appurtenances. The CONTRACTOR shall obtain the necessary permits prior to any roadway work.

Additionally, the CONTRACTOR shall provide advance notice to the appropriate authority, as required, prior to construction operations.

1. Roadway Restoration (within Lee County Department of Transportation & Engineering jurisdiction): Restoration shall be in accordance with the requirements set forth in the "Right-of-Way Utility Construction Activities Policy" and these Standards. The materials of construction and method of installation, along with the proposed restoration design for items not referred or specified herein, shall receive prior approval from Lee County DOT.

    a. Where existing pavement is to be removed, the surface shall be mechanical saw cut prior to trench excavation, leaving a uniform and straight edge parallel or perpendicular to the roadway centerline with minimum disturbance to the remaining adjacent surfacing. The width of cut for this phase of existing pavement removal shall be minimal.

    b. Immediately following the specified backfilling and compaction, a temporary sand seal coat surface shall be applied to the cut areas. This temporary surfacing shall provide a smooth traffic surface with the existing roadway and shall be maintained until final restoration. Said surfacing shall remain for a minimum of ten (10) days in order to assure the stability of the backfill under normal traffic conditions. Thirty (30) days following this period and prior to sixty (60) days after application, the temporary surfacing shall be removed, and final roadway surface restoration accomplished.

    c. In advance of final restoration, the temporary surfacing shall be removed, and the existing pavement mechanically sawed straight and clean to the stipulated dimensions, if needed. Following the above operation, the CONTRACTOR shall proceed immediately with final pavement restoration in accordance with the requirements set forth by Lee County Department of Transportation.

2. Roadway Restoration (outside Lee County Department of Transportation jurisdiction) – Work within the rights-of-way of public thoroughfares which are not under jurisdiction of Lee County, shall conform to the requirements of the Governmental agency having jurisdiction or the Florida Department of Transportation, if no governmental agencies have jurisdiction. Work within State Highway right-of-way shall be in full compliance with all requirements of the permit drawings, and to the satisfaction of the Florida Department of Transportation.

1.3 QUALITY ASSURANCE

A. Applicable provisions of the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", and Supplemental Specifications hereunder govern the work under this Section. The Florida Department of Transportation will hereafter be referred to as FDOT.

PART 2 PRODUCTS

2.1 MATERIALS

A. All materials utilized in flexible base pavement and base course shall be as specified in the latest version of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction".

PART 3 EXECUTION

3.1 CUTTING PAVEMENT

A. Cut and remove pavement as necessary for installing the new pipelines and appurtenances and for making connections to existing pipelines.

B. Before removing pavement, the pavement shall be marked for cuts nearly paralleling pipelines and existing street lines. Asphalt pavement shall be cut along the markings with a jackhammer, rotary saw, or other suitable tool, leaving a uniform and straight edge with minimum disturbance to the remaining adjacent surface.

C. No pavement shall be machine pulled until completely broken and separated along the marked cuts.

D. The pavement adjacent to pipeline trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, remove the damaged pavement and shall replace it at his own expense.

3.2 GENERAL RESTORATION

A. The restoration of existing street paving, driveways, etc., shall be restored, replaced or rebuilt using the same type of construction as was in the original. Be responsible for restoring all such work, including sub-grade and base courses where present. Obtain and pay for such local or other governmental permits as may be necessary for the opening of streets. Meet any requirements other than those herein set forth which may effect the type, quality and manner of carrying on the restoration of surfaces by reason of jurisdiction of such governmental bodies.

B. In all cases, maintain, without additional compensation, all permanent replacement of street paving, done by him under this Contract until accepted by the OWNER, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.

C. Complete all the final resurfacing or re-paving of streets or roads, over the excavations and relay paving surfaces of roadbed that have failed or been damaged prior to acceptance by the OWNER. Backfilling of trenches and the preparation of sub-grades shall conform to the requirements of Section 31 23 23.

D. All re-paving or resurfacing shall be done in accordance with Florida Department of Transportation Specifications, to which the following requirement of trench backfill will be added: Where pipeline construction crossed paved areas such as streets, the top 24 inches of trench below the road bases or concrete slabs shall be backfilled with compacted A-4 or better matter that will provide a bearing value of not less than 75 when tested by the Florida Department of Transportation Soil Bearing Test Methods.

3.3 PRIME AND TACK COATS

A. The work shall consist of the application of bituminous prime and tack coats on the previously prepared base course in accordance with Section 300 of the FDOT Specifications.

3.4 WEARING COURSE

A. The work shall consist of the construction of plant-mixed hot bituminous pavement to the thickness indicated in the drawings conforming to Type III asphaltic concrete in accordance with Section 333 of the FDOT Specifications. The requirements for plant and equipment are specified in Section 320 and the general construction requirements for asphaltic concrete pavement are contained in Section 330 of the FDOT specifications.

3.5 TESTING

A. All field testing shall be performed by an independent laboratory employed by the OWNER. All materials shall be tested and certified by the producer. Tests repeated because sub-grade or base does not meet specified compaction shall be at the CONTRACTOR's expense.

3.6 MISCELLANEOUS RESTORATION

A. Sidewalks cut or damaged by construction shall be restored in full sections or blocks to a minimum thickness of four inches. Concrete curb or curb gutter shall be restored to the existing height and cross section in full sections or lengths between joints. Concrete shall be as specified on the drawings. Grassed yards, shoulders and parkways shall be restored to match the existing sections with grass seed or sod of a type matching the existing grass.

3.7 CLEANUP

A. After all repair and restoration or paving has been completed, all excess asphalt, dirt, and other debris shall be removed from the roadways. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 32 16 00

SIDEWALKS, DRIVEWAYS AND CURBS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Sidewalks, sidewalk ramps, driveways, curbs and drive approaches complete with concrete materials, concrete curing compounds, joint materials, field quality control and appurtenances.

1.2 REFERENCES

A. Reference Standards: Conform the work for this Section to the applicable portions of the following standard Specifications.

1. ASTM - American Society of Testing and Materials
2. AASHTO - American Association of State Highway and Transportation Officials
3. FDOT - Florida Department of Transportation - Standard Specifications for Road and Bridge Construction.
4. FAC - Florida Accessibility Code.
5. ADAAG - American with Disabilities Act Accessibility Guidelines
6. UFAS - Uniform Federal Accessibility Standards

1.3 SUBMITTALS

A. Reports: Written permission for the use of all local disposal sites Furnish copies to the ENGINEER.

1.4 JOB CONDITIONS

A. Environmental Requirements:

1. Temperature: Comply with the requirements for concrete installation due to outside ambient air temperatures as specified under Article 3.3.I of this Section.

B. Protection:

1. Protection Against Rain: Comply with the requirements for protecting new work against damage from Rain, as specified under Article 3.3.I of this Section.

2. Protection Against Cold Weather: Comply with the requirements for protecting new work against damage from cold weather, as specified under Article 3.3.I of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete: Use 2,500 psi concrete except as modified herein.

B. Ready-Mixed Concrete: Use ready-mixed concrete which conforms to ASTM C94, Alternate 2.

C. Water: Use water for mixing and curing concrete reasonably clean and free from oil, salt, acid, alkali, chlorides, sugar, vegetable, or other substances injurious to the finished product. Waters from sources approved by the local Health Department as potable may be used without test. Test water requiring testing in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T-26.

D. Concrete Curing Compounds: Use white membrane curing compound for curing concrete which conforms to AASHTO M148, Type 1 clear, or Type 2 while per FDOT Section 925.

E. Premolded Joint Filler: Use fiber joint filler which conforms to ASTM D1751. Use filler of the thickness, as specified herein, or as directed by the ENGINEER.

F. Steel Hook Bolts: Use hook bolts which conform to ASTM A706, or for Grade 60 of ASTM A615, A616, or A617. Use 5/8-inch diameter hook bolts self tapping.

G. Joint Sealant: Use hot-poured type joint sealant which conforms to ASTM D1190.

PART 3 EXECUTION

3.1 CONTRACTOR'S VERIFICATION

A. Excavation and Forming: Prior to the installation of any concrete, examine the excavation and forms for the proper grades, lines, and levels required to receive the new work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.

1. Correct all defects and deficiencies before proceeding with the work.

B. Existing Improvements: Investigate and verify location of existing improvements to which the new work is to be connected.

1. Making necessary adjustment in line and grade to align the new work with the existing improvements must be approved by the ENGINEER prior to any change.

3.2 PREPARATION

A. Forms: Use wood or metal forms, straight and free from warp, clean, and sufficient strength to resist springing during the process of depositing concrete against them.

1. Use full depth of the concrete forms.

3.3 INSTALLATION

A. Sidewalks, Sidewalk Ramps, Driveways and Driveway Approaches: Construct all sidewalks and sidewalk ramps six (6) inches thick. Construct sidewalks five (5) feet wide unless otherwise noted on the Plans or directed by the ENGINEER, and slope per ADA requirements. Normally, sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1-foot from the property line.

1. Construct alleys, driveways and approaches six (6) inches thick. Construct the width of the driveways and driveway approaches as shown on the Plans or as directed by the ENGINEER.

B. Removal of Existing Curb for Sidewalk Ramps and Driveway Approaches: Conform construction of sidewalk ramps within street intersections where curbed pavement existing to the current FDOT Roadway and Traffic Design Standards.

1. Saw cut, to full depth of pavement, and remove a minimum of an 18-inch wide curb and gutter section where there is no proper curb drop for the sidewalk ramp or driveway approach. When mountable curbs are present, remove a 24-inch wide curb and gutter section for the construction of sidewalk ramps, as specified above.

2. Remove curb and gutter as determined by the ENGINEER in the field but remove curb and gutter at least as wide as the proposed sidewalk ramp plus 1-foot on each side.

3. Replace the removed curb and gutter section with materials, equal to what was removed and seal joint with hot poured rubber asphalt.

C. Install 5/8 inch diameter self tapping hook bolts, in the existing concrete pavement as indicated on the Plans prior to placing concrete for the removed curb and gutter section.

D. Placement of Forms: Use wood forms, straight and free from warp, of nominal depth for sidewalk sections less than 25 feet in length.

1. Stake forms to line and grade in a manner that will prevent deflection and settlement.

2. When unit slab areas are to be poured, place slab division forms such that the slab division joints will be straight and continuous.

3. Set forms for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. Use a uniform grade, except as may be necessary to eliminate short grade changes.

4. Oil forms before placing concrete. Leave forms in place at least 12 hours after the concrete is placed. Place forms ahead of the pouring operations to maintain uninterrupted placement of concrete.

5. The use of slip form pavers can be allowed when approved by the ENGINEER in lieu of the construction system described above.

E. Joints: Construct transverse and longitudinal expansion and plane-of-weakness joints at the locations specified herein, or as indicated on the Plans or as directed by the ENGINEER.

1. Place the transverse expansion joints for the full width and depth of the new work. Use transverse expansion joints placed against an existing pavement a minimum of six (6) inches deep but no less than the thickness of the concrete being placed.

2. Conform longitudinal expansion joints to the requirements as transverse expansion joints.

3. Construct joints true to line with their faces perpendicular to the surface of the sidewalk. Install the top slightly below the finished surface of the sidewalk. Construct transverse joints at right angles to the centerline of the sidewalk and construct longitudinal joints parallel to the centerline or as directed by the ENGINEER.

4. Place transverse expansion joints, 1/2-inch thick, through the sidewalk at uniform intervals of not more than 50 feet and elsewhere as shown on the Plans, or as directed by the ENGINEER.

5. Place expansion joints, 1/2-inch thick, between the sidewalk and back of abutting parallel curb, buildings or other rigid structures, concrete driveways and driveway approaches. When directed by the ENGINEER, place the expansion joint between sidewalks and buildings 1-foot from the property line and parallel to it.

6. Form plane-of-weakness joints every five (5) feet. Form joints by use of slab divisions forms extending to the full depth of the concrete or by cutting joints in the concrete, after floating, to a depth equal to 1/4 the thickness on the sidewalk. Construct cut joints not less than 1/8-inch or more than 1/4-inch in width and finish smooth and at right angles to the centerline on the sidewalk.

F. Placing and Finishing Concrete: Place all concrete on a prepared unfrozen, smooth, leveled, rolled and properly compacted base. Place concrete on a moist surface with no visible water present.

1. Deposit the concrete, in a single layer to the depth specified. Spade or vibrate and compact the concrete to fill in all voids along the forms and joints. Strike off the concrete with a strike board until all voids are removed and the surface has the required grade and cross section as indicated on the Plans, or as directed by the ENGINEER.

2. Float the surface of the concrete just enough to produce a smooth surface free from irregularities. Round all edges and joints with an edger having a 1/4-inch radius.

3. Broom the surface of sidewalks, driveways and approaches to slightly roughen the surface.

4. Texture the surface of the sidewalk ramps with a coarse broom transversely to the ramp slope, and coarser roughen than the remainder of the sidewalk. Contract the ramp slope in color (using a brick-red dye or approved equal) from the remainder of the sidewalk. Comply with minimum color contract and slope requirements from FAC, UFAS, ADAAG, Local Government Standards, or as directed by the ENGINEER.

G. Curing: After finishing operations have been completed and immediately after the free water has left the surface, completely coat and seal the surface of the concrete (and sides if slip-forming is used) with a uniform layer of white membrane curing compound. Do not thin the curing compound. Apply the curing compound at the rate of one gallon per 200 square feet of surface.

H. Barricades: Place suitable barricades and lights around all newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter sections in order to protect the new work from damage from pedestrians, vehicles and others until the concrete has hardened.

1. Leave barricades in place for a minimum of two (2) days, except for driveway approaches and curb and gutter sections. Leave barricades in place for a minimum of three (3) days.

2. Remove and replace any concrete that suffers surface or structural damage at no additional cost.

I. Protection:

1. Against Rain: Protect new concrete from the effects of rain before the concrete has sufficiently hardened. Have available on the job site at all times enough

burlap or 6-mil thick polyurethane film to cover and protect one day's work. Stop work and cover completed work when rain appears eminent. As soon as the rain ceases, uncover the concrete and burlap drag the surface where necessary. Apply curing compound to any areas where the compound has been disturbed or washed away.

2. Against Cold Weather: If concrete is placed between December 15 and February 15, have available on the site sufficient amount of clean, dry straw or hay to cover one (1) day's production. If the temperature reaches 40 degrees F and is falling, place the hay or straw 12 inches thick, immediately after the curing compound is applied.

3. Concrete Temperature Limitations: Do not place concrete when the temperature of the concrete at the point of placement is above 90 degrees F.

J. Cleanup: After the concrete has gained sufficient strength, but no sooner than within 12 hours, remove the fixed forms and backfill the spaces on both sides with sound earth of topsoil quality. Compact, level and leave backfill in a neat condition.

K. Gutters and Curbs: Construct gutters and curbs in accordance with Section 520 FDOT Standard Specifications for Road and Bridge Construction, latest edition, including supplements.

3.4 FIELD QUALITY CONTROL

A. Concrete Delivery Ticket: Use a ticket system for recording the transportation of concrete from the batching plant to point of delivery. Issue this ticket to the truck operator at the point of loading and give to the ENGINEER upon delivery.

B. Concrete Delivery Rejection: Remove concrete not permitted for inclusion in the work by the ENGINEER from the site. Rejection of concrete will be determined through Field Quality Control and elapsed time from mixer charging to delivery.

C. Concrete Testing at Placement: Perform tests of each batch of concrete delivered, each 50 cubic yards, or whenever consistency appears to vary. The sampling and testing of slump, air content and strength will be performed at no cost to the CITY.

1. Sampling: Secure composite samples in accordance with the Method of Sampling Fresh Concrete, ASTM C172.

2. Slump Test: Test in accordance with ASTM C143. Use the least slump possible consistent with workability for proper placing of the various classifications of concrete.

a. Place structural concrete for walls and slabs, by means of vibratory equipment, with a slump of four (4) inches.

b. A tolerance of up to 1-inch above the indicated maximum will be allowed for individual batches provided the average for all batches or the most recent ten (10) batches tested, whichever is fewer, does not exceed the maximum limit.

3. Air Content: Determine air content of normal weight concrete in accordance with Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method, ASTM C23 1, or by the volumetric method, ASTM C 173, for each strength test.

4. Compressive Strength: Make two (2) strength tests of three (3) samples each for each 50 cubic yards, or fraction thereof, of each mix design of concrete placed in any one (1) day.

   a. Handling Samples: Mold and cure three (3) specimens from each sample in accordance with Method of Making and Curing Concrete Test Specimens in the Field, ASTM C31. Record any deviations from the requirements of this Standard in the test report.

   b. Testing: Test specimens in accordance with Method of Test for Compressive Strength of Cylindrical Concrete Specimens, ASTM C39. Test one (1) specimen at seven (7) days for information and test two (2) at 28 days for acceptance. Use the average of the strengths of the two (2) specimens tested at 28 days. Discard results if one (1) specimen in a test manifests evidence of improper sampling, molding or testing, and use the strength of the remaining cylinder. Should both specimens in test shown any of the above defects, discard the entire test.

   c. Acceptance of Concrete: The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified 28-day strength and no individual strength test results falls below the specified 28-day strength by more than 500 psi. If the strength test is not acceptable, perform further testing to qualify the concrete.

   d. Concrete Temperature: Determine the temperature of concrete sample for each strength test.

D. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch and under strength by 200 psi, the total reduction is 20% plus 02% or 40% reduction.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCING AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing and installing vinyl coated galvanized steel chain link fencing and gates.

B. Related Work Specified in Other Sections Includes:

1. Section 03 30 00 – Cast in Place Concrete

2. Section 09 90 00 – Painting and Coating

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot Dipped Zinc Coated Welded and Seamless
2. ASME B36.10M - Welded and seamless wrought steel pipe

3. FS RR-F-191 - Fencing, Wire and Post, Metal

1.3 DESIGN

A. General: LS 617 - Provide fencing of the chain-link type and four (4) feet high with dark green PVC-coated diamond mesh woven wire fabric.

B. Fabric, Supports and Fittings: Provide steel fabric, supports and fittings except as specified. Provide aluminum hinges and latches.

C. Pipe Sizes and Weights: Provide pipe sizes and weights meeting the requirements of ASME B 36.10, Table 2 and ASTM A 53, Table 1. All pipe sizes listed are nominal, unless otherwise indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Company operating in the United States having U.S. manufacturing facility/facilities specializing in manufacturing chain link fence products with at least 5 years' experience. Framework, posts, rails, pipe for gates shall be manufactured by Merchants Metals, Stevens Pipe & Steel, or approved equal.

2.2 FABRIC

A. Provide fabric that is a one piece woven 2-inch mesh chain link of 6-gauge steel wire with a minimum breakload of 2170 lbs/ft. and which is interwoven to form a continuous fabric with no splices and is hot-dip galvanized after weaving. Provide the top selvage knuckled for fabric 60 inches high and under, and the bottom selvage twisted and barbed for fabric over 60 inches high. Clean the fabric of all grease and foreign matter before shipping. Stretch the fabric tightly approximately two inches above grade level and attach the fabric to the terminal or gate posts using beveled tension bands and tension bars.

2.3 BARBED WIRE

RESERVED.

2.4 TENSION WIRE

For the tension wire for the fence bottom, use minimum 6-gauge galvanized coil spring steel.

2.5 TOP AND BRACE RAILS

A. General: Furnish the top rail in approximately 20-foot lengths with couplings approximately 6 inches long for each joint. Provide one coupling in each 5 with an expansion spring. Provide the rail continuous from end-to-end for each run of fence. Provide brace rails at all terminal posts, locate the rails midway between the top and bottom of the fabric and extend from the terminal post to the first adjacent line post. Securely fasten rails at both ends. Provide top and brace rails that are galvanized steel.

B. Pipe Type: For galvanized steel top and brace rails, use 1-1/4-inch, Schedule 40 pipe or a 1.625- by 1.25-inch roll-formed section with minimum bending strength of 192 pounds on 10-foot span.

2.6 POSTS

A. General: Provide all posts that are galvanized steel pipe or roll-formed section.

B. Pipe Posts: Provide pipe posts as follows:

1. For end, corner and pull posts use 2-1/2-inch, Schedule 40 pipe

2. For line posts use 2-inch, Schedule 40 pipe

3. For gate posts use the following pipes for different leaves:

a. For leaves up to 6 feet wide, use 2-1/2-inch Schedule 40 pipe

b. For leaves over 6 feet to 12 feet wide, use 3-1/2-inch Schedule 40 pipe
c. For leaves over 12 feet to 18 feet wide, use 6-inch Schedule 40 pipe

C. Bending Strength: Provide materials with the minimum bending strength based on a 6-foot cantilever for rolled formed or tube posts as follows:

	Minimum Bending Strength, lbs
	Galvanized Steel
1. End, Corner and Pull Posts:	
2.875" O.D. roll formed or	444
2-1/2-inch square tube	547
2. Line Posts:	
For fences 8 feet maximum height 1.875- by 1.625-inch C-Section	245
For fences over 8 feet high 2.25- by 1.703-inch C-Section	347
3. Gate Posts:	
For leaves up to 6 feet wide (2.875-inch O.D. roll formed or	444
2-1/2-inch square tube	645

2.7 GATES

A. General: For the perimeter construction of gates with leaves up to 6 feet wide, use 1-1/2-inch steel tube, and for gates with leaves greater than 6 feet wide, use 2-inch square steel tube.

B. Braces: Provide the gates with sufficient horizontal and vertical members and bracing to ensure structural stability to prevent sagging and to provide for the attachment of fabric, hardware and accessories. Provide gates with diagonal cross bracing consisting of 3/8-inch diameter adjustable length truss rods where necessary to provide frame rigidity without sag or twist.

2.8 ATTACHMENTS

A. General: Provide all attachments fabricated of galvanized carbon steel.

B. Tension Bars: Provide 3/16-inch by 3/4-inch galvanized carbon steel tension bars attached to the terminal posts by means of beveled edge bands.

C. Truss Rods: Provide 3/8-inch diameter galvanized carbon steel truss rods. Securely mount truss rods between the line post end of the brace rail and the base of the terminal post.

D. Post Tops: Provide post tops of galvanized pressed steel or malleable iron to form weathertight caps for post or tube posts. Make provisions for installation or passage of the top rail.

E. Brace and Tension Bands: Provide galvanized steel brace bands and tension bands, of the "unclimbable" beveled edge type with 3/8-inch diameter square shouldered aluminum carriage bolts, nonremovable from outside of the fence.

F. Rail Couplings: Provide rail couplings of the outside sleeve type, not less than six inches long, self-centering, which allows for expansion and contraction. Provide galvanized steel rail couplings.

G. Fabric Ties: Provide 11-gauge galvanized steel fabric ties.

H. Hog Rings: Provide 11-gauge wire, aluminum alloy, Type 6061-T6 hog rings.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install all fencing and accessories according to the manufacturer's recommendations. Do not begin installation and erection before final grading is completed, unless otherwise approved.

B. Excavation: Drill or hand excavate holes for posts to the diameter and spacing indicated, in firm, undisturbed or compacted soil.

1. If not indicated, excavate holes for each post to the minimum diameter recommended by the fence manufacturer, but not less than four times the largest cross-section of the post.

2. Unless otherwise indicated excavate the hole depths approximately 3 inches lower than the post bottom, with the bottom of posts set not less than 36 inches below the finished grade surface.

C. Tension Wire: Attach the tension wire to the bottom of the fabric by hog rings spaced at 24-inch intervals and to terminal posts by brace bands.

D. Posts: Set posts plumb in concrete encasement at not more than 10-foot centers in the line of the fence with the tops properly aligned. Extend concrete encasement for line posts a minimum of three feet below finish grade with a minimum diameter of ten inches. Extend concrete encasement for terminal, corner and gate posts 40 inches below finished grade, except gate posts for leaves greater than 6 feet, for which extend the encasement 54 inches below grade. Provide the minimum diameter of encasement for terminal, corner and gate posts to be sufficient to provide not less than four inches between any part of the post and the face of the concrete and in no case provide the diameter to be less than 12 inches. Set line posts 32 inches into the concrete and set all other posts 36 inches, except gate posts for leaves greater than 6 feet wide, which are to be set 48 inches into the concrete. Slope the top exposed surface of the concrete to shed water and provide a neat appearance.

1. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold posts in position during placement and finishing operations.

    a. Unless otherwise indicated, extend the concrete footing 2 inches above grade and trowel to a crown to shed water.

E. Fabric Ties: Space fabric ties approximately 14 inches apart on the line posts and 24 inches apart on the rails.

F. Fabric: Leave approximately 2 inches between finished grade and the bottom selvage, unless otherwise indicated. Pull the fabric taut and tie to posts, rails, and tension wires. Install the fabric on the security side of the fence, and anchor the fabric to the framework so that the fabric remains in tension after the pulling force is released.

G. Fasteners: Install nuts for tensions bands and hardware bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent nut removal.

3.2 GALVANIZING

A. Provide galvanizing meeting the requirements of Section 05 50 01.

END OF SECTION

SECTION 32 92 00

LAWN RESTORATION

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. The work in this section consists of furnishing all labor, material and equipment to replace and maintain all areas disturbed during construction by establishing a stand of grass, within the areas called for by the furnishing and placing grass sod, or seeding, or seeding and mulching.

1.2 REFERENCE DOCUMENTS

A. The materials used in this work shall conform to the requirements of Florida Department of Transportation Standard Specifications for Road and Bridge Construction as follows:

1. Sod - Section 981-2
2. Fertilizer - Section 982
3. Water - Section 983

1.3 SUBMITTALS

A. Submit certifications and identification labels for all sodding supplied as specified in Section 01 33 00.

PART 2 PRODUCTS

2.1 SODDING

A. Types: Sod may be of either St. Augustine or Argentine Bahia grass or as that disturbed, as established prior to construction. It shall be well matted with roots. When replacing sod in areas that are already sodded, the sod shall be the same type as the existing sod.

B. Sod shall be provided as required in accordance with Florida Department of Transportation Specifications 575 and 981. The CONTRACTOR shall furnish sod equal to and similar in type as that disturbed. Placement and watering requirements shall be in accordance with FDOT Specifications Section 575.

C. The sod shall be taken up in commercial-size rectangles, preferably 12-inch by 24-inch or larger, except where 6-inch strip sodding is called for.

D. The sod shall be sufficiently thick to secure a dense stand of live grass. The sod shall be live, fresh and uninjured at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. It shall be reasonably free of weeds and other grasses. It shall be planted as soon as possible after being dug, and shall be shaded and kept moist from the time it is dug until it is planted.

E. Sod should be handled in a manner to prevent breaking or other damage. Sod shall not be handled by pitch forks or by dumping from trucks or other vehicles. Care shall be taken at all times to retain the native soil on the roots of each sod roll during stripping and handling. Sod that has been damaged by handling during delivery, storage or installation will be rejected.

2.2 FERTILIZER

A. Chemical fertilizer shall be supplied in suitable bags with the net weight certification of the shipment. Fertilizer shall be 12-8-8 and comply with Section 982 of the FDOT Standard Specification for Road and Bridge Construction.

B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid and (3) water soluble potash, contained in the fertilizer.

C. The chemical designation of the fertilizer shall be 12-8-8, with at least 50 percent of the nitrogen from a nonwater-soluble organic source. The nitrogen source may be a unreaformaldehyde source provided it is not derived from a waste product of the plastic industry.

2.3 EQUIPMENT

A. The device for spreading fertilizer shall be capable of uniformly distributing the material at the specified rate.

2.4 NETTING

A. Netting is fabricated of material similar to Geoscope Landscape Fabric or approved equal.

2.5 GRASSING

A. The CONTRACTOR shall grass all unpaved areas disturbed during construction which do not require sod. All grassing shall be completed in conformance with FDOT Specifications Sections 570 and 981. The grassed areas shall be mulched and fertilized in accordance with FDOT Specifications.

B. Grass seed shall be Argentine Bahia, 60 #/acre March 1 to November 1, 50 #/acre with 20 #/acre of rye grass seed November 1 to March 1. Argentine Bahia seed shall be a scarified seed having a minimum active germination of 40% and total of 85%.

C. Mulch material shall be free of weeds and shall be oat straw or rye, Pangola, peanut, Coastal Bermuda, or Bahia grass hay.

2.6 TOPSOIL

A. Topsoil stockpiled during excavation may be used. If additional topsoil is required to replace topsoil removed during construction, it shall be obtained off site at no additional cost to the OWNER. Topsoil shall be fertile, natural surface soil, capable of producing all trees, plants, and grassing specified herein.

2.7 MULCH

A. Mulch shall be fresh cypress mulch. Rate of application specified herein shall correspond to depth not less than 1-inch or more than 3-inches according to texture and moisture content of mulch material.

2.8 WATER

A. It is the CONTRACTOR'S responsibility to supply all water to the site, as required during seeding and sodding operations and through the maintenance period and until the work is accepted. The CONTRACTOR shall make whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs for his work. He shall also furnish all necessary hose, equipment, attachments, and accessories for the adequate irrigation of lawns and planted areas as may be required. Water shall be suitable for irrigation and free from ingredients harmful to plant life.

PART 3 EXECUTION

3.1 SOD BED PREPARATION

A. Areas to be sodded and/or seeded shall be cleared of all rough grass, weeds, and debris, and brought to an even grade.

B. The soil shall then be thoroughly tilled to a minimum 8-inch depth.

C. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over 1-inch in diameter or dimension. The surface shall conform to finish grade, less the thickness of sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.2 INSPECTION

A. Verify that soil preparation and related preceding work has been completed.

B. Do not start work until conditions are satisfactory.

3.3 SOD HANDLING AND INSTALLATION

A. During delivery, prior to planting, and during the planting of sod areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun. All sod shall be stacked during construction and planting so as not to be damaged by sweating or excessive heat and moisture.

B. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.

C. Sod shall be placed at all areas where sod existed prior to construction, on slopes of 3 horizontal on 1 vertical (3:1) or greater, in areas where erosion of soils will occur, and as directed by the ENGINEER. On areas where the sod may slide, due to height and slope, the ENGINEER may direct that the sod be pegged, with pegs driven through the sod blocks into firm earth, at suitable intervals.

3.4 USE OF SOD ON ROADWAY PROJECTS

A. In accordance with the FDOT District One Standard Practice, permanent green grass shall be established at the completion of roadway construction and maintenance work. The following shall apply to all restoration involving State or County roadways:

1. Sod in lieu of seed and mulch shall be used on all roadways with urban (raised curb) typical sections.
2. One inch water per week shall be required for a minimum of four (4) consecutive weeks for the purpose of establishing sod. This can be waived during construction, if and only if there is a minimum of one inch of rain per week on all sod on the project.
3. Sod shall be placed on slopes 1:3 or greater. Staked sod shall be placed on slopes 1:2 or greater.
4. On all curves with superelevation, sod shall be placed from the edge of pavement to the toe of slope on the downhill side(s) for the entire length of the superelevated roadway. On multi-lane divided rural facilities, sod shall be placed in the median and on the inside of the curve in the superelevated areas. This does not apply to reverse crowns.
5. For all projects with less than 10,000 square yards grass area, sod shall be used.
6. On tangent sections and on outside of curves, sod shall be used between the edge of pavement and a point 4 feet beyond the shoulder break point.
7. The entire width of sod should not exceed 15 feet from the edge of pavement.
8. Sod is to be used to eliminate narrow seed and mulch areas. Areas less than 6 feet in width shall be sodded.
9. Sod shall be placed around drainage structures as per the standard Indexes and extended to the edge of pavement.

3.5 SOD MAINTENANCE

A. The sod shall produce a dense, well established growth. The CONTRACTOR shall be responsible for the repair and re-sodding of all eroded or bare spots until project acceptance. Repair to sodding shall be accomplished as in the original work.

B. Sufficient watering shall be done by the CONTRACTOR to maintain adequate moisture for optimum development of the seeded and sodded areas. Sodded areas shall receive no less than 1.5 inches of water per week for at least 2 weeks. Thereafter, the CONTRACTOR shall apply water for a minimum of 60 days as needed until the sod takes root and starts to grow or until final acceptance, whichever is latest.

3.6 CLEANING

A. Remove debris and excess materials from the project site.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 05 01

LEAKAGE TESTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Testing for any signs of leakage in all pipelines and structures required to be watertight.

B. Due to the nature of this project, hydrostatic pressure testing of pipelines will be difficult, there the County will accept a visual test at typical operating pressure from the diesel pump.

1. Test gravity sewers and drain lines by low pressure air testing.

2. Test all other pipelines with water under the specified pressures, unless indicated otherwise.

C. Operation of Existing Facilities: Conduct all tests in a manner to minimize as much as possible any interference with the day-to-day operations of existing facilities or other contractors working on the site.

1.2 PERFORMANCE REQUIREMENTS

A. Written Notification of Testing: Provide written notice when the work is ready for testing, and make the tests as soon thereafter as possible.

1. Personnel for reading meters, gauges, or other measuring devices, will be furnished.

2. Furnish all other labor, equipment, air, water and materials, including meters, gauges, smoke producers, blower, pumps, compressors, fuel, water, bulkheads and accessory equipment.

1.3 REFERENCES

A. Codes and standards referred to in this Section are:

1. AWWA C 600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

1.4 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

B. Testing Report: Prior to placing the sewer system in service submit for review and approval a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

1. Reference Sewer Line Data

a. For Low Pressure Air Testing

(1) The length and diameter of the section of line tested (MH to MH) including any laterals.

(2) A complete description of test procedures and methods, including:

(a) Trench backfilling and sewer cleaning status

(b) Type of plugs used and where

(c) Depth of sewer, and ground water pressure over sewer pipe

(d) Stabilization time period and air pressure

(e) Actual air test pressures used if ground water is present

(f) The allowed time by specifications

(g) The actual test time

(h) The air pressure at beginning and end of test

(3) The name of the inspector/tester and the date(s) and time(s) of all testing, including any retesting.

(4) A description of any repairs made.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 LEAKAGE TESTING

A. All new sewer and water pipelines installed shall be tested for leakage. The test used will be Hydrostatic Testing for pressure lines and Low Pressure Air Testing for gravity

lines. Tests to be performed will be indicated by the ENGINEER and witnessed by the ENGINEER and the Lee County Utilities representatives.

1. Flushing

   a. All mains shall be flushed to remove all sand and other foreign matter. The velocity of the flushing water shall be at least 4 fps. Flushing shall be terminated at the direction of the ENGINEER. dispose of the flushing water without causing a nuisance or property damage.

   b. Temporary flush out connections shall be installed on all dead end water mains at the locations shown on the Drawings and in accordance with the detail shown in Section 9 of the Lee County Utilities Operations Manual.

2. Hydrostatic Testing

   Perform hydrostatic testing of the system as set forth in the following, and shall conduct said tests in the presence of representatives from the COUNTY and other authorized agencies, with 48 hours advance notice provided.

   Piping and appurtenances to be tested shall be within sections between valves unless alternate methods have received prior approval from the COUNTY. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

   Hydrostatic testing shall be performed with a sustained pressure for a minimum of two (2) hours at 150 psi pressure or 2-1/2 times working pressure, whichever is higher, unless otherwise approved by Lee County Utilities, for a period of not less than two (2) hours. Testing shall be in accordance with the applicable provisions as set forth in the most recent edition of AWWA Standard C600. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD\,(P)^{1/2}}{133{,}200}$$

   Where,

   L = Allowable leakage in gallons per hour;
   S = Length of pipe tested in feet;
   D = Nominal diameter of the pipe in inches;
   P = Average test pressure maintained during the leakage test in pounds per square inch

For 150 psi, $L = (9.195 \times 10^{-5}) SD$

The testing procedure shall include the continued application of the specified pressure to the test system, for the one hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

Should the test fail, necessary repairs shall be accomplished by the CONTRACTOR and the test repeated until results are within the established limits. The CONTRACTOR shall furnish the necessary labor, water, pumps, and gauges at specified location(s) and all other items required to conduct the required testing and perform necessary repairs.

General. All sanitary sewers and associated service lines shall be constructed watertight to prevent infiltration and/or exfiltration. All new sanitary sewer systems will be subject to low pressure air testing.

3. Low Pressure Air Test

After completing backfill of a section of gravity sewer line, conduct a Line Acceptance Test using low pressure air. The test shall be performed using the below stated equipment, according to state procedures and under the supervision of the ENGINEER and in the presence of a Lee County Utilities representative, with 48 hours advanced notice provided.

a. Equipment:

1. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.

2. Pneumatic plugs shall resist internal bracing or blocking.

3. All air used shall pass through a single control panel.

4. Three individual hoses shall be used for the following connections:

a. From control panel to pneumatic plugs for inflation.

b. From control panel to sealed line for introducing the low pressure air.

c. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

b. Procedures:

All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall be pressurized to 5 psi. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After a manhole to manhole reach of pipe has been backfilled and cleaned and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psi. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psi minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable", if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psi (greater than the average back pressure of any ground water that may be over the pipe) is greater than the time shown for the given diameters in the following table:

Pipe Diameter In Inches	Minutes
8	4.0
10	5.0
12	5.5
16	7.5
18	8.5
24	11.5

Time in minutes = 0.472 D
D = Diameter of pipe in inches.

In areas where ground water is known to exist, the CONTRACTOR shall install capped pipe adjacent to the top of one of the sewer lines. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, and a measurement of the height in feet of water over the invert of the pipe shall be taken. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psi. This increases the 3.5 psi to 8.5 psi, and the 2.5 psi to 7.5 psi. The allowable drop of one pound and the timing remain the same).

If the installation fails to meet this requirement, the CONTRACTOR shall, at his own expense, determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship.

3.2 LEAKAGE TESTS FOR STRUCTURES

A. Structure Leakage Testing: Perform leakage tests of wet wells, tanks, vaults and similar purpose structures before backfilling, by filling the structure with water to the overflow water level and observing the water surface level for the following 24 hours.

1. Inspect for leakage of the exterior surface of the structure, especially in areas around construction joints.

2. Leakage will be accepted as within the allowable limits for structures from which there are no visible leaks.

3. If visible leaks appear, repair the structure by removing and replacing the leaking portions of the structure, waterproofing the inside, or by other methods approved.

4. Water for testing will be provided by the OWNER at the CONTRACTOR's expense.

END OF SECTION

SECTION 33 05 03

LAYING AND JOINTING BURIED PIPELINES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Installation of all underground pipelines. Provide pipeline materials, coatings and linings as specified and pipe of the types, sizes and classes shown or specified.

1. Use proper and suitable tools and appliances for the safe and convenient cutting, handling, and laying of the pipe and fittings.

2. Use suitable fittings where shown and at connections or where grade or alignment changes require offsets greater than those recommended and approved.

3. Lay all underground pipelines not supported on piles or concrete cradle in select fill bedding material.

4. Close off all lines with bulkheads when pipe laying is not in progress.

B. Related Work Specified in Other Sections Includes:

1. Section 31 23 16 - Excavation - Earth and Rock
2. Section 31 23 23 - Backfilling
3. Section 33 05 01 - Leakage Tests
4. Section 33 11 02 - High Density Polyethylene (HDPE) Pipe and Fittings
5. Section 33 11 03 - Ductile Iron Pipe and Fittings
6. Section 33 11 12 - Disinfection
7. Section 33 34 01 - Polyvinyl Chloride (PVC) Pipe

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 2774 - Practice for Underground Installation of Thermoplastic Pressure Piping

2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances

3. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60000 psi Tensile

4. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, C25, 125, 250, 800

5. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges

6. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

7. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe With Threaded Flanges

8. ASTM E 165 - Practice for Liquid Penetrant Examination

9. ASTM E 709 - Practice for Magnetic Particle Examination

1.3 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

B. Transportation and Delivery: Take every precaution to prevent injury to the pipe during transportation and delivery to the site.

C. Loading and Unloading: Take extreme care in loading and unloading the pipe and fittings.

1. Work slowly with skids or suitable power equipment, and keep pipe under perfect control at all times.

2. Under no condition is the pipe to be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe or coating.

D. Sling: When handling the pipe with a crane, use a suitable sling around the pipe.

1. Under no condition pass the sling through the pipe.

2. Use a nylon canvas type sling or other material designed to prevent damage to the pipe and coating.

3. When handling reinforced concrete pipe or uncoated steel or ductile iron pipe, steel cables, chain or like slings are acceptable.

E. Damaged Piping: If in the process of transportation, handling, or laying, any pipe or fitting is damaged, replace or repair such pipe or pipes.

F. Blocking and Stakes: Provide suitable blocking and stakes installed to prevent pipe from rolling.

1. Obtain approval for the type of blocking and stakes, and the method of installation.

G. Storage for Gaskets: Store gaskets for pipe joints in a cool place and protect gaskets from light, sunlight, heat, oil, or grease until installed.

1. Do not use any gaskets showing signs of checking, weathering or other deterioration.

2. Do not use gasket material stored in excess of six months without approval.

1.4 FIELD CONDITIONS

A. Repair of Sanitary Sewers and Services: Re-bed, in compacted select fill material, sanitary sewers which cross over the new pipe, or which cross under the new pipe with less than 12 inches clear vertical separation. Compact the bedding to densities required for new pipeline construction and extend bedding below the sewer to undisturbed earth. Reconstruct sewers damaged by pipeline construction.

1. Furnish and install all materials and do all work necessary for the reconstruction or repairs of sanitary sewers and services.

2. Provide pipe for reconstruction of sanitary sewers and services meeting the appropriate specification requirements.

3. Provide pipe of the same size as the existing sewer or when the same size is not available, use the next larger size of pipe. Obtain approval of joints made between new pipe and existing pipe.

PART 2 PRODUCTS

A. The materials allowed for buried sewer pipes are PVC, HDPE or fiberglass. Use of ductile iron pipe is not allowed for sewer construction without specific approval of Lee County Utilities.

PART 3 EXECUTION

3.1 PREPARATION

A. Dry Trench Bottoms: Lay pipe only in dry trenches having a stable bottom.

1. Where groundwater is encountered, make every effort to obtain a dry trench bottom.

2. If a dry trench bottom has not been obtained due to improper or insufficient use of all known methods of trench dewatering, then the order to excavate below grade and place sufficient select fill material, crushed stone, or 2500 psi concrete over the trench bottom may be given.

3. If all efforts fail to obtain a stable dry trench bottom and it is determined that the trench bottom is unsuitable for pipe foundation, obtain an order, in writing, for the kind of stabilization to be constructed.

4. Perform trench excavation and backfill in accordance with Sections 31 23 16 and 31 23 23.

3.2 INSTALLATION

A. General: Install all piping in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Where pipe deflections are used, do not exceed 80 percent of the maximum deflection limits shown in AWWA C600.

1. Arrange miscellaneous pipelines, which are shown in diagram form on the Plans, clear of other pipelines and equipment.

B. Code Requirements: Provide pipeline installations complying with AWWA C600 for iron pipe, AWWA Manual M11 for steel pipe, ASTM D 2774 for thermoplastic pressure piping, and as modified or supplemented by the Specifications.

C. Pipe Laying - General:

1. For pipelines intended for gravity flow, begin pipeline laying at the low end of a run and proceed upgrade.

2. Generally, lay all pipe with bells pointing ahead.

3. Carefully place each pipe and check for alignment and grade.

4. Make adjustments to bring pipe to line and grade by scraping away or filling in select fill material under the body of the pipe.

5. Wedging or blocking up the pipe barrel is not permitted.

6. Bring the faces of the spigot ends and the bells of pipes into fair contact and firmly and completely shove the pipe home.

7. As the work progresses, clean the interior of pipelines of all dirt and superfluous materials of every description.

8. Keep all lines absolutely clean during construction.

9. Lay pipelines accurately to line and grade.

10. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other material from entering the pipe.

D. Pipe Laying - Trenches:

1. Lay all pipelines in trench excavations on select fill bedding, concrete cradle or other foundations as shown, specified or ordered in writing.

2. Properly secure the pipe against movement and make the pipe joints in the excavation as required.

3. Carefully grade and compact pipe bedding.

4. Bell Holes:

a. Cut out bell holes for each joint as required to permit the joint to be properly made and allow the barrel of the pipe to have full bearing throughout its length.

b. Thoroughly tamp bell holes full of select fill material following the making of each joint.

E. Other Foundations: Install pipelines laid on other types of foundations as specified for such other foundations or as ordered in writing.

F. Ductile Iron Pipe Mechanical Joints:

1. Assembly: In making up mechanical joints, center the spigot in the bell.

a. Thoroughly brush the surfaces with which the rubber gasket comes in contact with a wire brush just prior to assembly of the joint.

b. Brush lubricant over the gasket just prior to installation.

c. Place the gasket and gland in position, bolts inserted, and the nuts tightened finger tight.

d. Tighten the nuts with a torque wrench so that the gland is brought up toward the pipe evenly. Torque wrenches shall be set as specified in AWWA C111. Spanner type wrenches not loner than specified in AWWA C111 may be used with the permission of Lee County Utilities.

e. Prime all bolts by dipping with a bituminous coating, except the threads. Coat threads immediately prior to installation of nuts.

2. Torques: Apply the following range of bolt torques:

Size Inches	Range of Torque - ft. lbs
5/8	45 - 60
3/4	75 - 90
1	85 - 100
1-1/4	105 - 120

3. Remaking of Joints: If effective sealing is not obtained at the maximum torque listed above, disassemble and reassemble the joint after thorough cleaning.

G. Ductile Iron Pipe Rubber Gasket Joints:

1. Assembly: In making up the rubber gasket joint, brush the gasket seat in the socket thoroughly with a wire brush and wipe the gasket with a cloth.

a. Place the gasket in the socket with the large round end entering first so that the groove fits over the bead in the seat.

b. Apply a thin film of lubricant to the inside surface of the gasket that will come in contact with the entering pipe.

c. Brush the plain end of the pipe to be entered thoroughly with a wire brush and place it in alignment with the bell of the pipe to which it is to be joined.

d. Exert sufficient force on the entering pipe so that its plain end is moved past the gasket until it makes contact with the base of the socket to make the joint.

2. Positioning: Before proceeding with backfilling, feel completely around the joint using a feeler gauge to confirm that the gasket is in its proper position.

a. If the gasket can be felt out of position, withdraw the pipe and examine the gasket for cuts or breaks.

b. If the gasket has been damaged, replace it with a new one before re-installing the pipe.

3. Optional Mechanical Joints: Use mechanical joint fittings that meet the requirements of Section 33 11 03 with the rubber gasket joint pipe when specified or when rubber gasket fittings are not available.

H. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed, and in connections built into pipelines where adjoining pipelines or structures have not been completed and are not ready to be connected.

1. Remove bulkheads encountered in connecting sewers or structures included in this Contract, or in pipelines or structures previously built, when they are no longer needed or when ordered.

I. Sleeve Type Couplings: For sleeve type couplings, equally tighten diametrically opposite bolts on the connection so that the gaskets will be brought up evenly all around the pipe.

1. Torque Wrenches: Do the final tightening with torque wrenches set for the torque recommended by the coupling manufacturer.

J. Concrete Encasement: Concrete encasement shall be constructed in accordance with Lee County standard details when:

1. A waterline crosses at a depth which provides less than 18 inches clear distance from sewer lines. Encasement shall extend a minimum 10 feet on each side of the point of crossing. Encase the sewer main unless specifically approved by Lee County Utilities.

2. A waterline running parallel to a sewer line provides less than 10 feet separation. Encase the sewer main unless specifically approved by Lee County Utilities.

3. The Engineer has ordered the line encased.

The points of beginning and ending of pipe encasement shall be not more than 6 inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.

K. Valve Box Setting: Install valve boxes vertical and concentric with the valve stem.

1. Satisfactorily reset any valve box which is moved from its original position, preventing the operation of the extension valve stem.

2. Replace any extension valve stem which has been damaged so that it can be operated.

L. Jacking:

1. General: Perform jacking as shown. After jacking is completed, seal the ends of the casing pipe with brick masonry.

a. Jacking Pit: Provide jacking pit of adequate length to provide room for the jacking frame, the jacking head, reaction block, the jacks, rig, and jacking pipe.

b. Construct the pit to be sufficiently wide to allow ample working space on each side of the jacking frame and sufficiently deep so that the invert of the pipe will be at the elevation desired for the completed line when placed on the guide frame.

c. Tightly sheet the pit and keep it dry at all times.

d. Provide adequate protective railings at the top of the pit at all times.

2. Jacking Frame: Design the jacking frame so that it applies a uniform pressure over the entire pipe wall area of the pipe to be jacked.

3. Reaction Blocks: Adequately design the reaction blocks to carry the thrust of the jacks to the soil without excessive soil deflection in a manner which avoids any disturbance of adjacent structures or utilities.

4. Hydraulic Jacks: Use hydraulic jacks in the jacking operation, and take extreme care to hold the casing pipe to exact line and grade.

5. Advance Excavation: Advance excavation by augering.

6. Casing Pipe: Furnish steel casing pipe, unless otherwise specified, conforming to ASTM A 139 with wall thicknesses and pipe diameters shown on the Plans. Provide full penetration butt welded pipe joints.

7. Fill Material: Use fill material, consisting of 1-1/4 pounds of Bentonite per gallon of water, during jacking to fill any voids between the casing pipe and the earth.

M. Identification:

1. Identification Tape: For all types of pipe to be installed, 3-inch detectable marking tape of appropriate color, shall be placed along the entire pipe length. In all cases, marking tape shall be installed 12 inches to 18 inches below the finished grade during backfill operations. All PVC pipe, PVC fittings, and identification tape shall be color-coded per standards outlined in the Utility Location and Coordinating Council's Uniform Color Code as specified in Section 4 of the Lee County Utilities Operations Manual.

2. Locating Wire: A locating tracing wire shall also be installed with PVC, HDPE and fiberglass pipes and shall be a continuous No. 12 insulated copper tracing wire laid in the trench on top of the utility pipe and attached to the pipe at ten (10) foot intervals. This continuous tracing wire shall run along the entire pipe and be stubbed out at valves, pressure clean-outs and air release valves.

3.3 FIELD QUALITY CONTROL

A. Testing: Test pipelines in accordance with Section 33 05 01.

1. Test valves in place, as far as practicable, and correct any defects in valves or connections.

B. Inspection: Clean, inspect, and examine each piece of pipe and each fitting and special for defects before it is installed.

1. Cut away any lumps or projections on the face of the spigot end or the shoulder.

2. Do not use any cracked, broken, or defective pieces in the work.

3. If any defective piece should be discovered after having been installed, remove and replace this piece with a sound piece in a satisfactory manner at no increase in Contract Amount.

3.4 CLEANING

A. General: Thoroughly clean all pipe before it is laid and keep it clean until it is accepted in the completed work.

B. Removal of Materials: Exercise special care to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. If any particles are discovered before the final acceptance of the work, remove and clean the pipe.

3.5 DISINFECTION

A. General: Disinfect all pipelines that are to carry potable water in accordance with Section 33 11 12.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 11 02

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install High Density Polyethylene (HDPE) pressure pipe, fittings, and appurtenances as shown on the Drawings and specified in the Contract Documents.

B. High Density Polyethylene (HDPE) – Lee County Utilities has the option of approving the use of HDPE for water main crossings of roadways, ditches, canals, and environmentally sensitive lands. HDPE water mains shall have the same equivalent internal diameter and equivalent pressure class rating as the corresponding PVC pipe, unless otherwise approved by Lee County Utilities. For all roadway crossings refer to the design manual for casing requirements. The Department of Transportation having jurisdiction of said road and right-of-way must grant specific approval.

1.2 REFERENCED STANDARDS

A. All standard specifications, i.e., Federal, ANSI, ASTM, etc., made a portion of these Specifications by reference, shall be the latest edition and revision thereof.

1.3 QUALIFICATIONS

A. All HDPE pipe, fittings, and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the items to be furnished.

1.4 SUBMITTALS

A. Submit to the ENGINEER, a list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for all HDPE pipe and fittings.

B. Submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

C. Submit shop drawings showing installation method and the proposed method and specialized equipment to be used.

1.5 INSPECTIONS AND TESTS

A. All work shall be inspected by an Authorized Representative of the OWNER who shall have the authority to halt construction if, in his opinion, these specifications or standard construction practices are not being followed. Whenever any portion of these specifications is violated, the ENGINEER or his authorized representative, shall, by written notice, order further construction to cease until all deficiencies are corrected.

1.6 WARRANTY AND ACCEPTANCE

A. Warrant all work to be free from defects in workmanship and materials for a period of one year from the date of completion of all construction. If work meets these specifications, a letter of acceptance, subject to the one year warranty period, shall be given at the time of completion. A final acceptance letter shall be given upon final inspection at the end of the one year warranty period, provided the work still complies with these specifications. In the event deficiencies are discovered during the warranty period, they shall be corrected by the CONTRACTOR without additional charge to the OWNER before final acceptance. During the warranty period, the ENGINEER shall determine if warranty repairs or replacement work shall be performed by the CONTRACTOR. The decision of the ENGINEER shall be binding upon the CONTRACTOR.

PART 2 PRODUCTS

2.1 POLYETHYLENE PIPE AND FITTINGS

A. Polyethylene pressure pipe shall be manufactured from PE3408 polyethylene and shall meet AWWA C906 standards. When specified by the ENGINEER on the construction drawings, as an alternate to PVC, HDPE, Ductile iron pipe sized (DIPS) piping can be used for buried applications. Iron pipe sized (IPS) HDPE piping can be used for above-ground applications. HDPE (IPS) SDR-11 Hydrostatic Design Basis (HDB) piping shall be used for the riser pipes from the pump discharge and manifold as shown on the drawings.

B. Where HDPE pipe is joined to HDPE pipe, it shall be by thermal butt fusion. Thermal fusion shall be accomplished in accordance with the pipe manufacturer and fusion equipment supplier specifications. The CONTRACTOR installing thermal butt fused HDPE pipe shall have a minimum of five years experience performing this type of work.

C. Qualification of Manufacturer: The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. The Manufacturer’s production facilities shall be open for inspection by the OWNER or his authorized representative. Qualified manufacturers shall be approved by the OWNER.

D. Approved Manufacturer: Manufacturers that are qualified and approved are listed in the LCU Approved Materials List.

E. Materials: Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345434C or 345434E per ASTM D 3350; and shall be listed in the name of the pipe and fitting manufacturer in PPI (Plastics Pipe Institute) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

F. Interchangeability of Pipe and Fittings: Polyethylene pipe and fittings shall be produced by the same Approved Manufacturer. Products made by subcontractor's or Manufacturer's distributor are not acceptable. Pipe and fittings from different Approved Manufacturers shall not be interchanged.

G. Polyethylene Pipe: Polyethylene pipe shall be manufactured in accordance with ASTM F 714, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter or ASTM D 3035, Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter and shall be so marked. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, % carbon, (from pipe) dimensions and either quick burst or ring tensile strength (equipment permitting).

H. Color Identification: HDPE must have at least three equally spaced horizontal colored marking stripes. Permanent identification of piping service shall be provided by adhering to the following colors (in accordance with the coloring code in Section 09 90 00).

Blue – raw water
Blue – potable water
Green – wastewater, sewage
Pantone Purple – reuse or reclaimed water

I. Polyethylene Fittings and Custom Fabrications: Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.

J. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D 3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.

K. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full service pressure rating of the mating pipe. Directional fittings 16" IPS and larger such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Part drawings shall be submitted for the approval of the ENGINEER.

L. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against blow-out.

M. Back-up Rings and Flange Bolts: Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

2.2 MANUFACTURER'S QUALITY CONTROL

A. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for:

- Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/coil, whichever is less frequent.
- Out of Roundness at frequency of at least once/hour or once/coil, whichever is less frequent.
- Straightness, inside and outside surface finish, markings and end cuts shall be visually inspected as per ASTM F714 on every length of pipe.

2.3 COMPLIANCE TESTS

A. In case of conflict with Manufacturer's certifications, the CONTRACTOR, ENGINEER, or OWNER may request re-testing by the manufacturer or have re-tests performed by an outside testing service. All re-testing shall be at the requestor's expense, and shall be performed in accordance with the Specifications.

B. Installation shall be in accordance with Manufacturer's recommendations and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with the applicable codes and standards.

PART 3 EXECUTION

3.1 INSTALLATION OF HIGH DENSITY POLYETHYLENE PRESSURE PIPE AND FITTINGS

A. All high density polyethylene (HDPE) pressure pipe shall be installed by direct bury, directional bore, or a method approved by the OWNER/ENGINEER prior to construction. If directional bore is used, or if directed by the OWNER/ENGINEER, the entire area of construction shall be surrounded by silt barriers during construction.

Installation shall be in accordance with Manufacturer's recommendations, and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with the applicable codes and standards.

3.2 HEAT FUSION JOINING

A. Joints between plain end pipes and fittings shall be made by butt fusion, and joints between the main and saddle branch fittings shall be made using saddle fusion using only procedures that are recommended by the pipe and fitting Manufacturer. Ensure that persons making heat fusion joints have received training and certification for heat fusion in the Manufacturer's recommended procedure. Maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed.

3.3 MECHANICAL JOINING

A. Polyethylene pipe fittings, and stiffeners may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings) or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material. Mechanical couplings shall be fully pressure rated and fully thrust restrained such that when installed in accordance with manufacturer's recommendations, a longitudinal load applied to the mechanical cooling will cause the pipe to yield before the mechanical coupling disjoins. External joint restraints shall not be used in lieu of fully restrained mechanical couplings.

3.4 BRANCH CONNECTIONS

A. Branch connections to the main shall be made with saddle fittings or tees.

3.5 EXCAVATION

A. Trench excavations shall conform to this specification, Section 31 23 16, the plans and drawings, as otherwise authorized in writing by the ENGINEER or his approved representative, and in accordance with all applicable codes. Excess groundwater shall be removed by the CONTRACTOR. Where necessary, trench walls shall be shored or reinforced.

3.6 LARGE DIAMETER FABRICATED FITTINGS

A. Fabricated directional fittings 16" IPS and larger shall be butt fused to the end of a pipe. The flanged directional outlet connections shall be made up in the trench.

3.7 MECHANCIAL JOINT AND FLANGE INSTALLATION

A. Mechanical joints and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated, and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least one hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the Manufacturer.

3.8 FOUNDATION AND BEDDING

A. Pipe shall be laid on grade and on a stable foundation in accordance with Section 31 23 23.

3.9 PIPE HANDLING

A. When lifting with slings, only wide fabric choker slings shall be used to lift, move, or lower pipe and fittings. Wire rope or chain shall not be used. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or defective equipment shall not be used.

3.10 TESTING

A. Butt Fusion Testing: On each day that butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12 inches (min) or 30 times the wall thickness in length with the fusion in the center, and 1 inch (min) or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

Perform all butt fusion joints in the presence of the ENGINEER or his representative. Record the temperature and corresponding time for each fusion joint.

B. Low Pressure Testing: CONTRACTOR shall test Suction pipeline using Low Pressure Testing. The air test shall be made by attaching an air compressor or testing

apparatus to a suitable opening. After closing all other inlets and outlets to the system, force air into the system until there is a uniform gauge pressure of 5 psi. This pressure shall be held constant without introduction of additional air for a period of at least 30 minutes.

C. Hydrostatic Pressure Testing:

1. General

a. CONTRACTOR shall test discharge pipeline installed under this Contract in accordance with these specifications prior to acceptance of the pipeline by the COUNTY. All field tests shall be made in the presence of the COUNTY. Except as otherwise directed, all pipelines shall be tested. All piping to operate under liquid pressure shall be tested in sections of approved length. The pressure testing of an HDPE line section shall be tested separately from the PVC and DIP line sections. Where impractical, the HDPE test section shall include only a minimum amount of PVC and ductile iron pipe within the test section. If at all possible, the PVC and DIP test sections shall be left exposed during the pressure test for visual leakage observation. For these tests, the CONTRACTOR shall furnish clean water, suitable temporary testing plugs or caps, and other necessary equipment, and all labor required. If the CONTRACTOR chooses to pressure test against an existing COUNTY water main / valve, the new water main must be disinfected prior to connection to the COUNTY line. The COUNTY will not be responsible for failure of the pressure test due to the existing valve leaking. The COUNTY may elect to furnish suitable pressure gauges for these tests. If not, the CONTRACTOR will furnish suitable pressure gauges, calibrated by an approved testing laboratory, which increments no greater than 2 psi. Gauges used shall be of such size that pressures tested will not register less than 10 percent or more than 90 percent of the gauge capacity. All valved sections shall be hydrostatic tested to insure sealing (leak allowance) of all line valves.

b. Unless it has already been done, the section to pipe to be tested shall be filled with potable water and air shall be expelled from the pipe. If blow-offs or other outlets are not available at high points for releasing air, the CONTRACTOR shall provide 1-inch [minimum taps and blow-off valves (at the 12:00 position)], as necessary. The cost of constructing blow-off valves and plugging them, after a successful pressure test, shall be included in the unit price bid amount for the HDPE pipe.

2. Testing Criteria

a. Hydrostatic testing shall consist of a 150 psig test pressure for water and reuse water, and 100 psig for force main, based on the elevation of the highest point of the line or section under test. Pressure shall be applied by

means of a pump connected to the pipe in a manner satisfactory to the COUNTY. The pump, pipe connection and all necessary apparatus shall be furnished by the CONTRACTOR and shall be subject to the approval of the COUNTY.

b. Maximum duration for pressure test, including initial and final phase of the test, shall not exceed eight (8) hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, and then allow it to "relax" for at least eight (8) hours before bringing the test section up to test pressure again.

3. Procedure For Pressure Test

a. Initial Phase of Pressure Testing: First, all air must be removed from the test section. The pressure test shall be completed after the line is backfilled. If possible, all flanged or mechanical joint valves and fittings shall be left exposed for visual leak inspection. If possible all PVC and DIP test sections shall be left exposed for visual leak inspection. Initially, the pressure within the test section shall be raised to approximately 160 psi and then allowed to be idle (no additional make-up water / pressure to be injected), for approximately 3 hours. During this 3-hour period, the test section shall be allowed to stabilize and come to an equilibrium stage. No additional make-up water / pressure shall be applied to the test section during this 3-hour stabilization period unless the line pressure drops below 140 psi. In this case, make-up water / pressure shall only be applied to the test section to maintain a minimum of 140 psi (during the 3-hour stabilization period).

b. Final Phase of Pressure Testing: The final phase of the pressure test shall involve applying make-up water / pressure to achieve an "Initial test pressure" of 150 psi (minimum) / 155 psi (maximum). The test section is then allowed to be idle (no make-up water / pressure is added) for a period of 2 hours. After this 2-hour period, make-up water / pressure is applied and measured to re-establish the "initial test pressure." The quantity of water utilized to re-pump the line shall be measured and compared to the allowable quantities as determined by TABLE 1, shown below. If the actual make-up water quantity is equal to or less than the allowable amount, the pressure test passes. If the actual make-up water quantities are greater than the allowable amount, the pressure test fails.

TABLE 1: ALLOWABLE MAKE-UP AMOUINT (HDPE) PIPE	
Nominal Pipe Size (inches)	**Make-up Water Allowance (U.S. Gallons /100 ft. of Pipe) 2-Hour Test**
6	0.30
8	0.50
10	0.65
12	1.15
14	1.40
16	1.65
18	2.15
20	2.75
22	3.50
24	4.40
26	5.00
28	5.55
30	6.35
32	7.15
34	8.10
36	9.00
42	11.55
48	13.50
54	15.70

c. In the event a section fails to pass the tests, the CONTRACTOR shall do everything necessary to locate, uncover (even to the extent of uncovering the entire section), and replace the defective pipe, valve, fitting or joint. Visible leaks shall be corrected regardless of total leakage. Lines which fail to meet these tests shall be retested as necessary until test requirements are complied with. All testing shall be performed at the CONTRACTOR'S expense. A separate low pressure test shall be performed prior to HDPE pipe pullback into the bore hole.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 11 03

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install ductile iron pipe, fittings and appurtenances as shown on the Drawings and as specified herein.

B. NOTE: No buried ductile iron pipe shall be acceptable for sanitary force main construction. All water mains larger than 12 inches shall be constructed of Ductile Iron Pipe and shall be used for all vertical deflections ditch crossings, subaqueous crossings, and all paved surfaces unless otherwise approved by Lee County Utilities.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 05 03 - Laying and Jointing Buried Pipe

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards: (Latest Revision)

1. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. ANSI/AWWA C110/A21.10 Ductile-Iron Fittings, 3 in. Through 48 Inches, for Water and Other Liquids. (C110 2-48 inches).

3. ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges.

5. ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe.

6. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids.

7. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 inches through 64 inches, for Water and Other Liquids.

8.	AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances.
9.	AWWA C602	Cement-Motor Lining of Water Pipelines in Place 4-inch
10.	ASTM G62	Standard Test Methods for Holiday Detection in Pipeline Coatings
11.	ASTM F477	Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Material

1.4 CONTRACTOR SUBMITTALS

A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in the General Conditions, the requirements of the referenced standards and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.
2. For pipe 48 inches in diameter and larger, a line layout and marking diagram shall indicate the specific number and location (station) of each fitting.
3. In all cases, a line layout to indicate the limits of each reach of restrained joints, or of concrete encasement shall be supplied.

B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, which indicates that all tests have been made and that all results comply with the requirements of AWWA C151, including but not necessarily limited to the following:

1. Acceptance Tests.
2. Hydrostatic Tests.
3. Low Temperature Impact Tests.

C. Additional Documentation: Foundry records shall be furnished in the form of written transcripts upon request.

D. All expenses incurred for certification, testing, and data submittal shall be borne by the CONTRACTOR or the Supplier.

1.5 QUALITY ASSURANCE

A. Inspection: All pipe shall be available for inspection at the place of manufacture prior to shipping in accordance with the provisions of the referenced standards. Notify the ENGINEER in writing not less than 10 calendar days prior to the shipping of the pipe.

B. The ENGINEER shall be given access to all areas where manufacturing and testing is performed and shall be permitted to make all inspections necessary to confirm manufacturer compliance with these Specifications.

C. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

D. Provide data on material tests at no additional cost to the OWNER.

E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

1.6 CORROSION PROTECTION

A. The allowed force main pipe materials are polyvinyl chloride (PVC) or high-density polyethylene (HDPE) or fiberglass. Use of ductile iron pipe (DIP) and DIP fittings are not allowed without the specific approval of Lee County Utilities. Where a force main is expected to flow full pipe at all times, DIP may be used after specific approval by Lee County Utilities. The DIP pipe will be required to have an approved lining (see LCU Approved Materials List). The lining consists of a minimum of 60 mils thick polyethylene lining with a fusion bonded epoxy primer layer to the DIP pipe. This lining must extend through the bell of the pipe to a point under the sealing gasket. To ensure a holiday-free lining, documentation must be provided, prior to shipment, showing each section of the lined pipe has passed the holiday testing at production per ASTM G62 with a minimum of 10,000-volt charge.

B. If specifically approved by Lee County Utilities for use, exterior protection shall be provided for underground ductile iron pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas shall be those set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, ductile iron pipe crossing said utility shall be protected for a distance of 20 feet to each side. If ductile iron pipe is to be installed parallel to and within 10 feet of cathodically protected pipe, then protection shall be provided for the entire length. Steel pipe shall not be installed in severe corrosion areas.

PART 2 PRODUCTS

2.1 GENERAL

A. Cement mortar lined ductile iron pipe for water mains shall conform to ANSI/AWWA C151 and C104, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets as indicated in the Contract Documents, and all specials and fittings shall be provided as required under the Contract Documents.

B. Markings: Legibly mark specials 48 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.

C. Handling and Storage: The pipe shall be handled by wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe and its lining. The use of equipment or handling, which might injure the pipe and its lining, will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the ENGINEER.

D. Laying lengths: Maximum pipe laying lengths shall be 20 feet.

E. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness, in accordance with ANSI/AWWA C104.

F. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings or line layouts where applicable.

2.2 PIPE DESIGN CRITERIA

A. General: Ductile Iron pipe shall be designed in accordance with the requirements of ANSI/AWWA C150 as applicable and as modified in this Section.

B. Pipe Wall Thickness for Internal Pressure: The pipe shall be designed with a net thickness to withstand the design internal pressure in accordance with the hoop stress formula. In addition to the requirements of the Section, the minimum wall thickness shall be in accordance with the minimum thickness wall depicted in table 50.5 of ANSI/AWWA C150.

C. Ductile Iron Pipe shall be a minimum of Class 50 or pressure Class 250 and will be accepted in any diameter for use within the water distribution system.

D. All aboveground water main pipe shall be painted blue. The pipe wall thickness shall not be less than that required by a working pressure of 250 psi in laying condition Type 4 “B” with 5-foot cover in conformance with ANSI Standard A21.50.

E. Pipe color shall match existing paint color at each site.

2.3 MATERIALS

A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of ANSI/AWWA C151.

B. Cement: Cement for mortar lining for water pipe and fittings shall conform to the requirements of ANSI/AWWA C104; provided that cement for mortar lining shall by Type II or V. A fly ash or pozzolan shall not be used.

C. Adapters to connect ductile iron pipe or fittings to pipe or fittings of dissimilar materials shall be supplied by the CONTRACTOR in accordance with the pipe manufacturer recommendations, and as approved by the ENGINEER.

2.4 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe for water mains shall conform to the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10 for diameters 3 inches through 48 inches and shall have a minimum pressure rating of 250 psi. Ductile iron fittings shall be cement lined, seal coated and outside coated as specified. Ductile Iron fittings larger than 48 inches shall conform to the above referenced standard with the necessary modifications for the larger size manufacturer's standard.

B. All above-ground fittings in direct contact with wastewater shall be HDPE or ductile iron flanged joints with a minimum pressure rating of 250 psi conforming to ANSI A21.10. If above-ground ductile iron fitting is used, the fitting shall be lined with an approved liner (see LCU Approved Materials List) applied in strict accordance with the manufacturer’s specifications to a dry film thickness of 40 mils. All above-ground fittings shall have a factory applied exterior epoxy coating in accordance with AWWA C550.

2.5 DESIGN OF PIPE

A. General: The sewer pipe and fittings furnished shall be ductile iron pipe, lined with Protecto-401 or approved equal, and rubber gasketed joints.

B. The sewer pipe and fittings shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151.

C. Pipe Dimensions: The pipe shall be of the diameter and class shown. The minimum wall thickness for each pipe size shall be as specified herein or shown on the Drawings.

D. Fitting Dimensions: The fittings shall be of the diameter shown and class specified.

E. Joint Design: Ductile Iron pipe and fittings shall be furnished with mechanical joints, push-on joints and flanged joints as follows:

1. For buried pipe applications, unless otherwise indicated, mechanical and push-on joints shall conform to ANSI/AWWA C111/A21.11, with the minimum pressure rating of 250 psi.

2. For above-ground or buried vault applications, unless otherwise indicated, flanged joints shall conform to ANSI/AWWA C115/A21.15, with the minimum pressure rating of 250 psi. All above-ground fittings shall be painted blue.

F. Restraining Devices: Restraining joints shall be placed at all bends, tees, plugs, reducers, and other fittings to provide lateral support, and shall conform to the details shown on the drawings in Sections 9 of the Lee County Utilities Operations Manual. Concrete thrust blocks may be utilized as additional restraint if approved by Lee County Utilities.

1. See LCU Approved Materials List for Joint restraint devices for ductile iron mechanical joint pipe and ductile iron mechanical joint fittings to ductile iron pipe.
2. See LCU Approved Materials List for Bell joint restraint devices for ductile iron push joint pipe.

G. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself will provide watertight joints under all operating conditions when properly installed. Require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

H. Gaskets shall be a Buna N, Neoprene, or a Nitryl-based rubber product approved by the County. Gaskets shall have clean tips unless otherwise specified. Elastomeric gaskets conforming to ASTM F-477 shall also be acceptable.

I. Shop-applied interior linings and exterior coatings shall be applied evenly to the nominal thickness specified. Holiday free cement is not possible to manufacture. Exterior coatings: asphalt coating for buried pipe or primed pipe cannot be furnished holiday free.

2.6 LINING MATERIAL

A. The Standard of Quality for sewer pipes and fittings is Protecto 401 Ceramic Epoxy, or approved equal. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

B. A permeability rating of 0.00 when tested according to Method A of ASTM E-96, Procedure A with a test duration of 30 days

C. The following test must be run on coupons from factory lined ductile iron pipe:

1. ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years.
2. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77 °F. Results to equal no more than
   0.5 mm undercutting after 30 days.
3. Immersion testing rated using ASTM D-714.
   a. 20% Sulfuric acid – No effect after two years.
   b. 140 °F 25% Sodium Hydroxide – No effect after two years.
   c. 160 °F Distilled Water – No effect after two years.
   d. 120 °F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect.
4. ASTM G-22 Standard practice for determining resistance of Synthetic Polymeric materials to bacteria. The test should determine the resistance to growth of Acidithiobacillus Bacteria and should be conducted at 30 degrees centigrade for a period of 7 days on a minimum of 4 panels. The growth must be limited only to trace amounts of bacteria.

D. An abrasion resistance of no more than 3 mils (.075 mm) loss after one million cycles using European Standard EN 598: Section 7.8 Abrasion Resistance.

2.7 EXTERIOR COATING OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 90 00, “Painting and Coating”. All above-ground pipe shall be painted blue. All above-ground sewer pipe shall be painted to match existing at each station.

B. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately 1 mil thick, conforming to ANSI/AWWA C151.

2.8 CORROSION PROTECTION

A. The allowed force main pipe materials are polyvinyl chloride (PVC) or high-density polyethylene (HDPE) or fiberglass. Use of ductile iron pipe (DIP) and DIP fittings are not allowed without the specific approval of Lee County Utilities. Where a force main is expected to flow full pipe at all times, DIP may be used after specific approval by Lee County Utilities. The DIP pipe will be required to have an approved lining (see LCU Approved Materials List). The lining consists of a minimum of 60 mils thick polyethylene lining with a fusion bonded epoxy primer layer to the DIP pipe. This lining must extend through the bell of the pipe to a point under the sealing gasket. To ensure a holiday-free lining, documentation must be provided, prior to shipment, showing each section of the lined pipe has passed the holiday testing at production per ASTM G62 with a minimum of 10,000-volt charge.

B. If specifically approved by Lee County Utilities for use, exterior protection shall be provided for underground ductile iron pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas shall be those set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, ductile iron pipe crossing said utility shall be protected for a distance of 20 feet to each side. If ductile iron pipe is to be installed parallel to and within 10 feet of cathodically protected pipe, then protection shall be provided for the entire length. Steel pipe shall not be installed in severe corrosion areas.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE

A. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall and in accordance with ANSI/AWWA C600. Pipe shall not be placed directly on rough, rocky ground but in such instances shall be supported in a manner which will protect the pipe against injury whenever stored at such trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the ENGINEER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.

B. All pipe damaged prior to Substantial Completion or during warrantee period shall be repaired or replaced by the CONTRACTOR.

C. Inspect each pipe and fitting prior to installation to ensure that no damaged portions of the pipe get installed.

D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected therein and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work.

E. Pipe Laying: The pipe shall be installed in accordance with ANSI/AWWA C600.

F. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change

shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 70 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.

H. Pipe and Specials Protection: The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

I. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs per ANSI/AWWA C600 and C602 prior to testing and disinfecting the completed pipeline. Pipe larger than 12" diameter will utilize a polyurethane foam plug "Poly Pig" to remove all debris from main.

3.2 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket shall be placed in the bell groove. The bell and spigot end of push-on joint pipe shall be carefully cleaned and lubricated with a vegetable-based lubricant or per manufacturer's recommendation. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 INSTALLATION OF PIPE APPURTENANCES

A. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation.

B. All valves shall be installed so that the valve stems are plumb and in the location shown on the Drawings.

C. Mechanical joints consisting of bell, socket, gland, gasket, bolts, and nuts shall conform to ANSI Standard A21.11. Bolts and nuts shall be high strength, low alloy, Cor-Ten, T-Head Type having hexagonal nuts. Bolts and nuts shall be machined through, and nuts shall be tapped at right angles to a smooth bearing surface. Single sealed gasket push-on type joints shall conform to the requirements of ANSI A21.11 (see LCU Approved Materials List).

D. Mechanical joint retainer glands may be used to restrain mechanical joint pipe and fittings to the plain end of ductile iron pipe and fittings when used in conjunction with

thrust blocks of reduced size. The Utilities ENGINEER must approve thrust block size. Joint flexibility shall be maintained.

3.4 TESTING AND DISINFECTION

A. Test completed water pipeline in accordance with Section 33 05 01. Disinfect completed water pipeline in accordance with Section 33 11 12.

END OF SECTION

SECTION 33 34 01

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install polyvinyl chloride (PVC) force main pipe, fittings, and appurtenances a shown on the drawings and as specified herein.

1.2 SUBMITTALS

A. Submit to the ENGINEER within fourteen calendar days after receipt of Notice-to-Proceed a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Submit for approval, as provided in the General Conditions, complete, detailed shop drawings of all PVC pipe and fittings.

C. Submit and shall comply with pipe manufacturer's recommendations for handling, storing, and installing pipe and fittings.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Unless otherwise shown on the Drawings or specified, PVC force main pipe shall meet the following minimum requirements:

1. For PVC pipe not installed under roadway pavement:

    a. Pipe 4 inches through 24 inches in diameter shall be DR18, AWWA C-900.

    b. Pipe greater than 24 inches in diameter shall be DR25, AWWA C900.

2. For PVC pipe installed under roadway pavement by direct burial:

    a. Pipe 4 inches through 12 inches in diameter shall be DR14, AWWA C-900

    b. Pipe 14 inches through 24 inches in diameter shall be DR14, AWWA-C905.

    c. Pipe greater than 24 inches in diameter shall be DR25, AWWA C-900.

B. PVC fittings 4 inches and larger in diameter shall meet the requirements of applicable AWWA C900 and C905 specifications. Fittings shall be manufactured entirely of PVC meeting ASTM D1784, shall be formed by a thermal-form process and be of one-piece construction, able to withstand 755 psi quick burst pressure-tested in accordance with ASTM D1599 and withstand 500 psi for a minimum of 1,000 hours tested in accordance with ASTM D1598. Bells shall be gasketed push on type conforming to ASTM D3139 with gaskets conforming to ASTM F477. Approved fittings are listed in the LCU Approved Materials List. Ductile iron fittings with mechanical or push on joints conforming to AWWA C153 or C110 may be approved as alternative when PVC pressure fittings of the required sizes are not available. If ductile iron fitting is used, the fitting shall have a fusion bonded epoxy coating to a minimum of 20 mil thickness.

C. Pipe shall be homogeneous throughout. It shall be free from voids, inclusions, and other defects. Pipe surface shall be free from nicks and scratches, joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage.

D. All joints shall be made in accordance with the manufacturer's recommendations. The particular joint used shall be approved by Lee County Utilities prior to installation. No sulfur-based compounds shall be used.

E. Pipe shall be furnished in standard laying lengths not exceeding 20 feet.

F. Restrained joints shall be provided at all tees, plugs, horizontal bends, vertical offsets, and locations shown on the drawings. See the LCU Approved Materials List for Joint restraint devices for C-900 PVC pipe used with ductile iron mechanical joint fittings, Bell joint restraint devices for PVC push joint pipe, and restraints for C-900 PVC fittings. Bolts and nuts shall be Ductile Iron or 300 Series Stainless Steel, T-Head type with hexagonal nuts. Bolts and nuts shall be machined through and nuts shall be tapped at right angles to a smooth bearing surface. Restraints shall be Class 150 psi and shall be capable of withstanding 300 psi quick burst test without separation or failure. Suitable PVC/ductile iron adapters shall be provided, as necessary.

G. PVC pipe fittings for 2-inch and smaller diameter pipe shall be glued and shall be Schedule 80 and conform to the requirements of ASTM D-2464.

H. PVC odor ductwork shall be Schedule 80 pipe with solvent welded Schedule 80 PVC fittings and conform to the requirements of ASTM D1785

2.2 IDENTIFICATION

A. Pipe shall bear identification markings that will remain legible after normal handling, storage, and installation. Markings shall be applied in a manner that will not weaken or damage the pipe. Marking shall be applied at intervals of not more than 5 feet on the pipe. Marking on the pipe shall include the following:

B. Nominal size and OD base.

C. PVC.

D. Dimension ratio.

E. AWWA pressure rating.

F. AWWA designation.

G. Manufacturer's name or trademark.

H. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

I. All PVC sewage force main pipe shall be color coded green.

J. All SCH 80 PVC Odor Ductwork shall be standard gray.

2.3 STRUCTURE AND MANHOLE CONNECTIONS

A. Pipe stubs for all structure and manhole connections shall not exceed 12 inches in length unless otherwise shown on the drawings. Caps shall be furnished were required.

PART 3 EXECUTION

3.1 INSTALLATION

A. PVC pipes shall be installed in accordance with the manufacturer's recommendation, as shown on the Drawings, and as specified herein.

B. Use care in handling, storage, and installation of pipe and fittings. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation. Under no circumstances shall pipe or fittings be dropped into the trench.

C. Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings and as specified in Section 31 23 23. Blocking under the pipe will not be permitted.

D. When laying is not in progress, or the potential exists for dirt or debris to enter the pipe, the open ends of the pipe shall be closed with plug or by other approved means.

E. In all cases where PVC pipe is installed, a marking tape shall be located above the top of the pipe as specified in Section 33 05 03.

3.2 TESTING FORCE MAINS

A. Due to the nature of this project, hydrostatic pressure testing of pipelines will be difficult, there the County will accept a visual test at typical operating pressure from the diesel pump.

END OF SECTION

SECTION 33 34 12

WASTEWATER VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

B. The equipment shall include, but not be limited to, the following:

1. Eccentric Plug Valves
2. Check Valves
3. Pinch Check Valves
4. Vacuum Breakers
5. Air Release Valves
6. Corporation Stops
7. Flange Adapter Couplings
8. Flexible Couplings
9. Diaphragm Seals
10. Unions
11. Mechanical Type Seals
12. Hose End Faucets
13. Pressure Gauges
14. Reduced Pressure Backflow Preventor
15. Flow Meters
16. Tapping Sleeve

1.2 DESCRIPTION OF SYSTEMS

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of wastewater and reclaimed water.

1.3 QUALIFICATIONS

A. All of the types of valves and appurtenances shall be products of well established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.4 SUBMITTALS

A. Submit within 30 days after execution of the contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Complete shop drawings of all valves and appurtenances shall be submitted to the ENGINEER for approval in accordance with the requirements of Section 01 33 00 and the General Conditions.

1.5 TOOLS

A. Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 PRODUCTS

A. General:

1. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.

2. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

B. Eccentric Plug Valves

1. All valves shall be eccentric plug valves unless otherwise specified. Valves shall be of an approved make and model (see LCU Approved Materials List).

2. Plug valves shall be tested in accordance with AWWA C504 Section 5. Each valve shall be performance tested in accordance with AWWA C504 Section 5.2 and shall be given a leakage test and hydrostatic test as described in AWWA C504 Paragraphs 5.3 and 5.4. The leakage test shall be applied to the face of the plug tending to unseat the valve. The Manufacturer shall furnish certified copies of reports covering proof of design testing as described in AWWA C504 Section 5.5.

3. Plug valves shall be of the tight closing, resilient faced, non-lubricating variety and shall be of eccentric design such that the valve's pressure member (plug) rises off the body seat contact area immediately upon shaft rotation during the opening movement. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI B16.1-1967. Valves shall be drip-tight in both directions (bi-directional) at rated pressure, 175 psi through

12-inch diameter, 150 psi for 14-inch diameter and above. The valve shall be provided with a 2-inch square operating nut.

4. The valve body shall be constructed of cast iron ASTM A126, Class B. Body ends shall be mechanical joint to meet the requirements of AWWA C111/ANSI A21.11 or single gasket push-on type.

5. The valve plug shall be constructed of cast iron or ductile iron and shall have a conical seating surface which is eccentrically offset from the center of the plug shafts. The plug and shafts shall be integral. The entire plug face shall be totally encapsulated with Buna N (Nitrile) rubber in all valve sizes. The rubber to metal bond must withstand 75 lbs. pull under test procedure ASTM D-429-73, Method B. When the plug is in full open position, plug geometry and body waterway contours must provide a passageway that allows flow capacity **equal to 100% of the adjacent pipe area.**

6. Valve seat mating surface shall be constructed of a welded-in overlay of not less than 90% nickel or be a one-piece 304 stainless steel ring. Seat ring contour must be precision machined.

7. A mechanical "brake" shall be supplied on all valves and shall be capable of "locking" the valve in any intermediate position between full-open and full-closed.

8. Valves shall have multiple V-type packing and packing glands and shall be capable of being field adjusted or repacked without the bonnet or plug being removed from the valve with the valve under the full rated pressure. Valves shall have a port position indicator.

9. For corrosion protection, the interior ferrous surfaces of all plug valves shall have a 2-part epoxy internal coating to a minimum of 20 mils thickness.

10. Valve shaft seals shall be adjustable and comply with AWWA C507 Section 10 and with AWWA C507 Section 11.

11. Manual valves shall have lever or gear actuators and tee wrenches, extension stems, floorstands, etc. as indicated on the plans. All valves 6" and larger shall be equipped with gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. All actuator shafts shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be zinc or cadmium plated. Valve packing adjustment shall be accessible without disassembly of the actuator.

12. Valves and gear actuators for submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

13. Three-way plug valves shall be non-lubricated gear oriented. Valve bodies shall be ASTM A-126 Class, and be semi-steel with 125 lb. ANSI standard flanges. Plugs shall be resilient faced. Three-way valves shall be 3-way, 3 port 270 degree turn.

14. Plug valves installed such that actuators are 6 feet or more above the floor shall have chain wheels.

15. Where shown on the Drawings, plug valves shall be installed with extended shafts and actuators. Actuators for extended shafts shall be mounted on floor stands where indicated on the drawings or shall be removable handwheels where floor stands are not called for. Six-inch sleeves shall be provided for extended shafts in all floors; where necessary covers shall be provided. Shafts shall be of adequate strength to operate the valve and shall be 304 stainless steel where submerged and carbon steel elsewhere. Floor stands and covers, where called for shall be cast iron. Floor stands shall be equipped with valve position indicators. Where shown on the drawings, plug valves shall be furnished with extended bonnets, see LCU Approved Materials List.

16. All buried plug valves shall have a remote position indicator in the valve box showing position of the valve. A stainless steel centering and I.D. plate shall be provided showing direction of opening and number of turns to open for each valve.

C. Valves for Buried Service

1. Valves for buried service shall meet all the requirements as specified herein for interior except that buried valves shall have mechanical joint ends.

2. All buried valves shall have cast-iron three-piece valve boxes, valve boxes shall be provided with suitable heavy bonnets to extend to such elevation at the finished grade surface as directed by the ENGINEER. The barrel shall be two-piece, screw type, having 5¾" shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling, shall be designed so as to prevent the transmission of surface loads directly to the valve or piping, and shall be complete with cast iron covers. Covers shall have "SEWER" cast into the top. The covers shall be so constructed as to prevent tipping or rattling. Valve boxes shall be of an approved manufacture listed in the LCU Approved Materials List.

3. One tee-handled gatewrench of suitable length shall be furnished to operate each valve with a valve box.

4. Where valves are located out of pavement, the boxes shall be adjusted to finished grade and a concrete slab two feet square and six inches thick shall be poured around the box.

5. Valve boxes shall be of the heavy duty, traffic bearing cast iron, adjustable screw type with a drop cover. The valve box assembly shall consist of a bottom section, top section and cover which is cast from gray iron, formulated to ASTM specification A-48 latest revision, class 30 minimum and shall be free from blowholes, shrinkage or other imperfections not true to pattern. The shaft size shall be 5 1/4" and the adjustable length shall be from 18" to 24". The wall thickness shall be 3/16" $\pm$ 1/16". The weight of the assembly shall be 61 pounds $\pm$ 2 pounds, with the cover weight being a minimum of 12 pounds.

6. The name of the manufacturer and foundry of origin shall be cast into each of the components of the assembly in legible form. The assembly shall be suitable for highway traffic wheel loads of 16,000 pounds and shall withstand a proof load test of 25,000 pounds without failure or permanent deflection, as per Federal Specification RR-F-621-C, latest revision. The valve box shall be cast, machined, assembled, and packaged within the United States and shall fully comply with the Buy American provisions of Public Law 102-240, enacted 12/18/91.

D. Check Valves

1. Check valves smaller than 10 cm (4") shall have a bronze body with a bronze disk. Check valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the delivery pressure. The valve must be full opening, tight seating and its seat right shall be renewable and must be securely held in place by a threaded joint; the valve disc shall be bronze and shall be suspended from a non-corrosive shaft which will pass through a stuffing box.

2. The check valve 10 cm (4") and larger shall be a rubber flapper type swing check valve and the body and cover shall be cast iron construction meeting ASTM A126 Class B or ductile iron construction. The flapper shall be Buna-N having an “O” ring seating edge and be internally reinforced with steel.

3. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from line. Check Valves to have full pipe size flow area. Seating surface to be on a 45^{o} angle requiring the flapper to travel only 35° from closed to full open position, for minimum head loss and non-slam closure.

4. Non-slam closing characteristic shall be provided through a short 35º disc stroke and a memory flex disc return action.

5. When essential to create backflow through the check valve, i.e.; to prime or backflush a clogged pump, an external backflow device shall be included.

6. Valve exterior to be painted Phenolic Primer Red Oxide for high resistance to corrosion.

7. For corrosion protection, the interior ferrous surfaces of all check valves used in sewage applications shall be coated with a factory applied, two-part epoxy coating to a minimum of 20 mils thick.

8. Materials of construction shall be certified in writing to conform to A.S.T.M. specified above.

9. Valve shall be of an approved make and model (see LCU Approved Materials List).

10. All valves shall have a three-year 100% replacement guarantee.

E. Pinch Check Valves

1. Pinch check valves shall be of an approved make and model (see LCU Approved Materials List).

F. Air Release Valves

1. Air release valves (ARV) used on sewer force mains shall be of the automatic type designed for wastewater applications. The valve body shall be cast iron construction, ASTM A126, Class B, and all internal working parts shall be 316 Series stainless steel, and BUNA-N orifice button. The venting orifice shall be a minimum of 2.54 cm (1") in diameter. The inlet openings shall be sized per manufacturer's recommendation but no less than 5 cm (2") NPT screwed connection. ARVs shall be of an approved make and model (see LCU Approved Materials List).

2. The Bermad Flow Control Accessories model ARI D-40 combination valve shall be installed to release air from the discharge piping at the pump station. This valve shall be located as shown in Section 9 of the Lee County Utilities Operations Manual, just past the 90-degree bend on the header pipe detail. The working pressure shall be 200 psi minimum and shall have a 2-inch threaded connection. Air discharged from this valve shall be released through connecting 2-inch PVC or HDPE pipe back through into the wetwell.

3. Ball valve shall be stainless steel.

G. Corporation Stops

1. Corporation stops for connections to ductile iron or steel piping shall be all stainless steel suitable for 150 psi test pressure, see LCU Approved Materials List.

H. Flange Adapter Couplings

1. Flange adapter couplings shall be of the size and pressure rating required for each installation and shall be suitable for use on either cast iron or ductile iron pipe. They shall be of an approved make and model (see LCU Approved Materials List).

I. Flexible Couplings:

1. Flexible couplings shall be either the split type or the sleeve type as shown on the Drawings.

a. Split type coupling shall be either the split type or the sleeve type as shown on the Drawings. The couplings shall be mechanical type for radius groove piping. The couplings shall mechanically engage and lock grooved pipe ends in a positive coupling and allow for angular deflection and contraction and expansion.

b. Couplings shall consist of malleable iron, ASTM Specification A47, Grade 32510 housing clamps in two or more parts, a single chlorinated butyl composition sealing gasket with a "C" shaped cross-section and internal sealing lips projecting diagonally inward, and two or more oval track head type bolts with hexagonal heavy nuts conforming to ASTM Specification A183 and A194 to assemble the housing clamps. Bolts and nuts shall be Series 300 stainless steel.

c. Victaulic type couplings and fittings may be used in lieu of flanged joints. Pipes shall be radius grooved as specified for use with the Victaulic couplings. Flanged adapter connections at fittings, valves, and equipment shall be of an approved make and model (see LCU Approved Materials List).

d. Sleeve type couplings shall be used with all buried piping. The couplings shall be of steel and shall be of an approved make and model (see LCU Approved Materials List). The coupling shall be provided with stainless steel bolts and nuts unless indicated otherwise.

e. All couplings shall be furnished with the pipe stop removed.

f. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

g. If the Contractor decides to use victaulic couplings in lieu of flanged joints, he shall be responsible for supplying supports for the joints.

J. Diaphragm Seals:

1. Diaphragm seals shall be installed on pressure gauge connection to all lines where shown on the Drawings, to protect pressure switches used to monitor excessive pressures on pipe lines. The diaphragm shall be "thread attached" to both piping and pressure switches. Diaphragm seals shall be constructed of cadmium plated carbon steel, except for the lower housing which shall be specifically chosen according to the fluid pressure being monitored.

2. Diaphragm seals shall have a flushing connection and be of an approved make and model (see LCU Approved Materials List).

K. Unions

1. Unions on ferrous pipe 2" in diameter and smaller shall be 150 pounds malleable iron, zinc-coated. Unions on water piping 2-inch in diameter and larger shall be flange pattern, 125-pound class, zinc-coated. Gaskets for flanged unions shall be of the best quality fiber, plastic, or leather. Unions shall not be concealed in walls, ceilings, or partitions.

L. Mechanical Type Seals

1. Mechanical type seals shall consist of an adjustable modular bolted, synthetic rubber and plastic sealing element. The sealing element shall be of an approved make and model (see LCU Approved Materials List).

M. Hose End Faucets

1. Hose end faucets for potable water supply at submersible stations shall be of an approved make and model (see LCU Approved Materials List). Faucet shall be furnished with removable key and shall be lockable.

N. Pressure Gauges

1. Each pressure gauge shall be direct mounted, cast aluminum case, with a 2" diameter dial and furnished with a clear glass crystal window, 3/8" shut-off valve, and a bronze pressure snubber. Provide diaphragm seals between shut-off valve and pressure gauge on all sludge and lines with nonclear matter in suspension of solution. All gauges shall be weatherproofed. The face dial

shall be white finished aluminum with jet black graduations and figures. The face dial shall indicate the units of pressure being measured (e.g., feet, inches, etc.) or be dual scale.

2. If shown on the drawings, each pump discharge line shall be furnished with gauges sized 0-100 psi.

O. Reduce Pressure Backflow Preventor

1. If shown on the drawings, backflow preventors shall be supplied at each pump station.

P. Flow Meters

1. Meters shall be of the magnetic type with Teflon lining, stainless steel electrodes and ultrasonic cleaning, or the universal venturi type with flanged cast or ductile iron body and bronze throat. Flow meters shall be designed to record both the peak pumping station capacity and anticipated minimum flows with equally high accuracy. The meters shall be direct reading in gallons per minute, totalizing in million gallons per day and recording on 12-inch diameter, 24-hour linear charts in gallons per minute. All meters shall also be tied to the Radio Telemetry SCADA System. The flow metering system shall be installed within the pumping station structure, if space is available, or in an exterior protected and drained pit. In all cases, meter by-pass valves and piping shall be provided.
2. Flow meters shall be provided for all sewage pumping stations with ultimate ratings greater than 1500 gpm, or as directed by LCU.

Q. Tapping sleeves shall be provided from one of the manufacturers indicated on the LCU Wastewater Approved Materials list.

PART 3 EXECUTION

3.1 INSTALLATION

A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to the satisfaction of the ENGINEER before they are installed.

B. Valves shall be carefully inspected, opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. Valves, unless shown otherwise shall be set with their operator shaft vertically. Any valve that does not operate correctly shall be removed and replaced.

C. Valve boxes shall be carefully centered over the operating nuts of the valves so as to permit a valve wrench or key to be fitted easily to the operating nut. Valve boxes shall

be set to conform to the level of the finished surface and held in position by a ring of concrete placed under the support flange as shown on the details in Section 9 of the Lee County Utilities Operations Manual. The valve box shall not transmit surface loads to the pipe or valve. Care shall be taken to prevent earth and other material from entering the valve box. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset. Before final acceptance of the work, all valve boxes shall be adjusted to finish grade. Valve operating risers shall be installed with any valves required to ensure that the operating nut is 30-inches or less from the ground surface.

D. After installation, all valves and appurtenances shall be tested at least 1 hour at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the ENGINEER.

E. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.

F. Pipe for use with flexible couplings shall have plain ends.

G. Buried flanged or mechanical joints shall be made with Series 300, stainless steel bolts. All exposed bolts shall be made with Series 300 stainless steel bolts.

H. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

I. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8". Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6" from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flaires. After the bolts have been inserted and all nuts have been made up finger-tight, diametrically opposite nuts shall be progressively and uniformly tightened

all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3.2 SHOP PAINTING

A. Ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer. All pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

3.3 FIELD PAINTING

A. All metal valves and appurtenances specified herein and installed in valve and meter pits will be painted as specified in Section 09 90 00.

3.4 INSPECTION AND TESTING

A. Completed pipe shall be subjected to hydrostatic pressure test for hours at full working pressure. All leaks shall be repaired and line retested as approved by the ENGINEER. Prior to testing, the gravity pipelines shall be supported in an approved manner to prevent movement during tests.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 40 95 13

INSTRUMENTATION AND CONTROL SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. Furnish and install, complete with all accessories, a programmable logic control based monitoring and control system with its associated instrumentation as described herein and shown on the contract drawings. The system shall serve as a self-contained monitoring and control system for all aspects of the pump station operation. It shall also be capable of integration with the existing Lee County fiber optic based central control network through a cellular radio or fiber optic Ethernet TCP/IP connection per site specific requirements.

B. This Specification has been developed to establish minimum requirements for a pump controller. This system shall be designed, constructed, tested and documented in strict accordance with the guidelines of this document. All system construction and programming will be the responsibility of the control system integrator. All materials and labor shall be provided for a fully functional system including any items which are required for system operation but are not specifically addressed in this document or on the contract drawings.

C. This specification is intended to be used in conjunction with all drawings supplied and is not intended to be complete without reference diagrams on system configurations, etc. All bidders must conform to all areas of the documentation. It is the intent of this specification that the monitoring and control system contractor have single source responsibility for the complete control and instrumentation package for the project; including but not limited to flow, pressure, level instrumentation and control, Variable Frequency Drives, generator, ATS and interconnecting conduit and control wiring for total system responsibility.

D. The overall requirements for the Process Instrumentation and Control System are included in this section. The following associated sections contain specific requirements for individual subsystems that are in addition to the requirements of this section.
   1. 40 95 13– Appendix A MPS IO List

E. Lee County Utilities will self-perform all work required to integrate the Master pump station into the offsite central server. The instrumentation and control systems contractor will provide all local programming required for a fully functional pump control system and HMI operating panel.

1.02 CONTRACTOR QUALIFICATIONS AND ADDITIONAL RESPONSIBILITY

A. The contractor providing this system shall be an instrumentation and control systems contractor who is experienced in and regularly engaged in engineering, installation and service of systems of similar size and complexity within the water treatment industry. The panel supplier shall be a UL listed panel shop and all panels shall be UL-508 certified. All panels shall utilize components in order to achieve a minimum of 10KAIC rating.

B. The contractor shall assume total systems responsibility for all aspects of this system including installation, commissioning and start-up of the system, training of operating personnel and coordinating interfaces between this system and equipment provided by others. This responsibility shall include mounting and wiring of relays, transformers, disconnecting means, and other control devices as required forming a complete system.

C. The control system integrator shall insure the continued operation of the existing systems during tie-ins or interconnecting to the existing system. Provide temporary programming that may be required during construction to facilitate construction and testing as determined by the engineer and LCU.

D. The control system integrator shall assume full responsibility for all aspects of this system including components, devices, and systems not provided under this section, but that are directly interfaced by components or subsystems provided under this section such as VFDs and packaged local control panels.
Verify that the component, device, or system has been installed in accordance with the manufacturer's recommendations with respect to operation and control, coordinate installation, provide interfaces required.
1. Verify the calibration and adjustment of devices.
2. Verify proper control system interface and operation.
3. Start up and test to demonstrate proper control system interface and operation, in coordination with the equipment manufacturer.
4. The contractor shall provide the electrical contractor with complete and coordinated VFD control drawings for manufacturer's use in the submittal approval process.
5. Provide the necessary modifications to the equipment, or other controls to properly interface and control the equipment.
7. Provide as built documentation of the existing controls and instrumentation devices and their integration into the total control and monitoring systems.

E. The control system integrator shall obtain from the contractor the required information on those primary elements, valves, valve actuators, and other control equipment or devices (both new and existing) that are required to be interfaced with, but that are not provided under, this section.

F. All conduits are provided and installed under Division 26, BASIC ELECTRICAL MATERIAL AND METHODS. With the exception of certain specified special control, fiber optic and high speed communication cables, all wiring and cables are provided and installed under Division 26, BASIC ELECTRICAL MATERIAL AND METHODS. Specific control cables and high speed communication shall be provided and installed by the control system integrator.

G. Where the term "verify" and "certify" are stated in this specification, the intent is that the control system integrator shall issue formal statements in writing to the engineer and LCU that the particular activity has been accomplished.

1.03 SUBMITTALS

A. SHOP DRAWINGS shall include:

1. A cover sheet consisting of a Bill of Material, purchase order number, manufacturer's job number, Owner's name, location, application and shipping address.
2. Mechanical layouts detailing the overall external dimensions of all enclosures. Include all pertinent information such as location of door handles, windows, lifting lugs and enclosure mounted items such as pump controller chassis and I/O modules (show cable connections on modules), relays, cooling fans, etc.
3. Details for mounting of the processor, I/O racks, relays, motor starters, disconnect switch, fuse blocks, wireways, etc. All materials shall be labeled to provide easy cross-reference to the Bill of Material listing.
4. Electrical drawings detailing all hardwiring, done by the supplier, to devices such as relays, pump controller modules, disconnect switches, fuse blocks, etc. Provide individual wire numbers and relay contact cross-reference designations.
5. A description of all input and output modules by name, rack, module and terminal location.
6. Complete master wiring diagrams, elementary schematics and control schematics shall be submitted for approval before proceeding with manufacture. Suitable outline drawings shall be furnished as part of this submittal. Standard or typical pre-printed sheets or drawings simply marked to indicate applicability to this contract will not be acceptable. Shop drawings shall be on standard 24" X 36" or 11" X 17" media; drawn with a computer aided design package. The computer aided design package shall be AUTOCAD version as directed by LCU. Engineering plan backgrounds of the facility shown on the contract documents will be available to the contractor on request. Submittals shall include reproducible plots of the drawings on paper translucent bond and CD-ROM electronic copies.
7. A complete drawing indicating each point of interface with the process control system and the type of signal provided or accepted at each point. This drawing shall depict the actual interface terminal block including all circuit designations.
8. A complete sequence of operation describing the control strategy in response to external signals and the signals which will be provided to the process control system during operation of the plant. All interlocks and limits which are internal to the operation of the controls shall be included in this description.
9. A drawing showing the layout of the control panels indicating every device with complete identification.
10. Analog and digital loop diagrams showing all I/O from the point of origin in the field device through the wiring systems to the PLC and HMI systems. Include all terminal block points and identification, color codes, tag names and numbers, etc. Include device range and calibration data for the analog device loop diagrams.
11. The last sheet(s) in the set shall describe all terminal block designations and individual terminal numbers.
12. Submittals shall be provided in accordance with Section 26 05 02 BASIC ELECTRICAL MATERIALS AND METHODS.

B. SOFTWARE SUBMITTALS shall include:

1. Provide logic submittal diagrams in ISA format of all loops that are implemented in software and include a description of the control function

and its control strategy, a listing of the scanned inputs and the outputs of the control function, operator inputs or outputs to and from the function and displays related to the function; failure contingencies and cross reference to other loop diagrams.

2. Generate a complete listing of all virtual discrete and analog points that are used to link modules. The virtual tag lists shall be developed and submitted to the engineer and LCU to facilitate operator interface programming.
3. Critical Path Software Development: The control system integrator shall submit a system software functional design submittal and shall meet with the Engineer and LCU at a county office prior to software code development. The functional design submittal shall provide a description of the system on a functional level organized into functional subsystems. The submittal shall describe the individual programs that support these functions and include a subsystem summary; technical description from the user's standpoint; subsystem structure indicating data structures; interface structure; operator interface considerations and related operator interface display formats; initialization considerations and impacts of power failure or operator interface failure or shut down.
4. A written overview description of each ladder logic program. These descriptions shall lead the user through the major subsections of the programs. They shall generally describe the programming methods and techniques that were used to implement the functional requirements of this specification.
5. Each element (input, output, or function block) shall be fully described in a 15 character minimum description. Ladder rungs shall have comments that describe the function of the rungs. Provide an average of one 120 character comment line per ladder rung.
6. Discrete and analog input/output lists and cross reference. Each input and output shall be capable of being given up to a 27-character alpha-numeric functional identification that is printed above the respective input or output in the program listing. The cross reference shall indicate each rung number where the input or output is used.
7. Internal coils list and cross-reference. Each coil shall be capable of being given a 27-character alphanumeric function identification that is printed above the respective coil and all of its contacts in the program listing. The cross-reference shall indicate each rung number where the respective coil or contact is used.
8. Data register list and cross-reference. This listing provides a listing of the data registers used and their locations(s) in the program.
9. A listing of all programmed special functions, including memory locations used and location in the program where the special functions can be found. Function descriptions shall also be shown in the special function printout for all pertinent memory locations used in each special function. Programmed values of all memory locations used shall also be shown.
10. Timers, counters, integer add and subtract, move, master control relay, and jump functions shall show all memory locations used and their programmed values.
11. Variable data memory storage record, indicating the memory location and description of the variable data; i.e., tag number, timer number, counter number. Function listing; all identified DCS functions indicated on the drawings and specifications shall be listed and fully described.

12. These submittals shall be returned reviewed prior to software code development. This is a critical path item and should be given appropriate consideration by the contractor and control systems integrator.

C. O&M MANUALS

1. Submittal Requirements
   a. CONTRACTOR shall provide the OWNER and ENGINEER with a single hard copy each of the preliminary O&M manual for review.
   b. Upon approval of the preliminary O&M the CONTRACTOR shall provide the OWNER with three hard copies of the final O&M manual. Award of final completion is contingent on the receipt of final O&M manuals.
   c. CONTRACTOR shall provide the OWNER with six electronic copies of the final O&M manual on CD. Award of final completion is contingent on the receipt of these CD's.
   d. O&M manuals shall comply with Section 01 78 23 OPERATION AND MAINTENANCE MANUALS.

2. O&M manual shall include the approved shop drawing information as well as the following:
   a. As-Built drawings of the Control Panels
   b. Bill of Material listing for all components provided within the PLC panel (and any other panels provided) as well as provided external instrumentation devices, with cut sheets and operator's manual/user's reference books. Provide hard copy manuals and CD-Rom copy where available.
   c. Description of Operation, Local. Describe the control that takes place locally -- through the use of the local control panels and operator interface. The written description should be supported with pictorial representations such as the operator interface screens or portion of an electrical drawing.
   d. Description of Operation, SCADA. Describe the control that takes place at the Water Treatment Plant SCADA Server, similar to the local Operation Description listed above. Support the written description with pictorial representations -- screens from the Clear Scada, or pictures/images.
   e. Description of Operation Procedures. Describe Power up procedures, shut down procedures, troubleshooting procedures
   f. Complete documentation for the PLC and its programming. Include the RS Logix Report with: Processor Information listing, I/O configuration, channel configuration, program file list, data file list, complete ladder-logic printout, address assignment listings for all Data Files/Bits.

   g. Complete documentation concerning the Operator Interface and its database/address assignment.

   h. Complete documentation of the Clear Scada Screens and its database/address assignment, similar to that above for the operator interface. Include configuration/setup listings that were used for the SCADA programming. Manual shall contain a copy of the most current SCADA system project back up. It will also

include a back up of any include projects and the “Clear Scada.ini” file for all the automation computers.

i. Complete electronic copy (disk or CD-ROM) of the PLC ladder logic program. The licensed copy of the programming software as specified. The electronic copy shall contain the actual PLC program and not a PDF version of the program.
j. Complete electronic copy (disk or CD-ROM) of the operator interface program. The licensed copy of the programming software for the operator interface where required.
k. Complete electronic copy (disk or CD-ROM) of the Clear Scada Screen files and any other configuration files that are specific to the configuration/setup for the facility. Include a copy of the most current 3D model files used for the SCADA screens in the native format of the software.
l. Instrumentation Calibration Sheets and Settings Reports for all instruments as specified herein.
m. Alarms listings with clear descriptive messages. Alarm messages shall have the instruction address included in it.
n. A copy of the memory maps from PLC to PLC and all other devices such as power monitoring equipment. The electronic copy of the O&M manual shall contain the actual Excel file for the IO map and not a PDF version of the actual file.
o. Provide complete electronic file document library including AuotCAD files for all of the drawings, word processing files for all of the training and the sequence of operation.
p. System specifications.
q. Electrical power requirements.
r. Explanation of internal fault diagnostics.
s. Recommended spare parts list.

D. RECORD DRAWINGS

1. Record Drawings shall accurately show the installed condition of the following items:

   a. Underground raceway and duct bank routing.
   b. Field locate all in ground or above ground pullboxes.
   c. Field locate all in ground or above ground splice boxes.

2. Legibly record all existing conditions to scale on a set of Project Contract Drawings, (the "Record Drawings") or hand sketched drawings. Engineer and or LCU may be able to assist with providing scaled aerials or site plans to mark-up.
3. Submit a schedule of new fiber optic raceways, colors and numbers. Including the following information: Circuit origin, destination fiber color, and buffer tube color. Field wiring terminal strip names and numbers.
4. Submit a Control Network Rack schedule and label all cables to match schedule.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Master Station (MPS) electrical control equipment shall be wall mounted NEMA 3R enclosures of approximately 48”High x 36" wide x 12” in depth. The cabinet shall be arranged to separate the incoming field terminal interface blocks and surge suppression from the PLC I/O signals in the cabinet. See Drawing for arrangement details. Additional enclosures shall house the motor monitor units and the Backup Pump Controller.

B. PLC enclosures shall include the following features:
1. Internal Light with toggle-Switch
2. Internal Service Power Outlets
3. Uninterruptible Power Supply (UPS)
4. UPS Bypass-Switch
5. Door Activated Switch for Intrusion Alarm
6. Drawing Pockets in the back side of the door
7. Laptop Ethernet Connection

C. The software written for this application shall be in ladder logic and provide a flexible, configurable and expandable control system for the pump station. The vendor shall provide a licensed copy of all software used in this project and registered to Lee County. All ladder code provided with this contract shall be documented so that an experienced programmer can easily make modifications to the software without having to go back to the original vendor for information. Documentation shall be approved by the Engineer before final acceptance of the software. Lee County Utilities shall be the owner of the ladder logic program integration and shall have its unlimited use.

D. Components: All motor branch circuit breakers; motor starters and control relays shall be of highest industrial quality, securely fastened to the removable back panels with screws and lock washers. Back panels shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component. A circuit breaker shall be provided on each control panel as a means of disconnecting power to the control panel. Control transformers shall be installed where shown to provide 120VAC and 24VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. The transformer secondary shall be grounded on one leg.

E. All internal control panel wiring shall be identified at both ends with type written heat shrinkable wire markers with the numbering system shown on the control submittal drawings.

1. Control wiring shall be stranded copper, minimum size #1 AWG (except for shielded instrumentation cable may be #18 AWG), with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation. Each control wiring conductor shall have heat shrink identification labels on each end of termination. Terminations shall be made to screw terminal strips. All points of terminal strips are to be labeled to match conductor labeling. Control wiring shall be SIS or XHHW insulated; PVC insulated wire is not acceptable.

F. The control panel shall be provided with nameplates identifying each component, selector switches, pilot lights, etc. Nameplates shall be permanently affixed

using an epoxy process. Nameplates shall be laminated plastic, engraved white letters with a black background.

G. Corrosion Inhibitor Emitter: Provide an industrial corrosion inhibitor emitter, on all exterior mounted control panels that will protect internal components of the control panel from corrosion. Provide 1 year supply of spare corrosion inhibitors for each control panel.

H. Fused terminal blocks shall be provided for analog inputs and outputs. Blocks shall be permanently marked to indicate the appropriate I/O address of each circuit on the pump controller. Terminal strips shall be switch type with integral fuses equal to Allen Bradley 1492-H6. Wiring from the control panel to the terminal strips shall be factory installed. All spare conductors shall be terminated and identified.

I. The assembled system shall include circuit breakers, fuse blocks and other electrical components as required by the application and in accordance with the standard requirements of the National Electric Code as well as all State and Local electrical code requirements.

J. All I/O racks, processor racks and power supplies shall be grounded in accordance with the manufacturer's specifications.

K. All push-buttons, switches and other operator devices shall be UL listed and/or CSA approved and sufficiently large and durable to provide dependable, long life operation. Provide 30mm devices.

L. All cables, plugs, connectors and receptacles requiring user field installation shall be designed to withstand an industrial environment.

M. Surge suppressors shall be provided for all analog inputs and outputs and digital inputs that leave or enter the PLC and local control cabinets. Provide EDCO type HSP-121 surge suppressors for 120VAC power supply to all control panels. Provide Erico type UTB series for all digital circuits entering the PLC and local control cabinets. Provide Erico UTB series for all analog signals entering or leaving the PLC control panels.

N. RELAYS

1. Control circuit switching shall be accomplished with relays. These relays, for interfacing and control applications, shall be the compact general purpose plug-in type having low coil inrush and holding current characteristics. An LED status-indicating light shall be provided with each relay. Contact arrangements shall be as noted or shown, and shall be rated for not less than 10 amperes at 120V ac or 28V dc. Coil voltage shall be as noted or shown. Non-latching relays shall have a single coil. Latching relays are not acceptable. Relays shall have plain plastic dust covers, test buttons, and mounting sockets with screw terminals and holddown springs. Relays shall be UL recognized. Relays shall be Square D or Allen Bradley, Omron or approved equal.

2. Time on delay functions shall be accomplished with Square D 9050JCK60V20 time relays. Provide RK electronics CFB24D-7-2M relay for time off delay applications. Units shall be adjustable time delay relays with the number of contacts and contact arrangements as shown. A neon status-indicating light shall be provided with each relay. Contacts shall be rated for 10 amperes at 120V ac. Integral knob with calibrated scale shall be provided for adjustment of time delay. Initial setting shall be as shown with time delay range approximately three times the initial setting. Time delay rangeability shall be at least 10:1. Operating voltage shall be 120V ac, plus 10 percent, -15 percent at 60-Hz. Operating temperature shall be -20 degrees F to 165 degrees F. Repeat timing accuracy shall be plus or minus 10 percent over the operating range. Units shall be Socket-mounted relays, octal plug-in, adjustable range as shown on drawings, equal to Amerace Corp., Control Products Division, Agastat Series 7000, Cutler-Hammer Series D87, Square D, Allen Bradley or Omron
3. All relays shall have a screw terminal interface with the wiring. Terminals shall have a permanent, legible identification. Relays shall be mounted such that the terminal identifications are clearly visible and the terminals are readily accessible.

O. PANEL OPERATING CONTROLS AND INSTRUMENTS

1. All operating controls and instruments shall be securely mounted on the interior deadfront as detailed on panel enclosure drawings. All controls and instruments shall be clearly labeled to indicate function.
2. Indicator lamps shall be LED full voltage push to test type and mounted in NEMA 4X (800H) 30mm modules, as manufactured by Allen Bradley or SKPI as manufactured by Square D. Lamp modules shall be equipped to operate at 24 or 120 volt input. Lamps shall be easily replaceable from the front of the control compartment door without removing lamp module from its mounted position. Units shall be heavy-duty, oiltight, industrial type with screwed on prismatic glass lenses in colors as shown, and shall have factory engraved legend plates. LED's shall be high illumination type (5ma at 130V ac).
3. Selector switches shall be 30mm heavy-duty, oiltight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size, black field, legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as shown. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Units with up to four selection positions shall be Allen Bradley 800H, Square D Type K, Cutler-Hammer Type T, or equal.

2.02 PROGRAMMABLE LOGIC CONTROL SYSTEM

A. The control system integrator shall furnish programmable controllers (PLC's) as specified herein and as shown on the Drawings. PLC's shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein.

B. The programmable controller shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0^{o} - 60^{o} Celsius and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz and be provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

C. System configuration shall be as shown on the drawings. PLC's shall be Allen-Bradley Compact Logix 1769-L32E or better with Ethernet Network module as manufactured by Rockwell Automation. The PLC shall include provisions for automatically updating time for changes in daylight savings time. Time shall be automatically synchronized with the plant SCADA system every twenty-four hours. Time changes shall be automatically sent from the plant SCADA system to the remote PLCs.

D. The processor and its associated memory shall be enclosed in a modular enclosure. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output.

E. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level.

F. Create a master memory map that shall document every tag that is passed from one PLC to another. Tags that pass directly from the SCADA to a PLC do not need to be placed on this memory map. Memory map shall document which devices or PLC’s originate messages, and which devices or PLC’s receive messages, and what tags/address are passed back and forth.

G. Provide a user interface for operations and configuration. Provide an C-MORE HMI 12” touchscreen display. The display shall provide status of the pump station, control of pumps, resetting of faults, and configuration of parameters. The following parameters shall be displayed on the main screen: Level, Setpoints for alarms and pump start/stop, Pumps running/stopped, Pump available, Pump fault. The screen will also have buttons to allow the user to access Faults, and Settings. The following parameters shall be available via a user key press from the main screen: Status of all I/O. All parameter settings shall be password protected.

H. The main screen shall include a Fault button which takes the user to a Fault screen and allows them to check all current and unacknowledged alarms. The fault screen will detail the fault (e.g. VFD fault, seal fault, motor overtemp, over-current, etc) along with date/time each fault occurred and cleared. A reset option for a fault will be presented to the user when faults can be acknowledged and reset.

I. The user interface should allow password protected intuitive configuration of the system, including as a minimum:

1. Set-points, including alarm and pump setpoints.

2. Level alarms setpoints
3. Start, stop and alarm delays
4. Alternation/ fixed sequence of pumps
5. Assign pre-defined (or user-defined) faults, e.g. thermal overload, contactor fail, to any digital input
6. Zero and span analog inputs

J. Provide eight spare digital inputs and four spare digital output; two spare analog input and analog output for future designation.

2.03 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be Allen Bradley 1769 series point I/O (as appropriate for the CPU) plug-in modules in associated I/O rack assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active prewired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O rack space for the addition of future circuit cards or modules.

B. Discrete inputs shall be a 120VAC signal (integral to PLC) from dry field contacts. Discrete outputs shall be relay type output modules. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Maximum density for discrete I/O modules shall be 16 per input module and 16 per output module.

C. Analog input circuits shall be isolated, 12-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. Analog input modules shall be capable of receiving 4-20 mA signals. Analog outputs shall be coordinated with the receivers but shall be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Maximum density for analog I/O modules shall be 8 per module.

D. The modules shall be connected to wiring arms which can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals.

E. External power supplies shall be provided with the PLC as required to meet 150% of the specified installed I/O power requirements plus spares under full load conditions. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC. Power supplies shall be furnished with isolated lightning/surge protection systems.

2.04 CELLULAR ROUTER or FIBER BASED TELEMETRY SYSTEM

A. The Contractor shall furnish, test, install and place in satisfactory operation a mixed media Ethernet Industrial Protocol (IP) network. The network topology will

vary by location but basically consists of a combination of unshielded twisted pair (UTP) Cat-6 copper cable within control panels and single mode fiber optic cable from control panel to control panel or control panel to plant. Each connected device shall be equipped with its own network interface unit. The well PLCs will communicate with an existing SCADA system via single-mode fiber optic cable or cellular routers using TCP/IP protocols. A power monitoring system shall also communicate to the SCADA system via single-mode fiber optic cable using the TCP/IP protocols. Existing Human Machine Interfaces (HMIs) are located in the plant control room and will be modified by the CONTRACTOR to include the new Station.

B. For locations utilizing Fiber Optic communication, provide for an Ethernet/IP communications with the Central Telemetry SCADA system through a CAT6 UTP copper connection to the fiber optic backbone as shown on the drawings. Coordinate with the fiber optic contractor for connection to the fiber backbone switch and facilities for the IP addresses required. Provide a combination media converter/ unmanaged 100 base-T Ethernet switch in the Fiber optic conversion cabinet.

C. For locations utilizing cellular communication, provide for an Ethernet/IP communications with the Central Telemetry SCADA system through a CAT6 UTP copper connection to the owner provided Vanguard 3000 cellular router. Provide an unmanaged 100 base-T Ethernet switch in the Radio conversion cabinet.

D. Bi-directional communications between the fiber ready network and network connected equipment shall be provided by 10/100 base-T unmanaged Ethernet switches.

E. Each individual PLC shall be connected to the network via a dedicated 10/100 Base-T Ethernet port on its Ethernet module. The PLC Ethernet module shall be connected to the Ethernet switch located in the media(fiber or cellular) conversion cabinet. The PLC Ethernet Communication Interface shall provide for a minimum 100 M Baud TCP/IP network. True duplex peer-to-peer, networking shall be supported.

F. For locations utilizing cellular communication, install Modbus TCP/IP and Ethernet Citect drivers to allow direct communication of power monitoring media converters and control system switches through the cellular router to the existing Citect Global central server at LCU central operations facility.

2.04 PUMP STATION CONTROLLER OPERATION

A. The programmable logic controller (PLC) system shall perform all logic operations necessary to sequence and alternate the pumps to accomplish proportional level control and to ensure equal run times on all pumps. The PLC shall also automatically select one or multiple backup units in the event of a single or multiple pump failure. The PLC shall interface with the VFD's through discrete and analog module interfaces. The PLC coordinates the operation of the pump drive system; monitors status of the complete plant operation and provides

the SCADA interface. In normal operation the PLC shall schedule the pumps on and off to maintain wetwell level. The level control parameters will be based on values set by the operator from the HMI graphic screen. The initial wetwell proportional values are as indicated on the drawings. The control levels set by the operator are to be checked by the PLC to be within the minimum and maximum limits established. Initial minimum low level limits will be 48" above wetwell floor to protect pumps from running dry. Initial maximum high level control limit, high level alarm, start back up control for pump 1, start backup pump 2 will be set at start-up as directed by the County. Also provide virtual high level alarms from the level transmitter signal at 3" above high level control range.

B. The following operating modes shall be required for the pump controller:
   1. Maintain the wetwell level established by the proportional level control system, automatically and without regard to system flow. The turn on and turn off each pump (lead, lag and lag-2) based on high level range corresponding to 100% speed; and operator configurable with the initial values as indicated on the drawings. The pump controller shall insure speed matching of all VFD driven pumps. Speed matching shall be compared with monitored speed of each pump with a 5% pump speed deviation alarmed.
   2. Allow or disallow automatic operation of each pump via telemetry or locally from the local operator interface.
   3. The VFD external fault indication will provide for automatic pump shutdown on motor monitor relay system temperature high fault. Provide for operator initiated remote stop for other pump alarm conditions. Provide for SCADA password protected override of motor monitor system auto shutdown. An external (temperature) fault will require manual resetting and shall not be reset remotely via SCADA. VFD internal faults may be reset remotely via SCADA.

C. For each Drive in the system, the controller program shall control the RUN command and specify the operating mode (LEAD, LAG, LAG-2) of the pumps. The software internal to the controller shall coordinate the Drives to allow a lower priority pump to move up in the priority string in the event of the next higher pump is faulted. The drives will be hardwired control and monitored through an Ethernet connection. Provide start/stop, speed setpoint, speed feedback, drive fault and not-in-auto hard-wired control. All other parameters will be available through an Ethernet/IP connection.

D. As the level in the wetwell increases to the 100% level range (lead pump running at full speed), a signal shall immediately activate and latch to call on the lag pump. The lag pump will come on line and quickly ramp up and match the speed of the lead pump (10 second ramp). All VFD driven pumps will operate as speed matched units. As the level continues to rise and the Lead and Lag pumps are running at full speed, the level again reaches the 100% level range, a signal shall activate and latch to call on the Lag-2 pump. After the lag pump is called on a countdown timer (initial set of 45 sec) is set before the lag-2 pump is called on.

E. As demand decreases and wetwell level decreases, the Pump controller shall stage off the lag and lag-2 pumps based on "lag pump stop" elevations. As flow decreased further the lead pump ramps down based on level to minimum speed. The minimum speed is maintained until the level drops further to a "stop lead pump" wetwell level setpoint. The lead VFD pump shall be alternated on each operation based on the VFD pump with the least hours. Provide operator initiated

rotation of lead pump unit. The operator configurable VFD minimum speed shall be programmed into the VFD (initially 42hz). The critical setpoints such as pump start stop points, time delays, alarm setpoints shall be adjustable from the central station SCADA and located within a maintenance settings screen with limited access.

F. A backup pump controller shall override the control to the VFDs on initiation of a high-high level switch operation. The VFDs shall be programmed to start and run at a pre-determined speed until a low level float activates.

H. The control signals to and from the Pump Control Panel (PCP) shall be as shown in the PLC I/O list in the appendix. Provide for virtual alarm and setpoint signals.

2.05 DATA ACQUISITION AND GENERAL CONTROL LOGIC

A. Not in AUTO Alarms: Before operating any field device, the PLC program shall check to see that the device has been switched to the AUTO mode. If the device is not in AUTO, the PLC shall set an error bit and suspend control of the device until it is switched to AUTO.

B. No Response Alarm: If at any time a field device fails to respond to an output command from the PLC, the PLC shall set an error bit. The SCADA shall use the error bit to log a "No Response" alarm.

C. Adjustable Timers: The preset values for all PLC timers shall be adjustable through the HMI software by the operator under security password clearance.

D. PLC Diagnostic Alarms: In addition to the alarm conditions shown on the P&IDs, each PLC shall monitor its Central Processing Unit (CPU) and I/O modules. When the CPU or any I/O module fails, the PLC shall generate a PLC FAIL alarm.

E. Process Variable Filtering: Each analog process variable being transmitted to the SCADA shall have adjustable digital filtering applied.

F. Totalizer Current Average Value: The current average flowrate for each totalized value shall be provided for each flowrate input.

G. Flowrate Integration: Flowrate integration shall be provided for each analog flowrate input.

H. Daily Average: Daily average calculations shall be provided as required to support displays and reports.

I. Daily Totalizer Counter: Accumulate daily total over Ethernet signal. The totalizer shall be reset daily when the daily reports are produced.

J. Monthly Totalizer Counter: Accumulate daily total flow over Ethernet signal. The totalizer shall be reset monthly when the monthly reports are produced.

K. Cumulative Totalizer Counter: Accumulate total over flow over Ethernet signal.

L. Run Time: Each piece of equipment shall have a run timer, which accumulates time.

2.06 RADAR LEVEL TRANSMITTER

A. Provide non-contact level transmitters to sense the liquid level of the wetwell. The unit shall consist of a radar sensor and antenna system to provide continuous monitoring of the wetwell level. Provide IP68 plastic horn antenna. Provide connection cable with strain relief wire of Kevlar to hook mount antenna.

B. Provide transmitter with 4-20madc output, loop powered type, with output signal directly proportional to the measured level. Excitation range 9-35vdc.

C. Provide VEGAPULS WL 61 with 15m(49.21ft) max measuring range.

2.07 BALL FLOAT SWITCHES

A. Units shall be direct-acting float type level sensing device. The switch shall be chemical resistant polypropylene, normally open, type-S suspended type with built-in weight. The float cable shall be rated "continuous service" for high flexibility. All mounting hardware shall be 316 SS. All float fittings shall be flared and incorporate strain relief jacketing.

B. Cable shall be rugged and flexible with heavy neoprene or PVC jacket. The actuation/deactivation differential shall not exceed 4 inches. Units shall be pipe mounted or suspended type as noted, and provided with 40 feet of cable unless otherwise noted. Each pipe mounted type shall be provided with a clamp to secure the cable to 1-inch support pipe.

C. Each suspended type shall be provided with necessary brackets and clamps to suspend the unit from the top of a tank or vessel. The suspended type shall include an integral weight assembly for stabilization and positive operation of the unit. All mounting clamps shall be PVC or neoprene.

D. Provide Anchor Scientific suspended type Roto-Float switch.

2.08 PROCESS METERS

A. Process Meters: Provide digital programmable process meters designed for a 4-20mA current loop display and isolated retransmission of displayed output. Provide minimum 0.5" high, 4-1/2 digit LED display to indicate amplitude of current in the current loop and calibrated to engineering process units. In general, a loop current of 4mA corresponds to a display indication of 0 percent and a loop current of 20ma corresponds to a display indication of 100 percent. The meter shall be provided with programmable internal scaling adjustment. Provide units with NEMA-4X faceplate rating constructed of silicone coated Lexan and gasketed for NEMA 4 requirements; circuit boards coated for moisture resistance.

B. Provide YOKOGAWA UM33A or equal indicators.

2.9 ISOLATING TRANSMITTERS: CURRENT-TO-CURRENT ISOLATING TRANSMITTER

A. Unit shall receive 4 to 20 mA dc input signal and shall produce an isolated, proportional 4 to 20 mA dc output signal into loads in the range of 0 to 1,200 ohms minimum without load adjustments for a 24V dc supply. Input impedance shall be less than or equal to 50 ohms. Unit accuracy shall be plus or minus 0.25 percent of span, minimum. Unit shall be provided with multi-turn span and zero adjustments.

B. Unit shall be housed in a NEMA 1 rated enclosure and shall be furnished with an integral bracket for rear-of-panel mounting, unless otherwise noted. Unit shall have input/output and power isolation. Unit shall operate on 120-volt, 50/60-Hz power.

C. Provide isolating transmitters where required by system conditions. Unit shall be Moore Industries SCT/ECT/MIX or equal.

2.10 SPARE PARTS

A. Provide as part of this contract a complete compliment of replacement spare parts for all component parts of this system. It shall be the supplier's responsibility to prepare a detailed suggested replacement parts list for review and approval by the Owner.

B. As a minimum, the controls system supplier shall furnish one plug-in module for each type of control module used in the system; CPU module, one analog input module; one analog output module; one digital input module; one digital output module; two of each relay; one of each type power supply; one of each type Ethernet switch; 2 each type signal surge suppressor; two sets complete of each type fuse; two of each length patch cords; two of each pilot light; 12 fiber cable connectors; one level instrument; one ball float.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The work included in this section consists of furnishing, installing and placing in operation the instruments and appurtenances, including all conduit, wiring and circuitry, necessary to provide the Owner with a fully operable system properly calibrated and installed.

B. Include the services of a factory trained, qualified service engineer of the equipment manufacturer to inspect the complete equipment installation to assure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment furnished.

C. All workmanship utilized in the manufacture and installation of this system shall be of the highest quality and performed in a manner which is consistent with all accepted practices for industrial controls.

D. Provide continuous protection of the installed instrumentation equipment from the elements, moisture, construction damage, dust, debris, paint spatter or other

conditions which will adversely affect the unit operation until such time as the equipment is scheduled for start-up testing.

3.02 MOUNTING OF EQUIPMENT AND ACCESSORIES

A. Install and mount equipment in accordance with the Contract Documents, manufacturer's instructions and installation detailed shop drawings. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock and vibration; and freedom from interference with other equipment, piping, and electrical work. Do not install field enclosures, cabinets, and panels until heavy construction work adjacent to the equipment has been completed to the extent that there shall be no damage to the equipment.

B. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.

C. Coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

3.03 CALIBRATION

A. Calibrate each instrument in the factory before shipping and furnish with the calibration data and the certification of calibration.

B. The service technician shall calibrate all instruments and components of the instrumentation system with field adjustable ranges and/or settings after installation in conformance with the manufacturer's instructions, the Contract Documents and the reviewed shop drawings. Set each instrument and components for the specific conditions and intended application as specified for this installation. Replace defective instruments and components which cannot achieve correct calibration of stated accuracy, either individually or collectively within the system.

D. Certify in writing to the Owner that all calibrations have been completed and the instrumentation system is ready to be operated. Provide instrumentation calibration sheets in the O&M manuals for future reference for both factory and field calibration tests. Calibration certification documents shall be available on site at the time of substantial completion. Certification documents shall include the signature of the service technician performing the calibration.

3.04 GENERAL TESTING REQUIREMENTS

A. All system start-up and test activities shall follow detailed test procedures, check lists, etc., submitted and previously approved by the Engineer and LCU. The Engineer and LCU shall be notified at least 21 days in advance of factory system tests and reserves the right to have his and/or the Owner's representatives in attendance.

B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor shall maintain master log books for each phase of installation, startup and testing activities specified herein. Log book shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified here.

D. All test data shall be recorded on test forms, previously approved by the Engineer and LCU. When each test has been successfully completed, a copy of all test results shall be furnished to the Engineer and LCU together with a statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

3.05 START-UP SUPERVISION

A. The system supplier shall provide a qualified service technician to inspect all final connections and check the system prior to start-up of the system. The service technician shall coordinate with the owner's representative for functional check-out of the complete system.

B. A system software engineer shall be provided on site during start up of the pump stations to make adjustments to the Control Computer/ Operator Interface and tune the system as deemed necessary by the Engineer.

C. System verification marking end of supplier’s on-site start-up obligations will be issued after system functionality can be demonstrated for a period of 168 continuous hours without interruptions due to error on the part of the supplier.

D. At least two qualified control systems technicians shall be provided by the Contractor when loop checkout is being performed and at least one for all other control system startup and test activities.

E. The control system integrator's startup personnel shall be present and coordinate with all other startup and testing activities especially the pump, standby power system and variable frequency drive startups.

3.06 INITIAL FIELD TESTING

A. All system start-up and test activities shall follow detailed test procedures, test report, check lists, etc., submitted and previously approved by the Engineer and LCU

B. Control system start-up and testing shall be performed to ensure that all pump station processes shall be systematically and safely placed under digital control in the following order:

1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified.
2. Each final control element shall be individually tested by Contractor.
3. Each instrument and control loop shall be tested by Contractor.
4. Each control strategy shall be tested under automatic control as specified by Contractor.

5. The entire control system shall be tested for overall monitoring, control, communications, and information management functions, and demonstrated for system availability as specified.

C. System start-up and test activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.

D. Verify that each instrument, meter, and gage has been properly installed, connected, grounded and calibrated. Perform three-point calibration on continuous elements and systems. Provide calibration records.

E. Verify that the input/output functions of each instrument conform to the requirements of the application.

F. Exercise each system as defined by each loop description through operational tests to demonstrate that it performs as intended on a continuing basis and to demonstrate the integrity of the system.

3.07 LOOP CHECKS

A. Prior to control system startup and testing, each monitoring and control loop shall be tested by the Contractor and System Integrator on an individual basis from the primary element to the final element, including the RTU Controller I/O, PLC I/O module and PLC data table, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer and LCU. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all analog inputs shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the PLC, RTU or work station.

D. Final control elements and ancillary equipment shall be tested to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and local automatic (where provided) control circuits.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor and the Engineer/Owner upon satisfactory completion.

3.08 INITIAL START-UP TESTING

A. Perform satisfactory Contractor's initial start-up and functional test prior to demonstration for Owner and Engineer.

B. After the field testing has been successfully demonstrated, a date for system start up involving the Owner's operating personnel will be scheduled as agreed to by the Owner. Notify Engineer fourteen (14) days prior to initial start-up of each item of equipment.

C. Have Contract Documents, shop drawings, product data, and operation and maintenance data at hand during entire start-up process.

D. Provide control diagrams that show actual control components and wiring.

E. Coordinate sequence for initial start-up of various items of equipment

F. Verify control systems are fully operational in automatic and alternate modes of operation.

G. Start up and test the instrumentation equipment with the entire system operational. Conduct start-up and initial functional testing.

3.09 STARTUP AND FUNCTIONAL TESTING, DEMONSTRATION FOR OWNER AND ENGINEER

A. Perform pre-startup inspection of installation. Perform startup under no-load conditions, if possible. Observe noise, vibration and operation. If all operating characteristics are normal, proceed with startup. Operate equipment and systems under all load conditions and confirm all operating characteristics are normal. If normal operation is observed, proceed with witnessed functional test and performance test as required.

B. Perform functional and performance tests under supervision of responsible manufacturer's representatives, control system integrator, and Contractor personnel. Representatives of Owner and Engineer shall witness functional test. Perform functional and performance tests on each piece of equipment and operational system as specified in the individual product sections.

C. Demonstrate that equipment operates and complies with specified performance requirements. Demonstrate that control panel functions, including failures and alarms operate and comply with specified performance requirements.

D. Functionally test failures and alarm conditions; or if approved by Engineer simulate by jumping failure input terminals. Provide signal generators that simulate control conditions if it is not feasible to create actual conditions. Testing activities shall include the simulation of both normal and abnormal operating conditions.

E. Use Operation and Maintenance manuals, loop descriptions, submittals, graphic screens, etc., to demonstrate operation of equipment. Use actual as-built control diagrams in demonstration of functions.

F. Each control strategy shall be tested by the Engineer to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control

modules, and for adjusting and testing all control loops as required to verify specified performance.

3.10 WARRANTY

A. All products mentioned herein must be warranted by the supplier for a period of Two (2) years from the date of system turnover; final acceptance.

B. An unconditional warranty shall be provided for all equipment supplied for Two years from date of final acceptance of system by the Owner. THIS WARRANTY SHALL INCLUDE ANY DAMAGES CAUSED BY LIGHTNING INDUCED ELECTRICAL SURGES; ONLY DAMAGES CAUSED BY DIRECT LIGHTNING STRIKES TO THE BUILDING STRUCTURE (AS DETERMINED BY THE ENGINEER) SHALL BE EXCLUDED FROM THE WARRANTY. Theft, fire, vandalism and floods shall be excluded from the warranty except for fire damage which originates at equipment which is provided as part of this work.

F. CONTRACTOR shall issue two copies of a written warranty to the OWNER.
1. The warranty shall be a legal and binding document.
2. Warranty shall include the start and end date of the warranty period.
3. Warranty shall include the OWNER'S and CONTRACTORS name.

G. Warranty calls shall be broken into two categories, emergency and non-emergency. Whether the warranty call is emergency or non-emergency shall be dictated by the OWNER.
1. An emergency warranty call shall be responded to within 8 hours of the call, whether during business hours or not.
2. A non-emergency warranty call shall be responded to within 48 hours of the call, whether during business hours or not.

H. Telephone support for operating procedures and non-hardware problems shall be provided on an unlimited basis during the warranty period.

3.11 TRAINING

A. The system supplier shall provide a minimum of three (3) days of training instruction to the owner's personnel to include; one day operator training; and two days PCP and Controls system maintenance training including software maintenance training.

B. Training shall not occur until after completion of successful functional testing and performance testing. Provide training while equipment is fully operational

C. Training shall not occur until after review and approval of system O&M manuals. Use accepted Operation and Maintenance manuals as the basis of instruction.

D. Submit to OWNER not less than 14 days prior to each training session an outline of the training program and the qualifications of the trainer(s).

E. Coordinate services with the OWNER, with a minimum of two week's notice.
1. Training shall be held to accommodate OWNER'S schedule.

F. Training services are exclusive of travel time to and from the facility. The times specified shall not be construed as to relieve the manufacturer of any additional

visits to provide sufficient service to insure equipment is in satisfactory and continuous operation.

G. Trainings should be geared to not only impart knowledge of the control functionality of the new control system but also some background understanding of how and why things work.

H. Onsite Operations Staff Training Sessions shall be held over two full days. A full day training session shall cover all necessary material. Between the two different days all operations staff should be able to attend at least one training session.

I. Training Manual
   1. The operations staff training shall be based on the training manual created by the CONTRACTOR.
   2. All training manuals shall be provided with color graphics.
   3. The training manual shall provide DETAILED working knowledge of the control of the plant and how to use the SCADA interface.
   4. Each SCADA control object, whether it be a display field, push button, or set point field shall be specifically called out and its purpose explained.
   5. The underlying theory of why something is controlled shall be explicitly explained.
   6. All faults and permissives that affect the operation of equipment shall be explicitly called out.
   7. All set points shall be recorded under a separate section titled “Set Points.” An explanation of how the set point value was determined shall also be included next to the set point value.
   8. EACH section of the training manual shall include a 10 question quiz. Answer key for each quiz shall also be provided, but not as part of the training manual.
   9. The training manual will be used as the basis for the INITIAL Operations Staff Training Sessions. At the end of EACH section covered in the training manual the CONTRACTOR shall administer the 10 question quiz. At the end of the quiz the CONTRACTOR shall review the quiz with the operations staff and discuss what the correct answer was for each quiz question. Operations staff shall be allowed to keep their quizzes for further study.
   10. The training manual will be used as the basis for the FINAL Operations Staff Training Sessions. At the end of EACH section covered in the training manual the CONTRACTOR shall administer the 10 question quiz. At the end of the quiz the CONTRACTOR shall collect all quizzes, seal them in an envelope and give them to OWNER Process Control Engineer for grading.
   11. The course shall cover the following subjects, as a minimum:
      a. SCADA overview in which the basic systems design, configuration, and purpose is covered.
      b. DCS hardware in which the specific hardware elements and specific configurations provided are covered.
      c. How the actual PLC programs operate.
      d. Programmer equipment orientation in which the student becomes familiar with the operation and operational maintenance procedures.

e. Specific application program instruction covering the overall design and philosophy of the applications as provided under this contract. The intent shall be to make the student fully knowledgeable in all aspect of the system provided, along with methods for making additions, modifications, and deletions to the SCADA.
f. Complete systems backup and reload procedures.
g. Diagnostic software details including capabilities, usage, and interpretation of results.

END OF SECTION

Lee Country Utilities Pump Station Standards
MPS 6600 / LS 616 / LS 617 - PLC I/O List

DESCRIPITION	SOURCE	TYPE	STATUS
Effluent Pump 1	VFD 1	DI	IN AFC MODE
Effluent Pump 1	VFD 1	DI	IN BYPASS MODE
Effluent Pump 1	VFD 1	DI	RUNNING
Effluent Pump 1	VFD 1	DI	IN REMOTE
Effluent Pump 1	VFD 1	DI	IN LOCAL
Effluent Pump 1	VFD 1	DI	INTERNAL FAULT
Effluent Pump 1	VFD 1	DI	EXTERNAL FAULT
Effluent Pump 1	VFD 1 (1)	DI	CHECK VALVE
Effluent Pump 1	VFD 1	DO	START/STOP
Effluent Pump 1	VFD 1	AO	SPEED CMD
Effluent Pump 1	VFD 1	AI	SPEED FB
Effluent Pump 1	VFD 1	DO	RESET
Effluent Pump 1 Leakage	MMP	DI	ALARM
Effluent Pump 2	VFD 2	DI	IN AFC MODE
Effluent Pump 2	VFD 2	DI	IN BYPASS MODE
Effluent Pump 2	VFD 2	DI	RUNNING
Effluent Pump 2	VFD 2	DI	IN REMOTE
Effluent Pump 2	VFD 2	DI	IN LOCAL
Effluent Pump 2	VFD 2	DI	INTERNAL FAULT
Effluent Pump 2	VFD 2	DI	EXTERNAL FAULT
Effluent Pump 2	VFD 2 (1)	DI	CHECK VALVE
Effluent Pump 2	VFD 2	DO	START/STOP
Effluent Pump 2	VFD 2	AO	SPEED CMD
Effluent Pump 2	VFD 2	AI	SPEED FB
Effluent Pump 2	VFD 2	DO	RESET
Effluent Pump 2 Leakage	MMP	DI	ALARM
Wetwell Level	LIT	AI	Level
Wetwell P1 High Level	BUPCP (2)	DI	ALARM
Wetwell P2 High Level	BUPCP (2)	DI	ALARM
Backup Pump Controller Fault	BUPCP (2)	DI	ALARM
Flowmeter	FIT	ENET	Flow Rate
ATS- Test (start gen & transfer)	ATS (4)	DO	GEN TEST
ATS -Utility Power Failure	ATS (4)	DI	STATUS
ATS-Utility Service Supplying load	ATS (4)	DI	STATUS
ATS-In Emergency Status	ATS (4)	DI	STATUS
ATS-Emergency Source Available	ATS (4)	DI	STATUS
ATS-Utility Service Source Available	ATS (4)	DI	STATUS
ATS Common Alarm (trouble)	ATS (4)	DI	ALARM

Genset Alarm Shutdown	Genset (4)	DI	Shutdown
Genset Common WARNING	Genset (4)	DI	WARNING
Genset Battery Charger alarm	Genset (4)	DI	ALARM
Genset Not in Auto	Genset (4)	DI	ALARM
Genset Tank Leak Alarm	Genset (4)	DI	ALARM
Genset Fuel Tank level	Genset (4)	AI	0-100% FUEL
Genset Running	Genset (4)	DI	STATUS
Electric Room High Temperature	HVAC Control Panel (3)	DI	ALARM
PLC AC Power Failure	PLC Panel	DI	ALARM
PLC UPS Battery/Low Voltage	PLC Panel	DI	ALARM
PLC DC Power Failure	PLC Panel	DI	ALARM
PLC Cabinet High Temperature	PLC Panel	DI	ALARM
PLC Panel Intrusion	PLC Panel	DI	ALARM
Odor Control	Odor Control Pnl (3)	DI	FAULT
Odor Control	Odor Control Pnl (3)	DI	RUN
Mixer	MCP (3)	DI	FAULT
Mixer	MCP (3)	DI	RUN
FOCC or CRCC Intrusion	FOCC OR CRCC	DI	ALARM
Diesel Pump Running	Diesel Pump CP (3)	DI	RUNNING
Diesel Pump Common Alarm	Diesel Pump CP (3)	DI	ALARM
Diesel Pump Remote Call To Run	Diesel Pump CP (3)	DO	CALL TO RUN

(1) NOT USED
(2) INTEGRAL TO PLC PANEL
(3) MPS 6600 ONLY
(4) MPS 6600 AND LS 616 ONLY

SECTION 43 21 13

DIESEL BACKUP PUMP SYSTEM

PART 1 - GENERAL

1.1 PROJECT SCOPE

A. Requirements for providing a diesel driven sound attenuated pump, mounted on a skid.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1 – General

B. Division 9 – Finishes

C. Division 26 – Electrical

D. Division 40 – Instrumentation and Controls

1.3 SYSTEM DESCRIPTION

A. The pump specified in this section will be used to pump raw sewage in applications requiring a suction lift.

B. The pump and accessories shall be supplied by the pump manufacturer.

C. The pump shall be fitted with a fully automatic priming system incorporating an air compressor, air ejector assembly, and an air/water separation tank. No water shall be required in the pump to achieve a prime. The air ejector shall operate on the discharge side of the compressor, eliminating the possibility of water being drawn into the air source. The pump must be capable of running totally dry for extended periods.

D. It shall contain no moving parts or protective float gear. The priming system must be cast as part of the pump assembly. Self-priming pumps with an added priming system will not be accepted. A demonstration of the pump's ability to repeatedly cycle from pump/snore/repriming/pump shall be required.

E. Pump and priming system to be fully automatic, needing no form of adjustment on priming system. The pump shall be capable of static suction lifts to 16.5 feet, vertical, at sea level. It shall also be capable of operation using extended suction lines.

F. Equipment acceptance shall be contingent upon its ability to run in a completely dry condition for extended periods, up to 10 minutes, at full speed. This requires the draining of all residual water to initiate a dry suction starting condition. The Engineer my require the manufacture to demonstration this capability.

G. The pump offered shall be a manufacturer's standard production model. The pump design specified shall have been in continuous use by municipal and industrial owners for a minimum of five years. A list of five user contacts including contact names and telephone numbers for this type of pump shall be provided with the bid submittal. Failure to supply a verifiable user list will be cause for rejection of the bid.

1.4 DESIGN REQUIREMENTS

OPERATING SPEED (MAXIMUM)	1800 RPM
SUCTION SIZE	12 INCHES
DISCHARGE SIZE	12 INCHES
MAXIMUM SUCTION LIFT	16.5 FEET
PRIMARY DUTY POINT	2719 GPM AT 139' TDH
MINIMUM SHUTOFF HEAD	238 FEET
NPSHa	14.7 FEET
MAX PRIME TIME	94 SECOND

1.5 REFERENCES

A. ANSI B16.1 - Standard for Cast Iron Pipe Flanges and Flanged Fittings.

1.6 SUBMITTALS

A. Provide submittals and shop drawings in accordance with Division 1. Shop Drawings: The Contractor shall submit integrated shop drawings for the pumping system illustrating the mechanical and electrical equipment and components specified in this Section and include the following:

1. Product Data: For each mechanical and electrical component include the manufacturer’s descriptive literature, product specifications, published details, technical bulletins, performance, and capacity-rating curves with primary and secondary design conditions clearly noted, charts, and schedules, catalog data sheets, and other submittal materials as required to verify that the proposed products conform to the quality and function of the specified products.

a. Identification: Clearly indicate by an arrow on submissions covering more than one product type or style exactly which product is being submitted for approval.

b. Equipment Characteristics: Provide gear and bearing ratings, complete motor data, service factors, shaft diameters, coupling type, and weights of principal parts and assembled equipment.
c. Manufacturer: Include the catalog name, company name, address, and telephone number for each product submitted.

2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross-sections of system equipment and sub-assemblies.

3. Layout Drawing: Submit completely dimensioned drawing of a base-mounted pump assembly that includes foundation details, anchor bolt size and patterns, supports, installation notes, and other pertinent setting details.

4. Product List: Provide a list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.

1.7 WARRANTY

A. The manufacturer shall furnish the following to the owner in accordance with Division 1:

1. A copy of the engine manufacturer's parts and labor warranty. The engine warranty shall start on date of substantial completion.

2. A 1-year Parts and Labor Warranty issued by the manufacturer on the pump from the date of final completion in accordance with Division 1 and project Contract Documents other than extended duration of warranty specific to this equipment.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The pump shall be a GODWIN PUMP, or THOMPSON PUMP with a sound attenuated enclosure.

B. The horizontal end-suction pumps shall be by Godwin Pumps or approved equal that meets all project requirements. Other manufacturers that the County uses is Thompson Pumps. However, being listed here does not except manufacturers from meeting all requirements in this specification section and all other project requirements.

C. The design and configuration of the horizontal end-suction pumps shown on the Drawings is based on a pump from Godwin. If an alternate system is to be bid by the Contractor, meets all project requirements, and approved by the Engineer, the Contractor shall make all ancillary changes needed to accommodate the use of the alternate system at no cost to the Owner. The Contractor shall coordinate the

change with the pump manufacturer for design modifications required before the bid. All additional costs resulting from alternate system, including but not limited to structural, mechanical, and or electrical changes or revisions to the drawings, shall be the sole responsibility of the Contractor.

2.2 EQUIPMENT

A. Pump casting shall be cast iron. It shall be constructed so that the suction flow path is in axial alignment with the impeller eye. There shall be no turns, chambers or valves between the suction line (or inlet) and the impeller. Discharge shall be side underslung type.

B. IMPELLERS: The pump impeller shall be of open non-clog type with pump out vanes on the back shroud. The impeller shall be hardened cast chromium steel construction (minimum Brinell Hardness 200 HB), or approved equal.

C. WEARPLATES: Wearplates shall be fully adjustable and replaceable, wearplate shall be cast in 25% Chromium Iron. Wearplate clearances shall have no relationship to the ability of the pump to achieve a prime.

D. BEARINGS AND SHAFTS: Pump shall be fitted with a bearing bracket which contains the shaft, two sets of heavy-duty angular contact ball bearings at the drive end and cylindrical roller bearings on the hydraulic end. Bearings shall be of adequate size to withstand imposed loads and up to 60 psi of suction pressure. Minimum ISO L10 bearing life to be 100,000 hours. Impeller shafts shall be of 1½% nickel/chromium alloy.

E. SEALS: Seals shall be high pressure, capable of withstanding suction pressures to 60 psi. The pump seal will be a double mechanical seal arrangement designed to meet API Standards. The inboard mechanical seal shall be a mechanical self-adjusting type with both interfaces of reaction bonded solid silicon carbide. The outboard mechanical seal shall also be a mechanical self-adjusting type with reaction bonded solid silicon carbide and carbon interfaces. The mechanical seal shall be cooled and lubricated in its own cooling reservoir, requiring no maintenance or adjustment. Pump shall be capable of running dry, with no damage, for periods up to 24 hours. All metal parts shall be of stainless steel. Elastomers shall be Viton.

F. PUMP SUCTION AND DISCHARGE FLANGES: Shall be cast iron ANSI (B16.1) Class 150, raised faced.

G. PUMP GASKETS: Shall be compressed fiber and/or Teflon.

H. PUMP O-RINGS: Shall be Viton.

I. PRIMING SYSTEM: Pump shall be fitted with a fully automatic priming system incorporating a twin-cylinder compressor and air ejector assembly, or approved equal. The priming system shall require no fail-safe protection float gear or any adjusting at high or low suction lifts.

J. CHECK VALVE: Pump shall be supplied with an integral flap type check valve mounted on the discharge flange of the pump, allowing unrestricted flow into the impeller. The check valve shall prevent in-line return of flow when the pump is shut off. Non-return valve elastomers shall be Nitrile Rubber and shall be field replaceable.

K. DRIVE UNIT: The drive unit shall be a diesel water-cooled engine. The engine shall drive pump by use of direct connected intermediate drive plate. Starter shall be provided. Safety shut down switches for low oil pressure and high temperature shall be provided. Battery shall have 175-amp hour rating. Unit shall include a tachometer, an hour-meter, a battery trickle charger and a 110-volt block heater. Unit shall be a Caterpillar or Jonn Deererated at a minimum of 125 hp (continuous) at 1800 RPM. A certified continuous duty engine curve shall be supplied to the owner/engineer.

L. GOVERNOR: Governor shall be electronic. Engine speed shall be adjustable to operate the pump between maximum and minimum design operation speeds.

M. SOUND ENCLOSURE: The acoustical enclosure shall reduce pump and engine noise to (70) seventy dBa or less at a distance of thirty feet. The panels shall be removable for easy access to the engine / pump for maintenance and repair. The engine control panel shall have locking access door for visual inspection. For maintenance and service needs, the pump discharge side of the trailer shall have a hinged door for quick access to the engine oil fill, oil dipstick, and filters.

N. EXHAUST: Exhaust system shall include a critical grade muffler housed in a separate chamber within the enclosure. All exhaust piping and manifolds shall be encased in fitted acoustic blankets. They shall be constructed of high-density fiberglass material with waterproof jacketing.

O. SKID BASE / FUEL TANK: The pump and engine shall be mounted to a structural steel base. The skid base shall be equipped with forklift pockets and shall have a lifting bale with a single eyelet to lift the entire unit. The skid base shall have an integral 94-gallon dual-wall fuel tank for maintenance. The fuel system shall have three valves for connection to an auxiliary fuel cell. The engine shall be capable of operating satisfactorily on a commercial grade of distilled No. 2 fuel oil.

2.3 AUTOMATIC STARTING CONTROL SYSTEM

A. The engine shall be equipped with a factory installed Prime Guard microprocessor-based controller as supplied by Godwin Pumps of America, Inc. or approved equal.

2.4 ENGINE / PUMP CONTROL SPECIFICATIONS

A. The engine shall be started, stopped, and controlled by a PrimeGuard2 high performance state of the art digital controller as supplied by Godwin Pumps of America, Inc, or approved equal. The controller shall be weatherproof enclosed and contain an external weatherproof 12-position keypad accessible without the need to remove or open any protective cover or enclosure. It shall be designed to start/stop the engine with a submersible pressure transducer.

B. The PrimeGuard2 controller shall provide the following functions without modification, factory recalibration, or change of chips or boards, by simply accessing the keypad.

1. The keypad shall be a capacitive touch sensing system. No mechanical switches will be acceptable. The keypad shall operate in extreme temperatures, with gloves, through ice, snow, mud, grease, etc. and maintain complete weather-tight sealing of the PrimeGuard2 controller, or approved equal.

2. In automatic mode, the unit shall conserve energy and go to “sleep”.

3. The PrimeGuard2 controller, or approved equal shall function interchangeably from float switches, pressure switch, or transducer, as well as manual start/stop by selection at the keypad. No other equipment or hardware changes are required.

4. The start function can be programmed to provide three (3) separate functions each day for seven days (i.e., a start, exercise cycle) OR on three separate days at different times and for a varying length of time all via the keypad.

    a. The diesel backup pump shall run for 4 hours every month, 10:00 AM – 2:00 PM. Confirm with LCU Operations at startup.

5. Manual-Automatic Button:

    a. In Manual Mode, manual “Start” button shall start engine and engine shall continue to run until “Stop” button is depressed or an emergency shutdown occurs.
    b. In Automatic Mode, start/stop sequencing shall be initiated by either one (1) high-level N/O and one (1) low-level N/C narrow angler float switches, transducer, or a signal from a digital input..

6. The controller shall integrate the engine safety shut-off for low and high oil temperature and provide over-speed protection.

7. The controller shall include standard, field-adjustable parameters for engine cycle crank timer, and shutdown time delay.

8. The PrimeGuard2 controller, or approved equal shall have only one circuit board with eight built-in relays. Seven (7) of the relays shall be programmable to output desired parameter on display and to be used as dry contacts for communication with COUNTY SCADA system, all via the keypad without changing relays, chips, printed circuits, or any hardware or software.

    a. The controller shall include a single common alarm output and be factory programmed to include indication and alarms (setpoints shown are preliminary and shall be finalized by manufacturer) which will be provided as a dry contact for communication with COUNTY SCADA System:

        i. Run to destruct enabled
        ii. Engine Overspeed 2150 RPM
        iii. High Oil Temp Warning 245 F
        iv. High Oil Temp Shutdown 250 F
        v. High Temp Warning 230 F
        vi. High Engine Temp Shutdown 235 F
        vii. Battery Weak 5.5 VDC
        viii. Battery Low 10 VDC
        ix. Battery High Warning 16 VDC
        x. Fuel Low Warning 35%
        xi. Fuel Shutdown 5%
        xii. High Oil Pressure 140 PSI

9. Standard components shall consist of (6) digital inputs, (8) analog inputs, (1) magnetic pick-up input, (6) 10-amp form “C” relays, (2) 20-amp form “C” relays, (1) RS485 port, (1) J1939 port, and (1) 320x240 pixel full graphic LCD display with backlight, (1) 12 position keypad, LCD lamps for visual indication of shutdown (red), warning (amber) and power (green).

10. The industrially-hardened PrimeGuard2 Controller, or approved equal shall withstand Vibration of 3 g, 3 axis, frequency swept 10-1000 Hz, in an operating temperature Range of 4° to 176°F (-20° to 80° C) and an operating humidity range of 0-95% Non-Condensing.

2.5 FACTORY PAINTING

A. Factory Painting Pump, engine, and base shall be shop primed and finish painted at the place of manufacturer. Materials and dry film thickness for priming and finish paint shall be in accordance with manufacturer's standards. A 1-2 mil thick layer of primer, and 1-2 mil thick layer for finishing coat shall be applied. Provide color card for OWNER color selection.

PART 3 EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The manufacturer shall furnish the services of a competent factory representative to do the following:

1. Inspect the system prior to delivery, supervise the startup and testing of the system, and certify the system has been properly furnished and is ready for operation.

2. Instruct the owner's operating personnel in the proper operation and maintenance of the system for a period of not less than one half day.

3.2 TOOLS AND SPARE PARTS

A. The manufacturer shall furnish the following with the Pump System:

1. A recommended list of spare parts.

B. The manufacturer shall be able to demonstrate an ability to provide 24-hour parts availability. Manufacturers not stocking replacement pump parts for this model pump will be cause for rejection.

3.4 OPERATIONS AND MAINTENANCE MANUALS

A. Provide Operations and Maintenance Manuals as specified in Section 01 78 23.

END OF SECTION

SECTION 44 31 21

PRE-ENGINEERED BIOFILTRATION ODOR CONTROL SYSTEM (BID ALTERNATE)

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install and test the skid mounted dual-technology biotrickling filter with carbon polishing odor control system (System) complete with all appurtenances as specified herein.

1. Manufacturer shall furnish biotrickling filter and carbon polishing equipment including blower, filter vessel (s) complete with media, nutrient addition system, water addition system and control panel along with VFD, instrumentation and controls prewired for a fully functioning, skid mounted, system.

2. Manufacturer shall provide Shop drawings and Operation and Maintenance manuals.

3. Manufacturer shall provide Startup and performance acceptance testing services as specified herein.

4. Placement, installation, bolting to the pad and connection of ductwork, water piping, drainage piping and power provided by Contractor.

B. The System shall comprise the following major components:

1. Single or multi-stage biotrickling filter vessel(s) with a final carbon polishing stage in series. The HDPE or FRP vessel shall be skid mounted and house both stages of treatment in a single system. The synthetic media zone shall house the plastic, structured synthetic media and a single water/nutrient injection spray system.

2. Structured, engineered, synthetic media to optimize mass transfer and facilitate the growth of bacteria necessary for biological oxidation of odorous compounds. The media bed shall be uniform and structured throughout and made entirely of a plastic, synthetic, non-reactive material.

3. Granular Activated Carbon (GAC) bed suitable for final adsorption polishing of the airstream before discharge to atmosphere.

4. The skid shall be manufactured from 316 Stainless Steel.

5. A UL, factory-labeled electrical control panel housing a single Programmable Logic Controller (PLC) system, VFD and other components required for the control and monitoring of the System. Refer to Division 26 for additional requirements including manufacturer.

6. An Irrigation Water Control Panel (IWCP) that includes all the components

necessary for the control and monitoring of the media irrigation system.

7. Odor control blower (s) to move the odorous air from the source and be able to compensate for all pressure losses at the design airflow.

1.2 CONTRACTOR RESPONSIBILITY

A. Installation of all Manufacturer supplied equipment components, which includes among others, placement and bolting of skid to concrete pad, connection of ductwork, water piping, drainage piping, and power and control wiring, all in accordance with the Manufacturer's installation instructions.

B. Supply of all odorous air ductwork including flex connectors leading to the inlet of the vessel.

C. Site preparation and clearing.

D. Construction of concrete equipment pad for placement of the System skid (s) and supply of System anchor bolts.

E. External water piping and drain piping to and from the System.

F. Power supply to the electrical control panel, water supply to the irrigation water control system, and water drain line from the filter (s) drain sump.

G. Installation of any additional items as noted on the contract drawings.

H. Temporary piping for startup of the System.

I. All electrical installation shall comply with Division 26 requirements.

1.3 PROCESS DESCRIPTION

A. The odor control system shall remove hydrogen sulfide, organic reduced sulfur compounds (RSCs) and other odorous compounds from the foul air stream using a biotrickling filter operating in a counter-current fashion. Co-current systems shall not be allowed. Prior to discharge to atmosphere, the treated airstream shall be further polished by a granular activated carbon (GAC) bed.

B. The foul air shall enter the System at the bottom of each reactor and flow upward through each of the media layers. The biological stage media bed shall be intermittently irrigated from above using suitable reclaimed plant effluent or potable water, and a sump shall be provided to collect the drain water at the bottom of the reactor. The hydrogen sulfide is oxidized by the autotrophic bacteria resident on the lower media layer(s). As the foul air passes through the upper media layer (s), the resident heterotrophic bacteria will oxidize other organic odorous compounds. The airstream will then pass through the carbon polishing bed and blower before being released to the atmosphere via an exhaust stack.

C. The drain water from the system will pass from the sump in the bottom of the reactor

vessel and be piped to a discharge point as detailed on the Contract drawings.

1.4 REFERENCES

The following is a list of standards which may be referenced in this section:

A. ASTM E679: "Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits".

B. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts".

C. ASTM D-2583: "Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor".

D. American National Standards Institute (ANSI).

E. American Society of Mechanical Engineers (ASME).

F. Institute of Electrical and Electronic Engineers (IEEE).

G. National Electrical Manufacturers Association (NEMA).

H. National Electrical Code (NEC).

I. National Fire Protection Agency (NFPA).

J. National Bureau of Standards (NBS).

K. Underwriters Laboratories (UL).

L. American Society for Testing and Materials (ASTM).

1.5 SUBMITTALS

A. The Manufacturer shall submit information as required to show complete compliance with these specifications. At a minimum, this information should include the following:

1. Manufacturer's catalog/data sheets and descriptive literature for each piece of equipment supplied.

2. Technical data on each major piece of equipment including weights of all items greater than 200 Lbs.

3. Guarantee from the manufacturer that the total system noise shall not exceed 75 dBA at 3' from the system blower.

4. Detailed bill of material, complete with material of construction.

5. Dimensional drawings showing elevation and plan views of the System and all

applicable connections.

6. Process and Instrumentation Diagram (P&ID) showing all main equipment components, flow rates and instrumentation.

7. Electrical and panel drawings including panel layout/as-built fabrication drawings, schematic diagrams, wiring & connection diagrams (indicating vendor and contractor required wiring).

8. Process control narrative.

9. Equipment offloading and installation instructions with sufficient detail to allow the Contractor to complete the mechanical and electrical installation of all System components.

10. Annual utility and nutrient usage calculations (if applicable).

11. Statement of Manufacturer's Warranty.

12. Information on hazards associated with the System and appropriate safety precautions, including applicable Material Safety Data Sheets (MSDS).

B. The Manufacturer shall submit the following information, as a minimum, for the specification section 01 78 23 Operation and Maintenance Manuals .

1. As-built dimensional drawings showing plan and elevation views of the System and all applicable connections.

2. As-built Process and Instrumentation Diagrams (P&IDs).

3. As-built electrical and panel drawings.

4. Detailed bill of material along with specification of System components and materials of construction. The list to include the make, model number and descriptive literature of all items furnished by the Manufacturer.

5. Performance data for the odor control blower, to include curves showing capacity, pressure, horsepower demand and efficiency over the entire operating range, including blower manufacturer's descriptive literature and blower model number(s).

6. Special precautions for any components or materials associated with the System and its operation that should be subject to particular safety precautions, including MSDS.

7. Manufacturer's Service Department contact information and service order form.

8. Statement of Manufacturer's Warranty.

9. System startup and restart instructions.

10. Special maintenance procedures, including recommended weekly, monthly and annual preventative maintenance requirements.

11. Troubleshooting guide.

12. Individual Operation and Maintenance instructions for all major system components.

1.6 SHIPPING, DELIVERY, STORAGE & HANDLING

A. All equipment and materials shall be properly protected such that no damage will occur from the time of shipment until the time of installation.

B. All exposed openings shall be protected to prevent entrance of debris, moisture or water during transportation and storage.

C. Contractor shall be responsible for offloading all shipped equipment and shall inspect all equipment upon arrival. Contractor shall notify the Manufacturer within 24 hours of any damage to equipment or surface finish due to shipping.

D. Contractor shall store all equipment such that, for the duration of the storage period, there will be no deterioration in equipment appearance or performance. Manufacturer shall supply detailed storage instructions, as necessary, at the time of shipment.

1.7 WARRANTY

A. The biotrickling filter Manufacturer shall warrant that the equipment supplied meets the following specifications and specification from section 01 78 36 and the performances detailed in Section 2.4 and that it is new and unused, free from defects in materials and/or workmanship. This warranty shall be for 12 months from substantial completion. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

B. The biotrickling filter Manufacturer shall warrant the synthetic media against defects in material and workmanship for five (5) years from substantial completion. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

PART 2 PRODUCTS

2.1 GENERAL

A. The odor control equipment supplied under this section must be provided by a single Manufacturer who will be solely responsible for the design, delivery and performance of the system. The equipment must be new and unused and meet the detailed specifications and warranty requirements stated herein.

2.2 QUALITY ASSURANCE

The System Manufacturer is responsible for the coordination of all equipment specified herein. Systems shall be as manufactured by BioAir Solutions, LLC. Or Evoqua. No substitutions are allowed.

A. Experience Requirements

The odor control system Manufacturer shall be experienced in the design, manufacture, installation and operation of structured synthetic media biotrickling filters designed to remove hydrogen sulfide and organic RSCs from municipal water and wastewater odor sources. The System Manufacturer shall have a minimum of ten (10) years of experience producing substantially similar equipment, and shall show evidence of at least twenty (20) systems in satisfactory operation for at least five (5) years in the United States.

Any manufacturer whose primary business is FRP manufacturing will not be accepted as a supplier for the odor control system specified herein.

B. Substitution

Any substitutions or deviations in equipment or arrangement from that shown on the drawings or specified herein shall be the responsibility of the Contractor. Any deviation must be accompanied by detailed structural, mechanical and electrical drawings and additional supporting data for review by the Owner and the Owner's Engineer and must be stamped and certified by a Florida registered Professional Engineer (PE).

All costs associated with the review of substitutions or deviations, and costs to the Engineer or Owner associated with project drawing changes as a result of approval of the substitution, shall be borne by the Contractor. There shall be no additional costs to the Owner due to substitutions or deviations.

C. Acceptable Manufacturers

Where a Manufacturer's standard equipment name is used in these or referenced specifications, the intent is to establish a minimum standard in terms of equipment quality, performance, functionality and experience. Substitutions as detailed above must be pre-approved by the Engineer prior to bidding.

2.3 OPERATING CONDITIONS

A. The System shall be suitable to treat air coming from a continuous supply from the odor source. All equipment must be suited to the operating conditions to which it will be subjected and the various compounds/substances with which it will reasonably be expected to come into contact. The operating conditions, at a minimum, include the following:

Duty	Continuous (air supply and odor source)
Location	Outdoors
Inlet air temperature	55 – 100°F
Inlet air relative humidity	60 - 100%
Contaminants	Hydrogen sulfide, organic RSC's, ammonia, methyl mercaptan and sulfuric acid.

2.4 DESIGN REQUIREMENTS

At a minimum, the System shall treat the following and meet the following minimum performance criteria:

Number of vessels	One (1)
Model (Basis of Design)	Bio Air EcoPure Mini® EPM
Flowrate	300 scfm
Contaminant concentration:	
Average hydrogen sulfide concentration	100 ppmv
Peak hydrogen sulfide concentration	300 ppmv
Maximum System Height	6' (above grade)

Performance requirements (Biological Stage):
The system shall have passed the performance test if either one of the following conditions is true:

- H_2S removal efficiency is ≥ 99% for inlet air H2S concentrations ≥ 100 ppmv but ≤ 300 ppmv
- Outlet H_2S concentration is ≤ 1.0 ppmv for inlet air H2S concentrations ≤ 100 ppmv

Performance requirements (Total System):
The system shall have passed the performance test if either one of the following conditions is true for both H_2S and odor removal:

- H_2S removal efficiency is ≥ 99.9% for inlet air H2S concentrations ≥ 100 ppmv but ≤ 300 ppmv
- Outlet H_2S concentration is ≤ 0.1 ppmv for inlet air H2S concentrations ≤ 100 ppmv

- Odor removal efficiency is ≥ 98% for inlet air odor concentrations ≥ 4,000 Dilutions to Threshold* but ≤ 200,000 ppmv
- Outlet odor concentration is ≤ 400 D/T for inlet air odor concentrations ≤ 20,000 D/T

**Odor criteria shall be based on specification ASTM 679 with a presentation rate of 20 LPM.*

2.5 SYSTEM COMPONENTS

A. System Vessel

The System vessel shall be skid mounted, low profile configuration operating in a counter-current manner. Each vessel shall consist of one (1) or more stage of

EcoBase™ media and one GAC polishing stage. The vessel shall be constructed from High Density Polyethylene (HDPE) or Fiberglass Reinforced Plastic (FRP) and be designed with adequate strength to support the required media volume. The exterior color shall be Base White.

The System skid shall be provided with 316 stainless steel hold down lugs to account for all anticipated loads to comply with local wind code requirements.

B. Media

The synthetic structured media shall be high porosity, chemically resistant, engineered synthetic porous material. Organic, carbon derived media, and/or non-synthetic inorganic media or adsorbent materials shall not be allowed.

The media characteristics (available surface area, density, and pressure drop) shall be structured and uniform throughout the media bed. Random media types (chips, balls, cubes, etc.) shall not be allowed.

Media shall resist compaction or swelling due to varying moisture levels and shall not degrade when subjected to low pH (i.e., pH<2) conditions.

The uniform structure of the media shall minimize the potential for short circuiting and encourage a uniform water and airflow pattern over the entire media cross sectional area.

Sufficient media shall be provided to ensure the performance requirements listed in section 2.4 are met.

The carbon polishing bed shall be GAC suitable for the final polishing of organic compounds and to meet the requirements of section 2.4.

All media shall be pre-installed in the vessel prior to shipment to the job site.

C. Irrigation System

Each reactor shall be configured with at least one (1) irrigation point which shall distribute the irrigation water evenly over the entire upper surface of the synthetic media layer.

Each irrigation system shall be tested by the Manufacturer and a certificate of conformity supplied with the shop drawings to show that the nozzle has been tested and meets the Manufacturers standards for uniform distribution.

The irrigation system shall be supplied with a nutrient addition system to provide the macro and micronutrients required by the bacteria for optimal metabolism of the odorous compounds being treated.

D. Control System

1. Electrical Control Panel (ECP)

The ECP enclosure shall be NEMA 4X, powder coated, white and constructed of 316 stainless steel in accordance with Contract Documents. To comply with NFPA 820, the panel shall be mounted > 3' from the vessel and ductwork.

The ECP shall house the necessary electronic components and an Allen Bradley Controllogix PLC in accordance with Contract Documents for the control and monitoring of the irrigation system. The system shall be controlled on the basis of time for the irrigation cycle and irrigation time and shall be adjustable to sustain conditions appropriate to the activity of the bacteria. Dry contacts shall be provided for external notification of alarm status. Alarms, at a minimum, shall be provided for low irrigation water flow, high irrigation water flow, no nutrient flow (if applicable) and blower fail. There must be an allowance to manually open the irrigation spray valve (located in the IWCP) for the purpose of routine maintenance checks but the valve should be normally closed. A variable frequency drive (VFD) in accordance with Contract Documents shall be provided in the ECP for the control of the odor control blower. VFDs shall comply with specification 26 29 23 – Variable Frequency Drives

The ECP shall require a single electrical connection of 480V/3Phase/60Hz. Transformers shall be provided as necessary for power and control voltages and be mounted inside the control panel.

2. Irrigation Water Control Panel

The Irrigation Water Control Panel (IWCP) shall be constructed of FRP or 316 stainless steel and include valves, motorized ball valves, strainers, instruments and piping for the control of the irrigation system and shall operate from control signals from the ECP.

The IWCP shall allow for a single connection to either a potable water source or suitable final effluent plant water source.

The IWCP shall include the nutrient addition system.

E. Dampers

1. Flow Control Dampers shall be constructed of vinyl ester resin, of the single blade type complete with channel type frame, close fitting blade, full circumference blade stop, full length 316 stainless steel axle, and bearings. Dampers shall have the same inside dimensions as the connecting piping.

2. Isolation Dampers shall be constructed of vinyl ester resin, of the single blade type complete with channel type frame, close fitting blade, neoprene or EPDM blade and Viton shaft seals, full length 316 stainless steel axle, and bearings. Each damper shall have the same inside dimensions as the connecting piping.

3. Dampers shall be Swartwout, BioAir or Belco.

F. Odor Control Blower

1. The blower(s) shall be cast aluminum or FRP, direct drive pressure blower as designed and manufactured by Aerovent, Cincinnati Fan or approved equal. Model shall be AeroVent 18B10BCA, 2 HP, or Cincinnati Fan PB-18, 2 HP.

2. HOUSINGS - All housings shall be heavy duty cast aluminum or FRP construction. All units shall be built with an adjustable discharge housing which can be field rotated to any of the eight standard positions.

3. WHEELS - The wheel shall be of the radial bladed backplate or backward curved design, and shall be cast aluminum construction. Wheels shall be suitable for exhaust purposes where low volume and high pressure applications exist.

4. MOTORS - Fan motors shall be foot-mounted or C-Face NEMA Design B, standard industrial, inverter duty and continuous duty, ball bearing, variable torque type suitable for operation on voltage, phase and hertz, as listed in the fan schedule. Motor bearings shall have a minimum L-10 life, as defined by AFBMA, of at least 40,000 hours (200,000 hours average life). Motors shall comply with specification 26 24 20 – Electric Motors

5. BALANCING - Prior to shipment all fans shall be completely assembled and test run as a unit at the operating speed. Final balance of the completed fan assembly shall be taken by electronic equipment. Records of the vibration readings in the axial, vertical, and horizontal planes shall be maintained and a written copy of this record shall be available upon request.

6. Blower noise at 3’ from the System shall be less than 75 dBA.

G. Control Area

1. The Enclosure shall provide sound attenuation to the blower and the Manufacturer shall guarantee that the system noise shall meet the blower noise requirements listed above.

2. The Control Area shall be securable and lockable with an easily removal access panel the entire height of the control area or hinged access doors. Access panels, at a minimum, shall be 44” wide.

H. Ductwork and Connections

1. Odor control unit intake and discharge connections shall be flanged matching size of duct shown in the Drawings.

2. Odor control manufacture shall provide 6” SCH 80 PVC discharge stack straight up from unit to elevation shown on drawings for relocated carbon polisher, including top elbow and supports as needed to meet building code wind load requirements stated on structural Drawings.

3. Connection sizes and types for water service, irrigation feed, drains, etc. shall be

provided to the Contractor if requested for bidding purposes. Any changes in connections to the odor control system between bid and final shop drawings shall incur no additional cost to the Owner.

2.6 SPARE PARTS

At a minimum, the following spare parts shall be supplied with the equipment.
One (1) set of fuses, one (1) for each fuse rating.
One (1) set of lamp lenses.
One (1) strainer.
Spare parts shall be stored, by the Contractor, on site and shall be handed over to the Owner at equipment handover.

PART 3 EXECUTION

3.1 FACTORY ACCEPTANCE TEST

A. Reactor Vessel

The HDPE or FRP vessel shall be inspected prior to shipping for conformance to the following:

1. Dimensions match those shown on submittal drawings and are within Manufacturer's specified tolerances.

2. Flanges and connections between reactor parts fit securely without improper bending or stressing of parts.

3. Damage or imperfections.

4. Manufacturer shall provide airflow modeling results confirming uniform airflow distribution throughout the media.

5. Manufacturer shall keep a record of the quality control document for each reactor vessel(s) that is available to the Engineer upon request.

B. Electrical Control Panel

Electrical control panel shall be inspected prior to shipping for conformance to the following:

1. NEMA rating according to Section 2.5D and bear the UL508A label.

2. PLC program and HMI shall be tested for proper communication and functionality and communication with Master Lift Station Pump Control Panel.

3. PLC digital and analog inputs shall be electrically tested to ensure input recognition in the proper area of the PLC program.

4. All wiring between panel components and terminal strips shall be checked for

proper labeling and connection.

C. Irrigation Water Control Panel
All water piping and/or other pre-installed piping shall be tested prior to shipping for conformance to the following:

1. System shall have no leaks when subjected to a pressure test at 80 psi for a minimum of 1 hour.

2. All installed instruments, sensors, pumps, actuated valves, and other electrical components shall be tested for proper operation.

3. All wiring from terminal strips to all electrical components shall be tested to ensure proper wiring.

D. Spray nozzle

Irrigation System shall be factory tested to ensure compliance with Manufacturer standards for uniform distribution.

3.2 INSTALLATION & EQUIPMENT START-UP

A. As far as is reasonably possible, all equipment should be pre-assembled prior to shipment, to minimize the need for on-site assembly. Synthetic media should be pre-installed by the Manufacturer and certified to meet the specified performance requirements.

B. Installation of all equipment will be conducted by the Contractor and must be in accordance with Manufacturer's written installation and start-up instructions and by workers experienced in the handling of HDPE and FRP vessels, electrical work, plumbing and instrumentation. The final installation must be certified by the Manufacturer as complete and correct.

C. The Manufacturer shall provide the Contractor with required clearances, tolerances and limitations, such as smoothness/flatness of concrete pad and shall be available to answer questions prior to and during the installation of the equipment.

D. Once the installation has been certified by the Manufacturer, the Contractor, with assistance from the Manufacturer, shall start the System to begin the biological acclimation period. This start-up period shall take no longer than six (6) weeks but at any point during this start-up period, at the discretion and direction of the Manufacturer, the contractor shall switch the system over to normal operation. Any minor re-piping or plumbing required will be clearly detailed in the Manufacturer's installation and start-up manual and will be performed by the Contractor.

Any special tools or materials required for this start-up/acclimation period shall be provided by the Manufacturer.

After satisfactory start-up and the corresponding switch over to normal operation, the Contractor shall, in the presence of the Engineer, conduct the performance test as

detailed in section 3.5 below.

3.3 FIELD PAINTING & CORROSION PROTECTION

A. If painted surfaces are damaged during shipment, off-loading or installation, as long as the damage is surface only and in no way affects the integrity of the equipment or its ability to perform, these blemishes, scratches or other imperfections shall be touched up by the Contractor in accordance with instructions from the Manufacturer. Materials used shall be compatible with the original coating material in quality and color.

3.4 PERFORMANCE TESTING

A. Performance testing shall not commence until the Manufacturer and Engineer agree that they system has been satisfactorily started-up and sufficient time has been allowed for the acclimation of the bacteria.

B. After the odor control system has been satisfactorily started-up and switched to normal operation, the Contractor shall, in the presence of the Engineer, demonstrate that the system will perform as specified in section 2.4 of this specification.

C. The Contractor shall provide the Engineer with a written test protocol and the performance test may not be conducted until the test protocol has been reviewed and approved by the Engineer.

D. The Manufacturer may be present during the performance test and, at its own discretion, may conduct a parallel performance test as long as it does not interfere with the performance test being conducted by the Contractor.

E. The Contractor shall supply, install and operate all equipment, sensors and instrumentation required to complete the performance test.

F. H_2S Testing procedure

1. Measure airflow into each unit and, if necessary, adjust to the design airflow of 300 cfm +/- 10%. Airflow shall be witnessed by the Engineer. Airflow shall be measured at the beginning of the test period and every 30 minutes throughout the duration of testing. Ambient temperature and humidity shall be measured with each airflow measurement.

2. Measure pressure drop across each vessel at beginning of test period.

3. Measure temperature and relative humidity of the inlet, midpoint, outlet and ambient air.

4. Performance test period to begin at a noted time and last for four (4) hours. H_2S data from the common inlet location and from the outlet of each odor control system will be measured and logged once every 5 minutes to demonstrate performance during test period.

a. The inlet H_2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the inlet air stream (0-1000 ppmv or 0 - 200 ppmv range, 1 ppm display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).
b. The midpoint H_2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the midpoint air stream. (0.00 - 2.00 ppmv range, 0.01 ppmv display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).
c. The outlet H_2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the outlet air stream. (0.00 - 2.00 ppmv range, 0.01 ppmv display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).

G. H_2S Acceptance criteria:

1. The System's H_2S removal efficiency shall be determined by calculating the average inlet H_2S concentration and the average outlet H_2S concentration and using the following formula: H_2S removal efficiency (%) = (1 – (average outlet H_2S concentration/average inlet H_2S concentration)) x 100.

2. The system shall have passed the H_2S performance test meeting the requirements in section 2.4

3. For any inlet data points where the maximum H_2S concentration exceeds the maximum allowable H_2S concentration as listed in this Specification, the midpoint and outlet H_2S concentrations shall be excluded from the average calculations.

a. Odor Testing procedure

4. Measure airflow into each unit and, if necessary, adjust to the design airflow of 300 cfm +/- 10%. Airflow balancing may be witnessed by the Engineer and/or Contractor if desired. Airflow shall be measured at the beginning of the test period. The set position on the VFD(s) will be marked or noted. Airflow will not change as long as the VFD(s) remain in position.

5. Measure pressure drop across each biotrickling filter at beginning of test period.

6. Measure temperature and relative humidity of the inlet, outlet and ambient air.

7. Three (3) sets of air samples, each consisting of one (1) inlet air sample and one (1) outlet air sample from each odor control system, will be collected in 10 L Tedlar bags with a Vac'Scent air sampling chamber, without exception, simultaneously. (In the event that there is more than one odor control system, a separate inlet air sample will be taken for each outlet air sample as near simultaneously as possible.) Each set of samples shall be collected in duplicate to minimize the risk of sample loss during shipping. Only one (1) set of the duplicates shall be analyzed for odors. Bag samples will be shipped to St. Croix Sensory (Lake Elmo, MN) or equal laboratory via UPS Next Day Air for analysis within 30 hours in accordance with ASTM 679-91. The airflow presentation rate shall be 20 L/min.

a. Odor Acceptance criteria
b. The system's odor removal efficiency shall be determined by calculating the average inlet odor Detection Threshold and the average outlet odor Detection Threshold and using the following formula: odor removal efficiency (%) = (1 – (average outlet odor Detection Threshold / average inlet odor Detection Threshold)) x 100.
c. The system shall have passed the odor performance test meeting the requirements in section 2.4.
d. In the event that the maximum odor Detection Threshold during the four (4) hour test period exceeds the maximum allowable odor Detection Threshold listed in the Specification, the odor acceptance criteria shall not apply, and the system shall be considered to have passed the performance test.

3.5 MANUFACTURERS SERVICES

A. In addition to being available by phone to assist the Contractor during the off-loading, installation, and startup of the equipment, the following Manufacturer's services shall be provided with the number of trips and days on site as a minimum.

Startup assistance	One (1) Trip, Two (2) days on site
Performance testing assistance	One (1) Trip, One (1) day on site
Initial Training	One (1) Trip, 4-Hour
Final Training (3 Months Later)	One (1) Trip, 4-Hour

B. Notwithstanding the above, the Manufacturer shall continue to assist the contractor with questions, issues and remote assistance until the system is properly installed, running satisfactorily and handed over to the Owner.

3.6 EQUIPMENT LABELING AND NAME PLATES

A. Each separate piece of equipment shall be furnished with a unique name plate identifying the Manufacturer, model & serial number, date of manufacture and, if applicable, capacity and any performance limitations. The nameplates shall be Gravograph Gravoply 2 ply plastic and firmly affixed to the exterior surface of the equipment and in a location that is accessible and easily read. Electrical equipment labeling shall comply with specification 26 05 53 – Identification of Electrical Systems.

END OF SECTION

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SECTION 44 31 22

RELOCATION AND REHABILITATION OF BIOFILTRATION ODOR CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Relocation and rehabilitation of the existing BioAir biofiltration odor control system and appurtenances as shown on the Drawings and specified in this Section.

PART 2 PRODUCTS

2.1 MANUFACTURER AND MODEL

A. The existing system is a BioAir ECOPURE Mini EP451, BioAir project number P1111. Original installation submittal is in the appendix for reference.

B. All replacement material and equipment shall be as recommended by and furnished through BioAir.

PART 3 EXECUTION

3.1 RELOCATION AND REHABILITATION

A. Order of Shutdown (Contractor shall confirm with BioAir)
   1. Disconnect odorous air source(s).
   2. Remove all carbon from vessel (see instructions below)
   3. Ensure the vessel is empty of water
   4. At this point the vessel can be moved.
   5. Vessel must be lifted from steel base with spreader bars.

B. The existing granular activated carbon in the biofilter unit shall be removed before relocating unit in accordance with strict manufacturer instructions. Below shows an example of BioAir's instructions from 6/9/22 Site Service Report. The Contractor shall coordinate with BioAir and obtain specific instructions before performing work.

Carbon Removal
Materials needed:

- Full face respirator with particle filtering cartridges for all personnel
- Full body Tyvek suits (including hood) for all personnel
- Shovels
- Vacuum truck or shop vacuum
- Designated on-site area for vacuum truck or shop vacuum to offload carbon
- Garbage bags for spent carbon if using a shop vacuum
- Two 9/16" wrenches or a 9/16" driver
- Ladder – min. height 6 ft.

Instructions:

1. Turn the Blower and Nutrient Pump switches to the OFF position. Turn the Irrigation Valve to CLOSE.
2. Remove the irrigation piping at the union connections (red arrows). Then remove the carbon section roof of the EPM (blue arrow). You may use an impact gun at the lowest setting to remove the bolts. Please see figure 1.
3. The carbon section gasket should be reused. Take care not to damage it.
4. Check that the carbon is loose and not solidified. If it is solidified, use shovels to break up the carbon for the vacuum hose. Take particular care not to scrape or damage the plastic housing of the carbon section.
5. Bring in vacuum hose.
6. Vacuum out the spent carbon. Break up any clumps with shovels to ease with vacuum removal.
7. Once the upper layer carbon is removed, check the retention screen for any tears, leaks, or breakage. Then remove the carbon retention screen (it will be replaced by a new one) as well as the fiberglass grate.
8. Follow the same procedure to remove the lower layer of carbon.
9. Inspect the lower retention screen for any tears, leaks, or breakage.
10. Removal and disposal of spent carbon is the responsibility of the Owner of the unit.

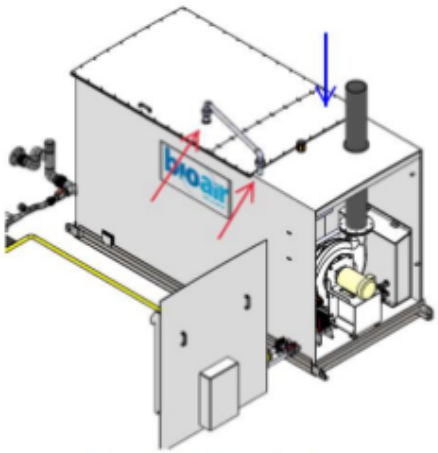

Figure 1 – EcoPure Mini System

C. A BioAir representative shall inspect the unit once the carbon has been removed duct work and piping disconnected.

D. The unit, panels, and appurtenances shall be relocated as shown on the Drawings. It is important that this equipment be relocated early in the project, prior to odor control rehabilitation, to keep the diesel pump installation on schedule.

E. Replace the blower and control panel door switches per BioAir 6/9/22 Site Service Report.

F. The Contractor shall proceed with installation of new activated carbon in both BioAir unit and separate carbon unit.

G. A BioAir representative shall be onsite for startup and check out of the rehabilitated system.

END OF SECTION

APPENDIX

Geotechnical Engineering Design Report - Florida Governmental Utility Authority (FGUA) - Proposed Waterway Estates Intermediate Pump Station - Lee County, Florida - January 31, 2011

Geotechnical Exploration – Universal Engineering Sciences – MPS 6600 Rehabilitation - February 27, 2020

Relocation and Rehabilitation of Biofiltration Odor Control System – General Arrangements Ecopure Mini Start-up Operation.

Florida Governmental Utility Authority (FGUA)

Proposed Waterway Estates Intermediate Pump Station

Lee County, Florida

January 31, 2011

Geotechnical Engineering Design Report

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Proposed Waterway Estates Intermediate Pump Station

Geotechnical Engineering Design Report

January, 2011

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Section 1
Introduction

1.1 Project Description and Location

Camp Dresser & McKee Inc. (CDM) was retained by Lee County and the Florida Governmental Utilities Authority (FGUA) to provide professional engineering and technical services associated with the design and construction of the proposed force main pipeline system for the Waterway Estates Interconnect Pipeline Design-Build Project located within the City of Fort Myers in Lee County, Florida. This report summarizes CDM's subsurface investigation and provides geotechnical engineering design recommendations for construction of the proposed Intermediate Pump Station associated with the project. The recommendations contained herein are considered preliminary at this time and are based on conceptual design of the pump station.

The site for the proposed pump station is located near the intersection of Pondella Road and Barrett Road within the City of Fort Myers, Florida. The proposed site is located in Section 9, Township 44 South, Range 24 East. The general site location of the proposed pump station is presented on **Figure 1-1**.

1.2 Purpose and Scope

The purposes of this report were to investigate subsurface conditions at the general location of the proposed pump station and to provide preliminary geotechnical engineering recommendations for foundation design and earthwork construction for the proposed structure. Specifically, the scope of work included the following;

- Conducting a field exploration program consisting of drilling three (3) Standard Penetration Test borings at the site of the proposed pump station to investigate subsurface conditions and obtain soil samples;
- Conducting geotechnical engineering laboratory tests to assist with classification of the encountered soils and to estimate the engineering properties of the soils;
- Developing geotechnical engineering recommendations for foundation design and earthwork construction; and
- Preparing this preliminary geotechnical engineering design report presenting CDM's recommendations, including all data collected as part of the investigation.

1.3 Horizontal and Vertical Survey Datum

The site surveys used the horizontal and vertical control network established by the National Geodetic Survey (NGS) District. The horizontal survey data presented throughout this report are reference on the State Plane Coordinate System, Florida West Zone based on North American Datum of 1983 (NAD 83/90) while the elevations noted herein are in feet and are referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Z:\Lee County, FGUA Pipeline (5000-79695)\GIS\IPS - Site Location Plan.mxd 1/13/10 EGutierrez

CDM

1 inch = 300 feet

600 300 0 600 Feet

Figure 1-1
Site Location Map
FGUA - Intermediate Pump Station
Lee County, Florida

1.4 Report Limitations

The information and preliminary recommendations contained herein have been prepared to support the design of the proposed Intermediate Pump Station associated with the proposed Waterway Estates Interconnect Pipeline Design-Build project as understood at this time and described in this report. This report has been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made. In the event that changes occur in the design, nature, or location of the proposed improvements, then the information contained herein should not be considered valid unless verified in writing by CDM's Geotechnical Services Division.

Section 2
Site and Subsurface Conditions

2.1 Existing Site Conditions

The Intermediate Pump Station is proposed to be located near the southwest corner of the intersection of Pondella Road and Barret Road. The site is a relatively flat, grass-covered area with sparse trees along the south boundary. Site elevations range from approximate El. +9.6 to El. +10.4. The site is bounded to the north by Pondella Road, to the south and east by developed properties and to the west by June Parkway.

2.2 Proposed Construction

The proposed Intermediate Pump Station consists of an approximate 16-foot diameter wetwell, a 6-foot by 8-foot valve vault, and a 12-foot by 8-foot generator concrete pad. Loading conditions, grading information and structural features have not been provided at this time; therefore, the following assumptions were made:

- The approximate foundation elevations of the valve vault and wetwell are anticipated to be about El. +5 and El. –6, respectively (about 5 and 16 feet below ground surface). The bottoms of the proposed valve vault and wetwell will function as mat foundations anticipated to exert net soil contact pressures of no more than 300 and 500 pounds per square foot (psf), respectively.

- The generator concrete pad will have a slab-on-grade foundation with thickened edges. Loading conditions are assumed to be on the order of 200 psf.

2.3 Subsurface Exploration Program

The subsurface exploration program consisted of drilling three (3) Standard Penetration Test (SPT) borings at the proposed Intermediate Pump Station site. The SPT borings, designated as B-1, B-2, and B-3, were drilled to depths of 20 to 50 feet. Logs of the SPT test borings prepared by CDM are included in **Appendix A.**

The test boring locations were surveyed by representatives of TKW Consulting Engineers, Inc. of Ft. Myers, Florida following the completion of the field exploration program. The approximate locations of the SPT borings are shown on **Figure 2-1**. The coordinates and ground surface elevations of the SPT borings are presented on the logs.

2.3.1 Standard Penetration Test (SPT) Borings

Each of the SPT borings was drilled with a SIMCO 2800 HS (HT), truck-mounted drill rig using mud-rotary drilling techniques to the termination depths of the borings. In general, split-spoon soil sampling was conducted continuously in the upper 10 to 20 feet of each boring and at five-foot depth intervals thereafter in general accordance with ASTM D 1586 using a 2-inch-diameter sampler driven 24 inches by blows from a 140-pound hammer falling freely for a 30-inch drop. The number of blows required to

Boring	Northing	Easting	Elevation
B-1	848136.2	685751.2	10.0
B-2	848128.2	685778.8	9.9
B-3	848136.2	685724.2	10.0
*Coordinates: State Plane, Florida West Zone (NAD83/90)			

Aerial imagery acquired in 2010.

Z:\Lee County, FGUA Pipeline (5000-79695)\GIS\IPS - Boring Locations Plan.mxd 1/7/10 EGutierrez

CDM

1 inch = 30 feet

60 30 0 60 Feet

Figure 2-1
Boring Location Plan
FGUA - Intermediate Pump Station
Lee County, Florida

drive the sampler each 6-inch increment was recorded and the Standard Penetration Resistance (N-value) was determined as the sum of the blows over the middle 12 inches of penetration. Upon completion, each of the boreholes was grouted with a Portland cement mixture from the bottom of the borehole to the ground surface.

Representative soil samples obtained from each split-spoon sample were stored in sealed jars for later review and geotechnical laboratory testing. A CDM geotechnical engineer observed the test borings in the field and visually classified the soil samples in accordance with the Unified Soil Classification System (USCS – ASTM D 2488).

Groundwater levels were measured at the boring locations. The depths to the stabilized groundwater levels within the borings were measured several times during the course of drilling, and following the completion of the drilling. Groundwater depths at the boring locations are presented on the SPT boring logs.

2.4 Laboratory Testing

Geotechnical laboratory testing on representative soil samples collected from the borings consisted of performing two (2) grain size analyses (ASTM D 422), three (3) percent fines determinations (percent by dry weight passing the No. 200 sieve size, ASTM D1140), two (2) Atterberg limits tests (ASTM D 4318), and one (1) organic content test (ASTM D 2974). The purpose of the testing was to assist with soil classification and to estimate engineering properties of the soils.

The resulting soil descriptions and the results of the laboratory classification tests are shown on the SPT Boring Logs presented in Appendix A. Test results are also summarized in **Appendix B**.

2.5 Subsurface Soil and Groundwater Conditions

Subsurface soil conditions described in this section are based upon the results of visual classification and laboratory testing of the encountered soils. Site-specific data gathered during the field exploration program were used to evaluate the subsurface stratigraphy and groundwater levels. The stratigraphy presented herein is generalized and highlights the three major layers and the predominant soil types that compose each layer. Subsurface conditions encountered at the site consist of the following, in order of their occurrence below grade:

- **Layer 1:** Layer 1 soils were encountered at each of the boring locations from the ground surface to depths ranging from 3 to 4 feet. Soils in this layer are comprised of possible FILL material consisting of loose Poorly Graded SAND with trace Gravel and trace roots with Standard Penetration Test N-values ranging from 5 to 9 blows per foot.

- **Layer 2:** Layer 2 soils were encountered at each of the boring locations between depths of about 2½ to 14 feet. These soils consist of loose to medium dense SAND with Gravel, Poorly Graded SAND, Poorly Graded SAND with Silt and Gravel,

and Silty SAND. Standard Penetration Test N-values ranging from 2 to 20 blows per foot.

Based on the results of laboratory grain size analyses, the percent fines ranged from 8 to 35. The percent of gravel-size pieces ranged from 5 to 24.

- **Layer 3:** Layer 3 soils consist of very soft to medium stiff Sandy CLAY with varying amounts of shell and shell fragments. These soils were encountered at each of the boring locations at depths below 12 to 14 feet and extended to a depth of at least 50 feet, the termination depth of Boring B-1. Standard Penetration Test N-values ranging from 2 to 7 blows per foot.

  Based on the results of laboratory grain size analyses, the percent fines were 57 and 58. In-place moisture contents ranged from 33 to 60 percent, and liquid limit and plasticity index values ranged from 32 to 41 and 17 to 21, respectively.

Groundwater was encountered at the boring locations at a depth of about 4 feet on the date drilled. Groundwater depths at the test boring locations are shown on the SPT Boring Logs presented in Appendix A.

2.6 Expected Variations in Subsurface Conditions

Interpretations of general soil conditions presented herein are based on soil and groundwater conditions observed at the boring locations. However, subsurface conditions may vary between exploration locations. If conditions are found to be different than those described herein, then the recommendations contained in this report should be reevaluated by CDM and confirmed in writing.

Water levels measured in the explorations should not necessarily be considered to represent stabilized groundwater levels. Actual groundwater levels encountered during construction may be different from those observed at the time of the exploration.

Section 3
Preliminary Engineering Evaluation and Foundation Design Recommendations

3.1 Geotechnical Engineering Evaluations

This section describes CDM's geotechnical engineering evaluation and foundation design recommendations for the proposed Intermediate Pump Station associated with the Waterway Estates Interconnect Pipeline Design-Build project. In general, the geotechnical engineering evaluations contained herein are based on the results of the field and laboratory programs described herein, published correlations with soil properties and the minimum requirements of the International Building Code (IBC 2006). In addition, recommended design criteria are based on performance tolerances, such as allowable settlement, as understood to relate to similar structures.

3.2 Foundation Design Recommendations

Based on the results of the subsurface exploration, the encountered soils appear to be suitable for supporting the proposed structures. With proper site preparation as described in this report, conventional shallow foundation systems bearing upon suitable foundation materials may be used for the proposed structures. Suitable foundation materials consist of properly compacted undisturbed, inorganic natural soils (Layer 2) or Structural Fill. Unsuitable soils include existing fill, soft clay, or any other soft, loose or disturbed soil present at or below foundation subgrade level.

3.2.1 Proposed Wetwell

The bottom of the proposed wetwell will function as a structural mat foundation founded approximately 16 feet below finished grade (El. -6). The mat foundation should be founded on 12 inches of compacted crushed stone or Structural Fill. The mat foundation can be designed for an allowable average contact pressure of 1,000 pounds per square foot (psf). Foundation settlement associated with this contact pressure is anticipated to be within tolerable limits (total settlement of less than 1 inch and no more than ½ inch of differential settlement as measured from edge-to-edge).

3.2.2 Proposed Valve Vault

The bottom of the proposed valve vault will function as a structural mat foundation founded approximately 5 feet below the existing ground surface (El. +5). The mat foundation can be placed on a prepared subgrade consisting of 12 inches of compacted undisturbed, inorganic natural soils (Layer 2) or compacted Structural Fill. The mat foundation can be designed for an allowable average contact pressure of 1,500 pounds per square foot (psf). Foundation settlement associated with this contact pressure is anticipated to be within tolerable limits (total settlement of less than 1 inch and no more than ½ inch of differential settlement as measured from edge-to-edge).

3.2.3 Proposed Generator Pad

The generator concrete pad is anticipated to be a slab-on-grade foundation with thickened-edge footings. The pad should be designed as a mat bearing on a minimum of 12 inches of compacted Structural Fill. The Structural Fill should be placed directly over suitable foundation bearing materials. The mat foundation can be designed for an allowable average contact pressure of 1,500 psf. This contact pressure should result in foundation settlement within tolerable limits (total settlement on the order of 1 inch and differential settlement (measured from edge-to-edge) of no more than ¾ inch).

3.3 Lateral Loads on Below-Grade Foundation Walls

The proposed valve vault and wetwell are proposed to be embedded approximately 5 and 16 feet below existing grade, respectively. Foundation walls should be designed to resist lateral loads from soil and groundwater, and surface surcharge loads. Below-grade foundation walls that are backfilled on one side and restrained against rotation at the top should be designed for lateral pressures from soil and groundwater having an equivalent fluid unit weight of 60 pounds per cubic foot (pcf) above the groundwater level and 90 pcf below the groundwater level. A design groundwater elevation equivalent to the finished ground surface should be used in the design.

Lateral loads due to surface surcharge loads should be assumed to be 0.5 times the vertical surcharge pressure at the ground surface. For surcharge loads used in design calculations, a pressure equal to 0.5 times the surcharge should be applied over the full height of all walls.

3.4 Resistance to Unbalanced Lateral Loads

Unbalanced lateral loads should be designed to resist friction on the bottom of the foundations and slab. For design purposes, a coefficient of friction of 0.4 should be used. It is expected that the available friction will be sufficient to resist all unbalanced lateral loads. However, in the event that lateral loads exceed the friction available, the surplus loads may be resisted by passive pressures on foundations. A passive pressure resistance of up to a maximum equivalent fluid pressure of 150 pcf may be assumed provided that foundations are backfilled with structural fill compacted to at least 95 percent of the soil's maximum dry density as determined by ASTM D 1557. Frictional resistance should be assumed to be mobilized first and to its full capacity before any passive pressure is developed.

3.5 Resistance against Buoyancy

The proposed structures should be designed to resist uplift due to hydrostatic pressure. The dead weight of the structures and the weight of any backfill directly over the extensions of the foundations may be used to resist flotation. Uplift resistance can also be developed using soil friction on a vertical plane extending upward from the edge of the foundation. For the purpose of design, the groundwater

level corresponding to the finished ground surface should be used. The evaluation should include all stages during construction and maintenance.

Section 4
Construction Considerations

4.1 General

The purpose of this section is to discuss issues related to geotechnical aspects of earthwork construction as required for development of the project specifications. Included are construction methods required to achieve the recommendations presented in Section 3, anticipated methods of construction, and identification of potential construction-related problems. The project geotechnical engineer should prepare and/or review geotechnical-related specifications and contract documents related to earthwork, dewatering, excavation support, and foundations.

4.2 Excavation and Excavation Support

Prior to excavation, the construction area should be stripped and grubbed of all surface vegetation, roots, debris and other deleterious materials within and at least 5 feet beyond the perimeter of the proposed structures. These deleterious materials should be removed from the project area and disposed off site. Special care should be taken to avoid mixing of these materials with excavated soils to be used as backfill.

Excavations for the proposed valve vault and wetwell will require some form of excavation support and groundwater control. For these structures, it is anticipated that excavations can be performed using conventional earth-moving equipment.

The bearing elevations of the proposed valve vault and wetwell will be well below the groundwater table. Therefore, some form of excavation support system (likely braced or tied-back sheet pile) in combination with lowering of the water table within the excavation will be required for the construction of this structure. If the Subcontractor decides to employ a temporary excavation support system, the design and selection of the type of excavation and support system is the sole responsibility of the Subcontractor. The excavation system needs to be designed by a professional engineer registered in the State of Florida retained by the Subcontractor. The Subcontractor needs to provide detailed submittals of the excavation support design for review and comments.

All excavations, excavation support systems, and side slopes for temporary excavations should be designed in compliance with all applicable OSHA and state regulations. For planning purposes, open dewatered cuts should have a minimum slope of 2 horizontal to 1 vertical with benches as appropriate for access, constructability, and/or dewatering equipment.

All excavations should be backfilled with compacted Structural Fill. Voids developed during the removal of excavation support systems and sheet pile should be backfilled with suitable compacted soil or grout. Care should be taken to avoid damaging existing structures during this process.

4.3 Dewatering

Based on the groundwater levels encountered during the field exploration program and the close proximity of the proposed structures to existing waterways, the Subcontractor should be prepared to provide extensive groundwater dewatering of excavations. Dewatering systems should be designed by a registered professional engineer of the State of Florida retained by the Subcontractor.

An improperly designed and/or constructed dewatering system can create a "quick" condition in the bottom of an excavation. Therefore, the dewatering system should be adequate to maintain a dry, undisturbed subgrade at all times during construction. All excavation and construction should be conducted "in-the-dry". To complete the work and avoid disturbance to the subgrade soils, the groundwater level should be lowered to at least 2 feet below the lowest excavation level. Groundwater levels should be lowered to target levels prior to excavation to minimize the potential for bottom heave or a quick condition within the excavation. Dewatering systems should not be decommissioned until excavation, compaction and the placement of fill and backfill soils is complete, and sufficient deadweight exists on the structures to prevent uplift. Decommissioning should be addressed in the dewatering submittal.

Care should be taken to avoid disturbance of the exposed subgrade by scheduling excavations to limit the duration of open cuts, sloping the bottoms of the excavations to facilitate drainage, and providing berms to limit runoff into the excavations. In addition, excavated material to be reused as fill should be safely stockpiled away from the top of slopes in such a manner that promotes runoff and limits saturation of the materials.

4.4 Backfill Materials and Compaction Requirements

4.4.1 Structural Fill

Materials used as Structural Fill should consist of a mineral soil, free of organic material, debris, or other deleterious or objectionable material that may be compressible or which cannot be properly moisture conditioned and compacted. The poorly graded SAND and SAND with silt soils having less that 12 percent fines may be reused as Structural Fill. With proper moisture conditioning, these soils should densify using conventional compaction equipment. Shell fragments content shall be no more than 10 percent as measured by particle size analysis (ASTM D422). The organic content shall be no greater than 3 percent as determined by ASTM D2974 (Method D) on the portion of a sample passing the No. 4 sieve.

Structural Fill should be placed in level layers no thicker than 8 inches in uncompacted thickness and compacted with suitable compaction equipment to at least 95 percent maximum dry density as determined by ASTM D 1557. Lift thickness should be reduced to 4 inches in confined areas that are accessible only to hand guided compaction equipment.

Backfill soils placed adjacent to and within 5 feet of the walls of the valve vault and wetwell should consist of free-draining granular soils that contain less than 12 percent fines. These soils should be placed in thin lifts no greater than 6 inches in uncompacted thickness and compacted with hand-held compaction equipment to achieve a density no greater than 97 percent maximum dry density as determined by ASTM D 1557. Over-compaction of these backfill soils should be avoided so as not to cause excessively large earth pressures to develop against the walls.

4.4.2 Common Fill

Common Fill used a fill below access roadways and landscape areas should consist of granular soil free of organic material, topsoil, debris, or other deleterious or objectionable materials that cannot be properly compacted. It should contain stones no larger than 6 inches, have no more than 12 percent by dry weight passing the No. 200 sieve, and be placed such that the cobble size pieces are not nested. It should be placed in level layers not to exceed 12 inches in uncompacted thickness and compacted with suitable compaction equipment to at least 98 percent maximum dry density beneath roadway areas and at least 95 percent maximum dry density in all other areas. Maximum dry density should be determined by ASTM D 1557. Lift thicknesses should be reduced to 6 inches in confined areas accessible to only hand-guided compaction equipment.

4.4.3 Crushed Stone

Crushed stone if used should be hard, durable, rounded, or sub-angular particles of proper size and gradation, and should be free of sand, loam, clay, excess fines, and other deleterious materials. The material should conform to the gradation requirements provided by the Florida Department of Transportation, for No. 57 Stone. Filter fabric in accordance with FDOT Index 199 will be required to reduce the potential for the migration of fines.

Crushed stone should be compacted by mechanical means and vibratory action during construction.

4.5 Protection and Preparation of Subgrades

Care should be taken to avoid excess disturbance to the excavated subgrades prior to placement of the Structural Fill, crushed stone, or concrete foundations. Subgrades should be compacted prior to the placement of fill materials. Any unstable or unsuitable material present at the subgrade level should be removed and replaced with compacted Structural Fill.

Unsuitable soils beneath the wetwell should be over-excavated to a depth of 12 inches below the bottom of the mat foundation, plus a horizontal margin of at least 3 feet outside the footprint of the foundation, and replaced with compacted crushed stone or Structural Fill. Prior to backfilling, the bottom of the excavation should be uniformly compacted to achieve a subgrade that is firm and unyielding to the

compaction equipment. This firm and unyielding condition may be used in lieu of meeting a specified density requirement.

FILL soils should be excavated from beneath foundations and replaced with compacted Structural Fill. Structural Fill should extend at least 2 feet beyond the edge of the foundation, then downward at a slope of one horizontal to one vertical (1H:1V) to suitable bearing material. Prior to backfilling, exposed subgrade soils should be uniformly compacted to a depth of 12 inches.

4.6 Protection of Adjacent Structures

During construction, the Subcontractor needs to protect and preserve all adjacent existing facilities, utlities and structures. Regarding protection of adjacent structures, settlement monitoring points should be located on all structures within the influence zone and within 50 feet of any excavation activities. The monitoring points should be surveyed to the closest 0.005 ft. on a minimum weekly basis during the construction. Should unexpected settlement be observed, construction should temporarily cease. The Contractor shall propose revised construction methods to limit further movement.

4.7 Construction Sequence

The nature of the proposed construction will likely require special construction sequencing from a geotechnical engineering point of view. Analyses of excavation support and groundwater dewatering are the sole responsibility of the Subcontractor.

4.8 Construction Monitoring

It is recommended that a Geotechnical Engineer or a designated representative under the direction of the Geotechnical Engineer be present during construction to confirm that the Subcontractor complies with the intent of these recommendations. Specifically, the field representative would undertake the following responsibilities:

- Confirm removal of all materials deemed unstable or unsuitable;
- Confirm that appropriate dewatering methods and excavation support systems are employed;
- Confirm that the subgrade conditions encountered are suitable for support of the proposed structures; and
- Observe, test and document the placement and compaction of backfill and fill material, where appropriate.

In addition, the field representative should be present to identify and provide a response should conditions encountered differ from those assumed during preparation of this report.

4.9 Closure

The recommendations contained herein have been prepared for specific application to the subject project as understood at this time and described in this report. These recommendations have been prepared in accordance with generally accepted geotechnical and foundation engineering practices. No other warranty, expressed or implied, is made. As changes in the design or locations of the structures occur, the conclusions and recommendations contained herein should not be considered valid unless verified in writing by a representative of CDM's Geotechnical Services Division.

Appendix A

Standard Penetration Test (SPT)
Boring Logs

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-1

Client: FGUA
Project Name: Waterway Estates Interconnect - IPS
Project Location: Lee County, Florida
Project Number: 5000-79695

Drilling Contractor: Allied Engineering and Testing, Inc.
Surface Elevation (ft-NGVD 1929): 10.0
Drilling Method/Rig: Mud Rotary/Simco 2800 HS (HT)
Total Depth (ft.): 50
Drillers: Craig Griffey
Depth to Groundwater Level (ft.BLS): 4.0 - 1/6/11
Drilling Date: Start: 01-06-11 **End:** 01-06-11
Abandonment Method: Grouted to ground surface
Borehole Coordinates:
Field Screening Instrument: None
N 848136.2 E 685751.2
Logged By: Eduardo Gutierrez, EIT

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
10.0														
0	SS	S-1	24/24	3 6 3 5	9			SP	**Poorly Graded SAND**, fine, loose, dry, grayish brown. **(Possible FILL).**					
	SS	S-2A S-2B	24/24	3 2 3 1	5				Grades to moist and brown.					
								SM	**Silty SAND**, fine, loose, moist, dark brown; trace roots up to 1/8-inch size.					
5.0 5	SS	S-3	24/14	1 10 9 9	19			SP-SM	**Poorly Graded SAND with Silt and Gravel**, fine to coarse, medium dense, wet, brown.		23.7/53.5	8.6		
	SS	S-4	24/18	6 6 9 7	15									
	SS	S-5	24/16	7 3 2 3	5			SP-SM	**Poorly Graded SAND with Silt**, fine, loose, wet, light grayish brown; trace fine-size gravel.					
0.0 10	SS	S-6	24/18	2 2 1 2	3			SM	**Silty SAND**, fine, very loose, wet, light gray; trace fine-size gravel.		4.9/59.7	35.3		

EXPLANATION OF ABBREVIATIONS

SAMPLING TYPES:
SS - Split Spoon
HA - Hand Auger

OTHER:
WOH - Weight of Hammer
WOR - Weight of Rod
BLS - Below Land Surface

NGVD - National Geodetic Vertical Datum
USCS - Unified Soil Classification System

NOTES

Hammer Weight = 140 lb.
Hammer Drop Height = 30 in.
Spoon Size = 2 in. OD and 24 in. length.

REMARKS

Reviewed by: William L. Fox, P.E. **Date:** 01-14-11

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS-IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-1

Client: FGUA

Project Name: Waterway Estates Interconnect - IPS

Project Location: Lee County, Florida

Project Number: 5000-79695

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
	SS	S-7	24/20	2 1 1 2	2			CL	**Sandy Lean CLAY**, very soft, wet, light gray; with some shell fragments (fine to coarse sand size).					
-5.0 15	SS	S-8	24/16	1 1 1 1	2									
	SS	S-9	24/16	1 2 1 1	3				Grades to soft.	33.0		57.1	32/17	
	SS	S-10	24/22	1 2 2 2	4									
-10.0 20														
	SS	S-11	24/No Recovery	2 3 3 3	6			CL	**Sandy Lean CLAY**, medium stiff, wet, greenish gray.					
-15.0 25	SS	S-12A S-12B	24/24	2 1 2 3	3				Grades to soft.					
	SS	S-13	24/24	1 1 2 3	3									
-20.0 30														
	SS	S-14	24/24	1 2 3 3	5				Grades to medium stiff.	59.7		57.8	41/21	
-25.0 35														

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS- IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-1

Client: FGUA

Project Name: Waterway Estates Interconnect - IPS

Project Location: Lee County, Florida

Project Number: 5000-79695

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
								CL						
	SS	S-15	24/24	1 1 1 2	2				Grades to soft.					
-30.0 40														
-35.0 45														
	SS	S-16	24/24	1 1 2 4	3									
-40.0 50									**Boring terminated at 50 feet BLS.**					
-45.0 55														
-50.0														

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS- IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-2

Client: FGUA
Project Name: Waterway Estates Interconnect - IPS
Project Location: Lee County, Florida
Project Number: 5000-79695

Drilling Contractor: Allied Engineering and Testing, Inc.
Surface Elevation (ft-NGVD 1929): 9.9
Drilling Method/Rig: Mud Rotary/Simco 2800 HS (HT)
Total Depth (ft.): 20
Drillers: Craig Griffey
Depth to Groundwater Level (ft.BLS): 4.0 - 1/6/11
Drilling Date: Start: 01-06-11 **End:** 01-06-11
Abandonment Method: Grouted to ground surface
Borehole Coordinates:
Field Screening Instrument: None
N 848128.2 E 685778.8
Logged By: Eduardo Gutierrez, EIT

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
9.9														
0	SS	S-1	24/16	3 3 3 5	6			SP	**Poorly Graded SAND**, fine, loose, dry, mixed brown and gray; trace roots up to 1/8-inch size at 6 inches bls. **(Possible FILL).**					
	SS	S-2A S-2B	24/8	4 4 4 2	8				Grades to moist and brown.					
								SM	**Silty SAND**, fine, loose, moist, brown; trace roots up to 1/8-inch size.					
4.9 5	SS	S-3	24/12	5 10 10 9	20			SP-SM	**Poorly Graded SAND with Silt and Gravel**, fine to coarse, medium dense, wet, brown.					
	SS	S-4A S-4B	24/22	4 3 3 4	6			SP	**Poorly Graded SAND**, fine, loose, wet, light grayish brown; with some shell fragments (fine to coarse sand size).					
	SS	S-5	24/20	1 2 2 2	4			SP-SM	**Poorly Graded SAND with Silt**, fine, loose, wet, light grayish brown; trace fine-size gravel.					
-0.1 10	SS	S-6	24/20	1 1 1 2	2				Grades to very loose and without gravel.					

EXPLANATION OF ABBREVIATIONS

SAMPLING TYPES:
SS - Split Spoon
HA - Hand Auger

OTHER:
WOH - Weight of Hammer
WOR - Weight of Rod
BLS - Below Land Surface

NGVD - National Geodetic Vertical Datum
USCS - Unified Soil Classification System

NOTES

Hammer Weight = 140 lb.
Hammer Drop Height = 30 in.
Spoon Size = 2 in. OD and 24 in. length.

REMARKS

Reviewed by: William L. Fox, P.E. **Date:** 01-14-11

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS-IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-2

Client: FGUA

Project Name: Waterway Estates Interconnect - IPS

Project Location: Lee County, Florida

Project Number: 5000-79695

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
	SS	S-7	24/18	1 1 2 2	3			SP-SM SM	**Silty SAND**, fine, very loose, wet, light yellowish brown.					
-5.1 15	SS	S-8	24/20	3 3 4 2	7			CL	**Sandy Lean CLAY**, medium stiff, wet, light gray; with some shell fragments (fine to coarse sand size).					
	SS	S-9	24/14	2 1 2 2	3			CL	**Sandy Lean CLAY**, soft, wet, light gray; trace shell fragments (fine to coarse sand size).					
-10.1 20	SS	S-10	24/12	1 2 3 3	5				Grades to medium stiff without shell fragments.					
									Boring terminated at 20 feet BLS.					
-15.1 25														
-20.1 30														
-25.1 35														

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS- IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-3

Client: FGUA
Project Name: Waterway Estates Interconnect - IPS
Project Location: Lee County, Florida
Project Number: 5000-79695

Drilling Contractor: Allied Engineering and Testing, Inc.
Surface Elevation (ft-NGVD 1929): 10.0
Drilling Method/Rig: Mud Rotary/Simco 2800 HS (HT)
Total Depth (ft.): 20
Drillers: Craig Griffey
Depth to Groundwater Level (ft.BLS): 3.8 - 1/6/11
Drilling Date: Start: 01-06-11 **End:** 01-06-11
Abandonment Method: Grouted to ground surface
Borehole Coordinates:
Field Screening Instrument: None
N 848136.2 E 685724.2
Logged By: Eduardo Gutierrez, EIT

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
10.0														
0	SS	S-1	24/14	3 3 3 4	6			SP	**Poorly Graded SAND**, fine, loose, dry, brown; trace rock fragments (fine gravel size). **(Possible FILL).**					
	SS	S-2A S-2B	24/22	4 4 4 4	8			SP-SM	Grades to moist and gray. **Poorly Graded SAND with Silt**, fine, loose, moist, black; trace organics.			8.1		4.3
5.0 5	SS	S-3	24/16	2 2 1 7	3				Grades to very loose, brown and trace roots up to 1/8-inch size.					
	SS	S-4	24/14	5 7 8 9	15			SP-SM	**Poorly Graded SAND with Silt**, fine, medium dense, wet, brown; with some fine-size gravel.					
	SS	S-5	24/16	11 7 7 5	14			SP-SM	**Poorly Graded SAND with Silt and Gravel**, fine to coarse, medium dense, wet, brown.					
0.0 10	SS	S-6	24/18	2 2 2 3	4			SP-SM	**Poorly Graded SAND with Silt**, fine, loose, wet, grayish brown.					

EXPLANATION OF ABBREVIATIONS

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Hammer Weight = 140 lb.
Hammer Drop Height = 30 in.
Spoon Size = 2 in. OD and 24 in. length.

REMARKS

Reviewed by: William L. Fox, P.E. **Date:** 01-14-11

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS-IPS.GPJ CDM_CORP.GDT 01/18/11

CAMP DRESSER & McKEE

CDM

SPT BORING LOG
B-3

Client: FGUA

Project Name: Waterway Estates Interconnect - IPS

Project Location: Lee County, Florida

Project Number: 5000-79695

Elev. Depth (ft.)	Sample Type	Sample Number	Penetration / Recovery (Inches)	Blows per 6-in	In-Situ Test (N value)	Hand Cone Penetrometer (tsf)	Graphic Log	USCS Group Symbol	Material Description	Moisture content (%)	%gravel size / %sand size	%Fines	Liquid Limit / Plasticity Index	Organic Content (%)
	SS	S-7	24/22	3 3 3 2	6			SP-SM						
-5.0 15	SS	S-8	24/20	1 1 1 1	2			CL	**Sandy Lean CLAY**, very soft, wet, light gray; with some shell fragments (fine to coarse sand size).					
	SS	S-9	24/4	2 2 3 3	5				Grades to medium stiff.					
-10.0 20	SS	S-10	24/22	2 3 3 3	6									
									Boring terminated at 20 feet BLS.					
-15.0 25														
-20.0 30														
-25.0 35														

FGUA-FT MYERS PROJECT -BOREHOLE- BORINGS FGUA- FT MYERS- IPS.GPJ CDM_CORP.GDT 01/18/11

Appendix B

Laboratory Test Results

Project: **Waterway Estates Interconnect** Job Number: **20810-8** Sheet **1** of **1**

Manager: _____ Client: **CDM** Project Description: _____

Location: _____

Boring / Depth	Sample Description	#4	#10	#40	#60	#100	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		AASHTO	USCS
B-1	Olive brown sand with silt and rock														
4.0		62.1	51.7	43.7	32.8	12.7	8.6								
B-1	Light gray silty sand with trace rock														
10.0		95.1	90.2	81.4	70.4	40.0	35.3								
B-1	Light gray sandy clay with shell														
16.0							57.1	33.0	31.7	16.8					
B-1	Olive gray sandy clay														
33.0							57.8	59.7	41.4	21.2					
B-3	Very dark brown sand with silt and roots														
3.0							8.1				4.3				

Summary Of Laboratory Test Results

ANTILLIAN
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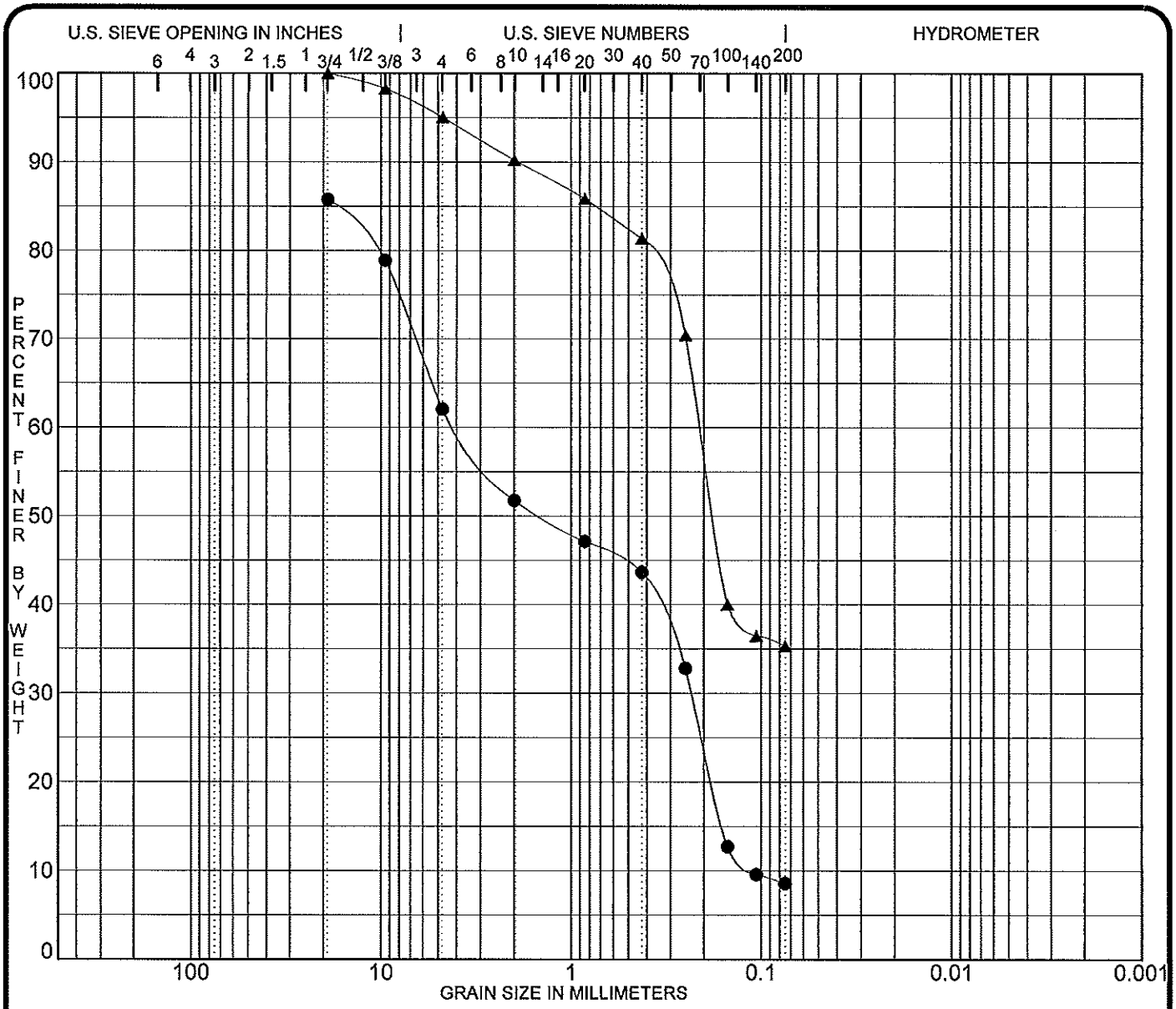


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	B-1	4.0	Olive brown sand with silt and rock					0.12	35.9
▲	B-1	10.0	Light gray silty sand with trace rock						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	4.0	19.00	3.99	0.233	0.1111	23.7	53.5	8.6	
▲	B-1	10.0	19.00	0.21			4.9	59.7	35.3	

PROJECT Waterway Estates Interconnect

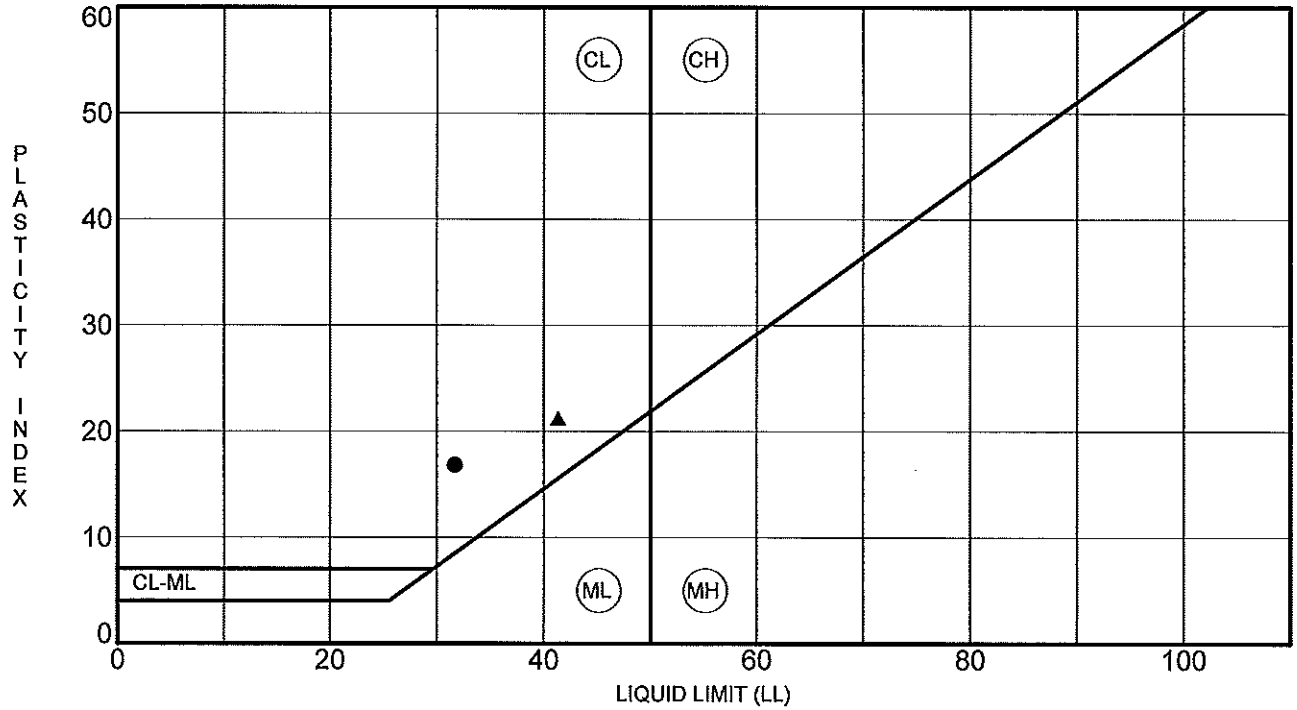
JOB NO. 20810-8

DATE 01/13/11

GRADATION CURVES

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA



Specimen Identification			LL	PL	PI	Fines	Classification
●	B-1	16.0	32	15	17	57.1	SANDY LEAN CLAY CL
▲	B-1	33.0	41	20	21	57.8	SANDY LEAN CLAY CL

PROJECT **Waterway Estates Interconnect**

JOB NO. **20810-8**

DATE **01/12/11**

ATTERBERG LIMITS

ANTILLIAN ENGINEERING ASSOCIATES, INC.

Orlando, Florida, USA

UNIVERSAL
ENGINEERING SCIENCES

GEOTECHNICAL EXPLORATION

MPS 6600 Rehabilitation
S.E.C. Pondella Road and June Parkway
North Fort Myers, Lee County, Florida
UES Project No. 0530.2000005.0000

PREPARED FOR:

McKim and Creed
5701 Division Drive Suite A
Fort Myers, FL 33905

PREPARED BY:

Universal Engineering Sciences
5971 Country Lakes Drive
Fort Myers, Florida 33905
(239) 995-1997

February 27, 2020

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- Rockledge
- Sarasota
- Tampa
- Tifton
- West Palm Beach

February 27, 2020

McKim and Creed
5701 Division Drive Suite A
Fort Myers, FL 33905

Attention: Mr. Thomas Pugh
TPugh@mckimcreed.com

Reference: **Geotechnical Exploration**
MPS 6600 Rehabilitation
S.E.C. Pondella Road and June Parkway
North Fort Myers, Lee County, Florida
UES Project No. 0530.2000005.0000

Dear Mr. Pugh:

Universal Engineering Sciences, Inc. (UES) has completed a geotechnical exploration on the above-referenced site in Lee County, Florida. Our scope of services was in general accordance with the McKim and Creed Sub-Consultant Agreement dated November 15, 2019.

This report contains the results of our study, an engineering interpretation of the subsurface data obtained with respect to the project characteristics described to us, geotechnical design recommendations, and general construction and site preparation considerations.

We appreciate the opportunity to have worked with you on this project and look forward to a continued association with your firm. Please contact us if you have any questions, or if we may further assist you as your plans proceed.

Respectfully Submitted,
UNIVERSAL ENGINEERING SCIENCES, INC.
Certificate of Authorization No. 549

Ashok Neela
Staff Engineer

Lindsey N. Weaver, P.E.
Regional Manager
Florida Registration #41790

LINDSEY N. WEAVER LICENSE NO. 41790 STATE OF FLORIDA PROFESSIONAL ENGINEER

1 – Client (email only)

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EXECUTIVE SUMMARY

We prepared this summary to provide a quick overview of our findings. Please review, and rely on, the full report for recommendations and other considerations.

Project Description

We understand that the project consists of the design of the rehabilitation for Master Pump Station 6600 located at the southeast corner of the intersection at Pondella Road and June Parkway in North Fort Myers, Lee County, Florida. The rehabilitation will include a master manhole and a pad mounted diesel pump set.

Soil and Groundwater Conditions

The soils found consist of dark brown, dark gray and gray fine sand to around 4.5 feet underlain by medium dense dark brown fine sand to around 5.5 feet below ground surface. Fractured rock was encountered to around 7.5 feet underlain by medium dense light brown and light gray fine sands and fine sand with silt fines and trace of phosphates to around 10 feet below ground surface. Very stiff light gray fine sandy clay with rock fragments was encountered up to around 23 feet underlain by medium dense gray and green silty fine sand up to around 33 feet below the ground surface. Very stiff to stiff green lean clay was encountered to the maximum depth explored of 40 feet below ground surface.

The groundwater was measured at a depth of 4.0 feet below existing grade. Estimated seasonal high groundwater levels could be around 1 to 2 feet below the ground surface at the boring locations.

Foundation Design

Based on our exploration and analyses the manhole and pump may be supported on a typical base slab or equipment pad.

Site Preparation

A normal earthwork practice is envisioned to prepare the subgrades and place and compact fill soils in the proposed equipment pad.

Excavation Considerations

Fractured rock (which may contain boulders or lenses of hard rock) was encountered at the boring location at depths of 5.5 to 7.5 feet below ground surface. We anticipate any fractured rock encountered can likely be excavated with a large track hoe by using the seams, voids and crevices in the rock to pry and dislodge the large material. Specialized procedures such as pneumatic rams, headache balls, etc. will likely be necessary to excavate into or through the hard rock or fractured rock.

1.0 INTRODUCTION

1.1 GENERAL

In this report we present the results of our geotechnical exploration on the site of the Master Pump Station 6600 located at the southeast corner of the intersection at Pondella Road and June Parkway in North Fort Myers, Lee County, Florida. This report contains the results of our study, an engineering interpretation of the subsurface data obtained with respect to the project characteristics described to us, and our recommendations for geotechnical design and general site preparation. Our scope of services was in general accordance with McKim and Creed Sub-Consultant Agreement dated November 15, 2019.

1.2 PROJECT DESCRIPTION

We understand that the project consists of the design of the rehabilitation for Master Pump Station 6600 located at the southeast corner of the intersection at Pondella Road and June Parkway in North Fort Myers, Lee County, Florida. The rehabilitation will include a master manhole and a pad mounted diesel pump set.

No anticipated structural loads were available for our analyses. It is anticipated the master man hole will be relatively lightly loaded structure with a maximum loading condition on the order of 500 psf. The maximum invert elevation for the master manhole is anticipated to be approximately 6 feet below the ground surface.

We were provided with a site plan depicting the location of the proposed improvements. We used this information to perform our exploration.

Based on current site grades, we anticipate nominal amounts (0 to 1 feet) of fill will be required to raise site grades to finished levels.

Our geotechnical recommendations are based upon the above provided information, assumptions and considerations. ***If UES is not informed of changes to final design information, the recommendations contained herein are not considered valid as we cannot be responsible for the consequences of changes of which we were not informed.***

A general location map of the project area appears in Appendix A: Site Location Map.

2.0 PURPOSE AND METHODOLOGIES

2.1 PURPOSE

The purpose of our services was:

- to generally characterize the shallow subsurface conditions at the site using a limited amount of Standard Penetration Test (SPT) borings;
- to evaluate the soil/structure relationships using subsurface information interpreted from the borings and project information described to us or assumed by us; and
- To provide geotechnical engineering design information and recommendations, and general recommendations for equipment pad subgrade preparation.

Recommendations concerning other earthwork related aspects of the proposed construction were beyond the scope of this study. Our work did not address the potential for surface expression of deep geological conditions, such as sinkhole development related to karst activity. This report presents an evaluation of site conditions on the basis of traditional geotechnical procedures for site characterization. The recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. Universal Engineering Sciences would be pleased to perform these services, if you so desire.

2.2 FIELD EXPLORATION

The subsurface conditions in the master pump station 6600 site was explored with one (1) boring completed to a depth of 40 feet below ground surface. The boring was advanced using the rotary wash method, and samples were collected while performing the Standard Penetration Test (SPT) at regular intervals.

We performed the SPT test in general accordance with ASTM D-1586 guidelines. However, at depths of 10 feet or less we sampled continuously in order to note variations in the upper soil profile. In general, the SPT test consists of a standard split-barrel sampler (split-spoon) driven into the soil using a 140-pound hammer free-falling 30 inches. The number of hammer blows required to drive the sampler 12 inches, after first seating it 6 inches, is designated the penetration resistance, or SPT-N value. This value is used as an index to soil strength and consistency.

Consider the indicated locations, elevations and depths to be approximate. Our drilling crew located the borings based upon estimated distances and taped measurements from existing site features. If more precise location and elevation data are desired, a registered professional land surveyor should be retained to locate the borings and determine their ground surface elevations. The Boring Location Plan is presented in Appendix B.

Soil, rock, water, and/or other samples obtained from the project site are the property of the client. Unless other arrangements are agreed upon in writing, UES will store such samples for no more than 60 calendar days from the date UES issued the first document that includes the data obtained from these samples. After that date, UES will dispose of all samples.

2.3 LABORATORY TESTING

The soil samples recovered from the soil test borings were returned to our laboratory and then an engineer visually examined and reviewed the field descriptions. We selected representative soil samples for laboratory testing consisting of four (4) wash 200 analysis and four (4) moisture content tests.

We performed these tests to aid in classifying the soils and to help evaluate the general engineering characteristics of the site soils. The results of the tests are presented at the respective boring and depth where the sample was obtained on the Boring Log, Appendix B.

3.0 FINDINGS

3.1 SURFACE CONDITIONS

The site of the master pump station area is a gravel covered fenced enclosure located at the southeast corner of the intersection of the Pondella Road and June Parkway. There are numerous above and below grade pipes and structures located within the existing pump station. It is relatively level. We did not note any surficial debris or standing water on site at the time of our field exploration. At the start of our geotechnical exploration, we reviewed aerial photographs available from the Lee County Property Appraiser's office and USGS topographic quadrangle maps. According to the provided topographic information, the elevation across the property is on the order of +9 feet NGVD.

3.2 SUBSURFACE CONDITIONS

3.2.1 SOIL SURVEY

We also reviewed current USDA Natural Resources Conservation Service (NRCS) data for Lee County. According to NRCS, there are one native, surficial soil groups underlying this site. A summary of selected properties for the identified soil group on the site is included below in Table 1.

TABLE 1: SUMMARY OF SOIL INFORMATION

Soil Map Unit & Name	Hydrologic Soil Group	Indications of Shallow Rock	Water Table Type	SHWT Depth	Location
123 - Myakka fine sand, Urban land complex, 0 to 2 percent slopes	A/D	> 80 inches	Apparent	About 6 to 18 inches	Entire site

3.2.2 SOIL BORINGS

The boring locations and detailed subsurface conditions are illustrated in Appendix B: Boring Location Plan and Boring Logs. The classifications and descriptions shown on the logs are based upon visual characterizations of the recovered soil samples. Refer to Appendix B: Soils Classification Chart, for further explanation of the symbols and placement of data on the Boring

Logs. The general subsurface soil profile on the site, based on the soil boring information, is presented below. For more detailed information, please refer to the boring logs.

Table 2: General Soil Profile

Typical Depth	Soil Descriptions
0 – 4.5	Dark brown, Dark Gray and Gray Fine Sand [SP]
4.5 – 5.5	Medium Dense Dark Brown Fine Sand [SP]
5.5 – 7.5	Fractured Rock
7.5 - 10	Medium Dense Light Brown and Light Gray Fine Sands and Silty Fine Sands with Trace of Phosphates [SP, SM]
10 - 23	Very Stiff Light Gray Fine Sandy Clay with Rock Fragments [CL]
23 - 33	Medium Dense Gray and Green Silty Fine Sand [SM]
33 – 40*	Very Stiff to Stiff Green Lean Clay [CL]

*** Termination of Deepest Boring**
[ ] Bracketed Text Indicates: Unified Soil Classification

The shallow water table was measured at approximately 4.0 feet below existing grade at the boring locations, measured upon first encounter. These readings were unstabilized and are subject to fluctuation.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Our field exploration did not find unsuitable or unexpected materials at the time of occurrence. However, borings for a typical geotechnical report are widely spaced and generally not sufficient for reliably detecting the

presence of isolated, anomalous surface or subsurface conditions, or reliably estimating unsuitable or suitable material quantities. Accordingly, UES does not recommend relying on our boring information to negate presence of anomalous materials or for estimation of material quantities unless our contracted services ***specifically*** include sufficient exploration for such purpose(s) and within the report we so state that the level of exploration provided should be sufficient to detect such anomalous conditions or estimate such quantities. Therefore, UES will not be responsible for any extrapolation or use of our data by others beyond the purpose(s) for which it is applicable or intended.

4.0 RECOMMENDATIONS

4.1 GENERAL

In this section of the report we present our geotechnical design recommendations, general site preparation recommendations and information pertaining to the construction related services UES can provide. Our recommendations are made based upon a review of the attached soil test data, our understanding of the proposed construction as it was described to us, and our stated assumptions. ***If UES is not informed of changes to the provided final design information, the recommendations contained herein are not considered valid as we cannot be responsible for performance issues that may arise from design changes of which we are unaware.*** Additionally, if subsurface conditions are encountered during construction that was not found in the test borings, report those conditions immediately to us for observation and recommendations.

4.2 GROUNDWATER

Based upon our visual review of the recovered soil samples, review of information obtained from SWFWMD and the USDA Soil Survey of Lee County, and our general knowledge of local and regional hydrogeology, our estimated seasonal high groundwater level could be around 1 to 2 feet below the existing grade at the test boring locations, on average.

Several factors influence the determination of the seasonal high water table (SHWT). Over time natural, undisturbed soils are subjected to alternating cycles of saturation and drying, resulting in discoloration or staining that is not part of the dominant soil color occurs. This is called mottling, and manifests itself in various shades of gray, brown, red or yellow. There are numerous processes that lead to this discoloration, including mineral accretions, oxidation, and bacteria growth within the soil. The presence of this discoloration indicates that groundwater has repetitively reached that elevation and remained there long enough to cause any or all of these processes to occur. The SHWT elevation is assumed to be the highest level at which mottling is observed in the natural soil profile, regardless of whether water is present at the time of observation. This estimate is independent of the actual location of the groundwater table. Because the mottling process takes time and repetitive episodes, man-made soil fills do not exhibit such mottling and seasonal high estimates cannot be made in this manner.

It should be noted that the estimated SHWT does not provide any assurance that groundwater levels will not exceed this level in the future. Should impediments to surface water drainage exist on the site, or should rainfall intensity and duration exceed the normally anticipated amounts, groundwater levels may exceed our seasonal high estimate. Also, future development around the site could alter surface runoff and drainage characteristics, and cause our seasonal high estimate to be exceeded. We therefore recommend positive drainage be

established and maintained on the site during construction. Further, we recommend permanent measures be constructed to maintain positive drainage from the site throughout the life of the project. Finally, we recommend all foundation and pavement grades account for the seasonal high groundwater conditions.

Temporary dewatering may be required for some parts of this site if construction proceeds during the wet season, particularly if deep excavations are necessary. Therefore, we recommend that the contract documents provide for determining the depth to the groundwater table just prior to construction, and for any required remedial dewatering. Further, we recommend that the groundwater table be maintained at least 24 inches below all earthwork and compaction surfaces.

4.3 EQUIPMENT SLAB AND MASTER MANHOLE

4.3.1 GENERAL

The soil strata found at the SPT boring locations should be adaptable to support pump equipment and master manhole using normal good practice site preparation procedures.

4.3.2 EQUIPMENT SLAB

The equipment (diesel pump set) slab may be ground supported and in the case of a monolithic floor slab adequately reinforced to prevent distress due to differential movements. A fibermesh concrete mix or welded wire fabric may be used to reduce thermal cracking. If welded wire is used, we recommend using flat wire instead of rolled. Normal weight concrete having a 28-day compressive strength (f'c) of at least 2500 psi should be used. A conservative modulus of subgrade reaction of 100 pci can be used for slab design, assuming the slab is supported on compacted structural fill or well compacted existing subgrade soils (minimum 95% MPMDD).

4.3.3 MASTER MANHOLE

The elevation of the manhole base is anticipated to be approximately 6.0 feet below existing grade. Difficulty may be encountered during the lower portion of the excavation for the master manhole. Fractured rock was encountered at depths of 5.5 to 7.5 feet below existing grade. If encountered at the manhole invert elevation, we recommend a layer of #57 stone be placed between the rock surface and the manhole base slab to provide a uniform bearing surface.

4.3.4 ESTIMATED STRUCTURAL SETTLEMENT

For foundations designed as recommended and site earthwork accomplished according to the recommendations provided later in this report, we estimate total and differential foundation settlement due to structure loads of less than one inch, and less than one half inch, respectively. **However, if the site is not prepared according to the guidelines provided later in this report, our estimates of total and differential settlement may be exceeded during the design life of the structure.** We note that our settlement estimates do not include potential settlement from the following: erosion of foundation subgrade soils; ground subsidence from sinkhole activity; localized hydraulic compaction of soils from storm or irrigation waters; undermining of foundations from adjacent excavation; or any other cause not related to the actual soil stresses induced by the structural loads.

4.3.5 SUBGRADE PREPARATION

We recommend normal, good-practice subgrade preparation procedures for the master pump station rehabilitation site. We recommend the existing soils to a depth of 1 foot below the proposed master man hole and equipment pad areas and any additional fill to achieve subgrade elevation be compacted to at least 95 percent of the Modified Proctor maximum dry density. Test the fill areas and subgrade for compaction at a frequency of not less than one test per lift per structure. The fill and backfill should consist of fine sand with less than 5 percent soil fines. You may use fill materials with soil fines between 5 and 12 percent, but strict moisture control may be required. Place fill or backfill in uniform 10 to 12-inch loose lifts and compact each lift to a minimum density of 95% MPMDD at a moisture content of +/- 2% of optimum (OMC).

4.4 EXCAVATION CONSIDERATIONS

Fractured rock (which may contain boulders or lenses of hard rock) was encountered at the boring location at depths of 5.5 to 7.5 feet below ground surface. We anticipate any fractured rock encountered can likely be excavated with a large track hoe by using the seams, voids and crevices in the rock to pry and dislodge the large material. Specialized procedures such as pneumatic rams, headache balls, etc. will likely be necessary to excavate into or through the hard rock or fractured rock.

All excavation work must meet OSHA Excavation Standard Subpart P regulations, Type C Soils. Either a trench box, braced sheet pile structure or an excavation with temporary side slopes cut back at 1.5 horizontal to 1.0 vertical can be implemented. The side slope of 1.5 horizontal to 1.0 vertical is contingent upon the dewatering system adequately controlling slope seepage. Sheet piling should be designed according to OSHA sheeting and bracing requirements. We recommend a Florida registered Professional Engineer design any required sheeting/bracing system. Provisions for maintaining workman safety within excavations is the sole responsibility of the contractor.

4.5 CONSTRUCTION RELATED SERVICES

Universal Engineering Sciences (UES) operates and maintains an in-house, Florida Department of Transportation certified Construction Materials Testing laboratory. Our technicians are highly trained and experienced, and our engineering staff is already familiar with the details of your project. Therefore, we recommend the owner retain UES to perform construction materials testing and field observations on this project. This includes monitoring all stripping and grading, observation of foundation excavation and construction and all other construction testing and inspection services that may be needed on this project.

The geotechnical engineering design does not end with the advertisement of the construction documents. It is an on-going process throughout construction. Because of our familiarity with the site conditions and the intent of the engineering design, our engineers are the most qualified to address problems that might arise during construction in a timely and cost-effective manner.

5.0 LIMITATIONS

Our services were rendered in general accordance with generally accepted principles and practices of the geotechnical community and our proposal contract agreement. It is not uncommon for project plans to change or for more specific project information to become known after completion of our geotechnical services. We strongly recommend that UES be contacted to review final design plans and modify or amend the recommendations contained herein as appropriate. ***If UES is not informed of changes to the final design information, the recommendations contained herein are not considered valid as we cannot be responsible for the consequences of changes of which we were not informed.***

Our field exploration found unsuitable or unexpected materials at the time of occurrence. However, borings for a typical geotechnical report are widely spaced and generally not sufficient for reliably detecting the presence of isolated, anomalous surface or subsurface conditions, or reliably estimating unsuitable or suitable material quantities. Accordingly, UES does not recommend relying on our boring information to negate presence of anomalous materials or for estimation of material quantities unless our contracted services ***specifically*** include sufficient exploration for such purpose(s) and within the report we so state that the level of exploration provided should be sufficient to detect such anomalous conditions or estimate such quantities. Therefore, UES will not be responsible for any claims, damages, or liability associated with any extrapolation, interpretation, or use of our data by others beyond the purpose(s) for which it is applicable or intended.

During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible subsurface variations. An Association of Engineering Firms Practicing in the Geosciences (ASFE) publication, "Important Information about Your Geotechnical Engineering Report" appears in Appendix C, and will help explain the nature of geotechnical issues. Further, we present documents in Appendix C: Constraints and Restrictions, to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

APPENDIX A

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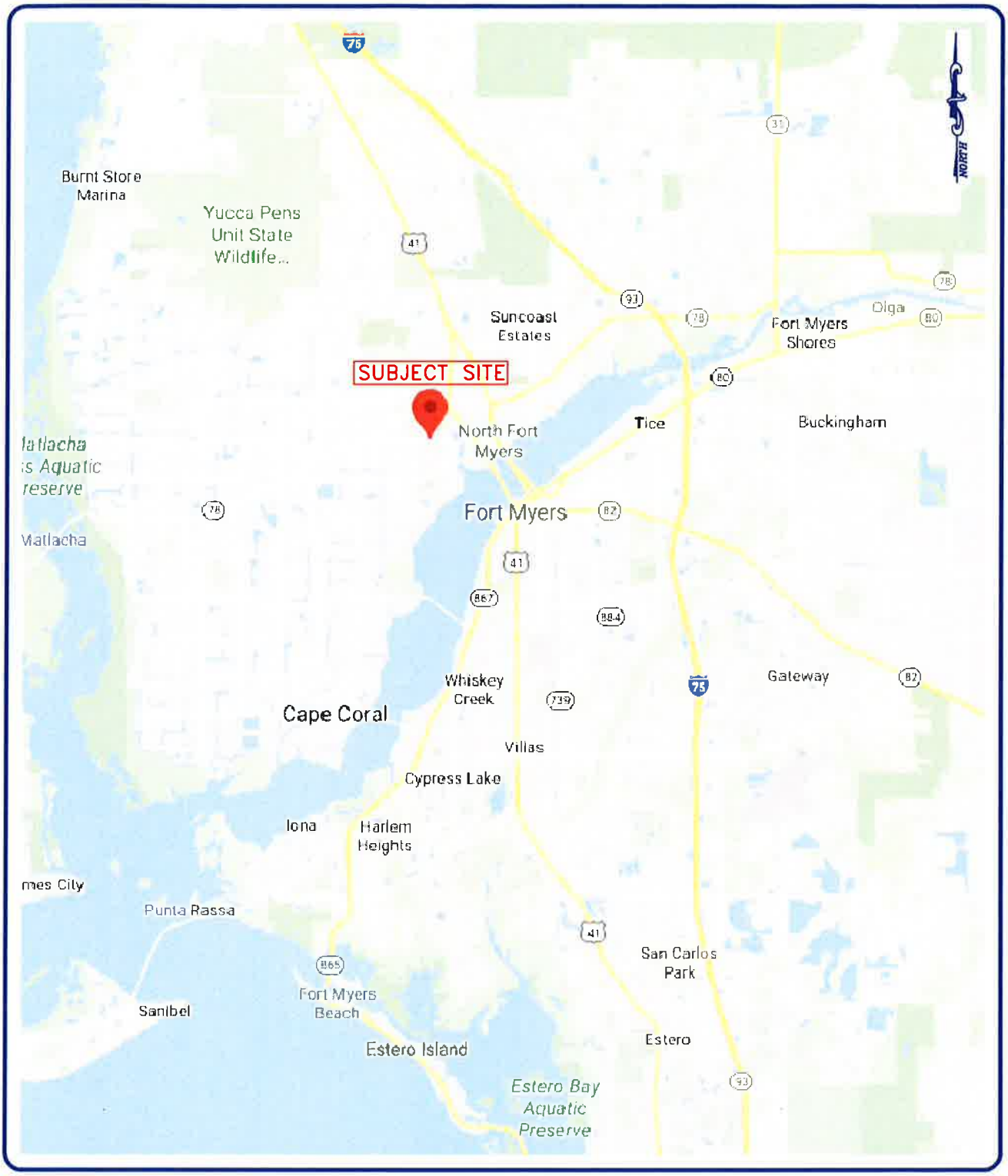

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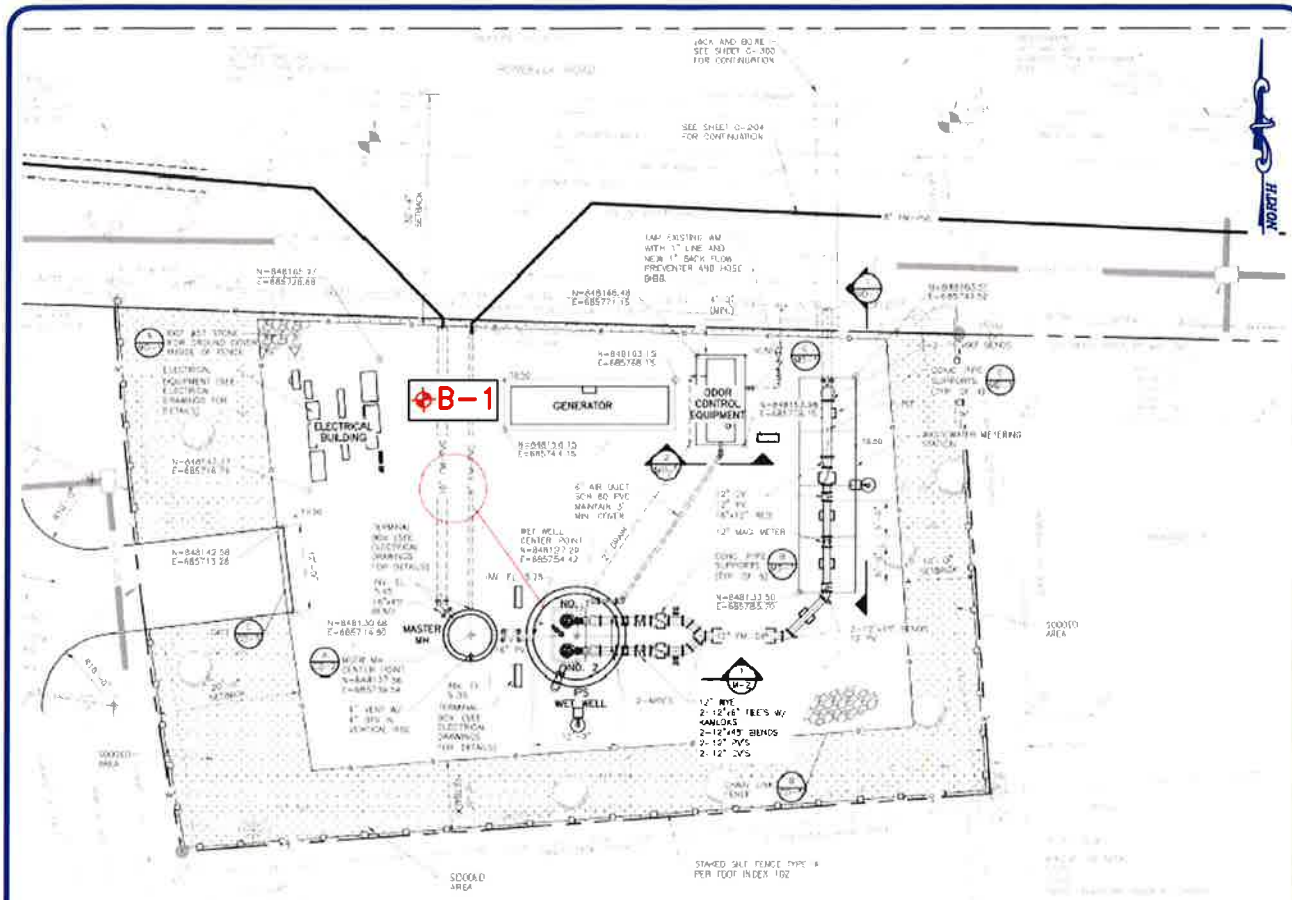
MPS 6600 REHABILITATION
S.E.C. PONDELLA ROAD AND JUNE PARKWAY
NORTH FORT MYERS, LEE COUNTY, FLORIDA

SITE LOCATION MAP

CLIENT: McKIM & CREED		DRAWN BY: AN	DATE: 02/21/2020
SCALE: NOT TO SCALE	PROJECT NO: 0530.2000005	REVIEWED BY: LW	APPENDIX: A

APPENDIX B

UNIVERSAL
ENGINEERING SCIENCES



LEGEND:

B-1 Approximate SPT boring location

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ENGINEERING SCIENCES

MPS 6600 REHABILITATION
S.E.C. PONDELLA ROAD AND JUNE PARKWAY
NORTH FORT MYERS, LEE COUNTY, FLORIDA

BORING LOCATION PLAN

CLIENT: McKIM & CREED		DRAWN BY: AN	DATE: 02/26/2020
SCALE: NOT TO SCALE	PROJECT NO: 0530.2000005	REVIEWED BY: LW	APPENDIX: B

UNIVERSAL ENGINEERING SCIENCES
BORING LOG

PROJECT NO.:	0530.2000005.0000
REPORT NO.:	
PAGE:	1

PROJECT: MPS 6600 Rehabilitation
S.E.C. Pondella Road and June Parkway
North Fort Myers, Lee County, FL

BORING DESIGNATION: **B-1** SHEET: **1 of 1**
SECTION: TOWNSHIP: RANGE:

CLIENT: McKim and Creed

LOCATION: See Boring Locaton Plan

REMARKS:

G.S. ELEVATION (ft):
WATER TABLE (ft): 4.0
DATE OF READING: 02/20/2020
EST. W.S.W.T. (ft):

DATE STARTED: 2/20/20
DATE FINISHED: 2/20/20
DRILLED BY: L/L JR/ED
TYPE OF SAMPLING: ASTM D1586

DEPTH (FT.)	SAMPLE	BLOWS PER 6" INCREMENT	N (BLOWS/ FT.)	W.T.	SYMBOL	DESCRIPTION	-200 (%)	MC (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PI	UCS (tsf)	ORG. CONT. (%)
0				▼		Dark Brown, Dark Gray and Gray Fine Sand (SP)						
5		9-11-13	24			Medium Dense Dark Brown Fine Sand (SP)						
		30-43-36	79			Fractured Rock						
		13-12-11	23			Medium Dense Light Brown Fine Sand (SP)						
10		10-9-9	18			Medium Dense Light Gray Silty Fine Sand with trace of Phosphates (SM)						
15		9-12-8	20									
						Very Stiff Light Gray Fine Sandy Clay with Rock Fragments (CL)						
20		12-11-9	20				71	28				
						Medium Dense Gray and Green Silty Fine Sand (SM)						
25		8-8-9	17				40	42				
30		5-6-7	13				50	48				
						Very Stiff to Stiff Green Clay (CL)						
35		6-8-13	21				95	90				
40		2-4-6	10			BORING TERMINATED						

BORING_LOG 0530.2000005.GPJ UNIENGSC.GDT 2/28/20

UNIVERSAL ENGINEERING SCIENCES

KEY TO BORING LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS (major portions retained on No. 200 sieve): includes (1) clean gravel and sands and (2) silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests.

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50.

FINE-GRAINED SOILS (major portions passing on No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count, or unconfined compression tests.

Descriptive Terms	Unconfined Compressive Strength kPa	SPT Blow Count
Very soft	< 25	< 2
Soft	25 to 50	2 to 4
Medium stiff	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very stiff	200 to 400	15 to 30
Hard	> 400	> 30

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

2. Surface elevations are based on topographic maps and estimated locations.

3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times.

SYMBOLS

▼ Measured Water Table Level

▽ Estimated Seasonal High Water Table

Major Divisions			Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limits above "A" line or P.I. greater than 7
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP	Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line or P.I. greater than 7
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, organic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt	Peat and other highly organic soils	

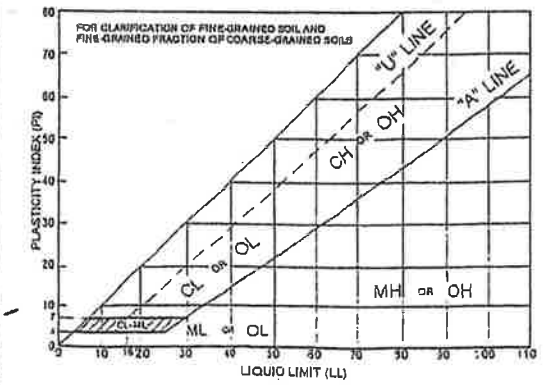
Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows:

Less than 5 percent..... GW, GP, SW, SP
More than 12 percent..... GM, GC, SM, SC
5 to 12 percent..... Borderline cases requiring dual symbols*

Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols

Particle Size	Sieve sizes	mm
Material		
Silt or clay	< #200	< 0.074
Sand		
Fine	#200 to #40	0.074 to 0.42
Medium	#40 to #10	0.42 to 2.00
Coarse	#10 to #4	2.00 to 4.76

Particle Size	Sieve	mm
Material		
Gravel		
Fine	#4 to 3/4 in.	4.76 to 19.1
Coarse	3/4 in. to 3 in.	19.1 to 76.2
Cobble	3 in. to 12 in.	76.2 to 304.8
Boulders	12 in. to 36 in.	304.8 to 914.4



Plasticity Chart

* When the percent passing a No. 200 sieve is between 5% and 12%, a dual symbol is used to denote the soil. For example: SP-SC, poorly-graded sand with clay content between 5% and 12%.

APPENDIX C

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Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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CONSTRAINTS AND RESTRICTIONS

WARRANTY

Universal Engineering Sciences has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Universal Engineering Sciences, as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Universal Engineering Sciences of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Universal Engineering Sciences to monitor field conditions and changes, to verify design assumptions and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Universal Engineering Sciences is responsible for the conclusions and opinion contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Universal Engineering Sciences.

CHANGED STRUCTURE OR LOCATION

This report was prepared in order to aid in the evaluation of this project and to assist the architect or engineer in the design of this project. If any changes in the design or location of the structure as outlined in this report are planned, or if any structures are included or added that are not discussed in the report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions modified or approved by Universal Engineering Sciences.

USE OF REPORT BY BIDDERS

Bidders who are examining the report prior to submission of a bid are cautioned that this report was prepared as an aid to the designers of the project and it may affect actual construction operations.

Bidders are urged to make their own soil borings, test pits, test caissons or other investigations determine those conditions that may affect construction operations. Universal Engineering Sciences cannot be responsible for any interpretations made from this report or the attached boring logs with regard to their adequacy in reflecting subsurface conditions which will affect construction operations.

STRATA CHANGES

Strata changes are indicated by a definite line on the boring logs which accompany this report. However, the actual change in the ground may be more gradual. Where changes occur between soil samples, the location of the change must necessarily be estimated using all available information and may not be shown at the exact depth.

OBSERVATIONS DURING DRILLING

Attempts are made to detect and/or identify occurrences during drilling and sampling, such as: water level, boulders, zones of lost circulation, relative east or resistance to drilling progress, unusual sample recovery, variation of driving resistance, obstructions, etc.; however, lack of mention does not preclude their presence.

WATER LEVELS

Water level readings have been made in the drill holes during drilling and they indicated normally occurring conditions. Water levels may not have been stabilized at the last reading. This data has been reviewed and interpretations made in this report. However, it must be noted that fluctuation in the level of the groundwater may occur due to variations in rainfall, temperature, tides, and other factors not evident at the time measurements were made and reported. Since the probability of such variations is anticipated, design drawings and specifications should accommodate such possibilities and construction planning should be based upon such assumptions and variations.

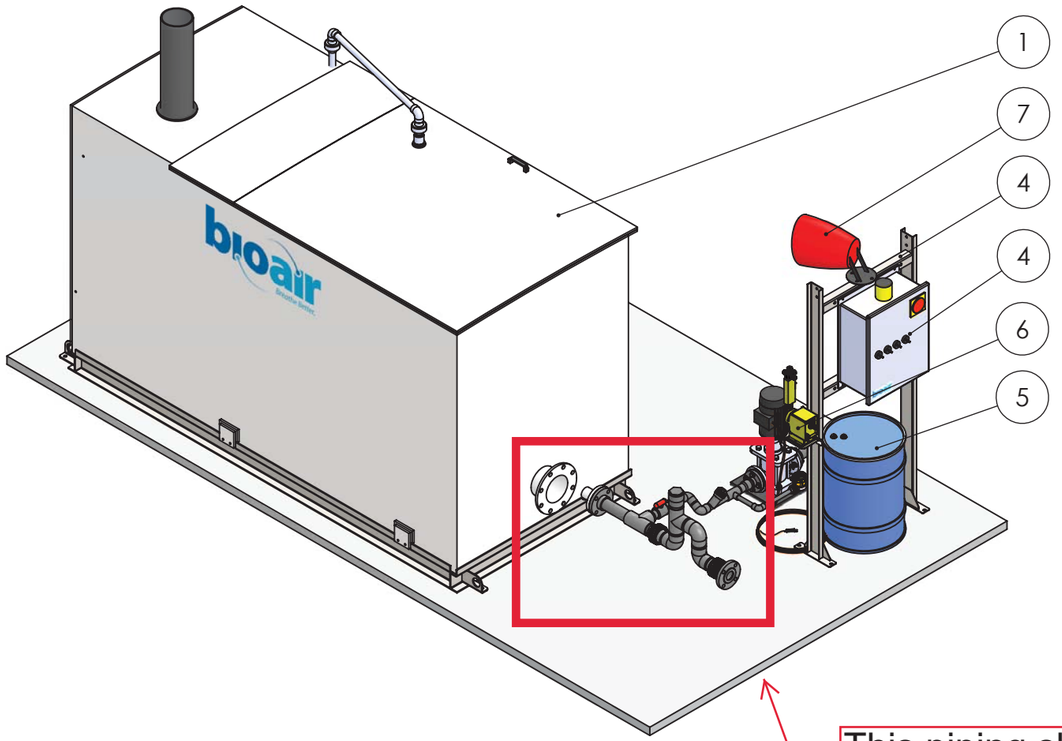
LOCATION OF BURIED OBJECTS

All users of this report are cautioned that there was no requirement for Universal Engineering Sciences to attempt to locate any man-made buried objects during the course of this exploration and that no attempt was made by Universal Engineering Sciences to locate any such buried objects which are subsequently encountered during construction that are not discussed within the text of this report.

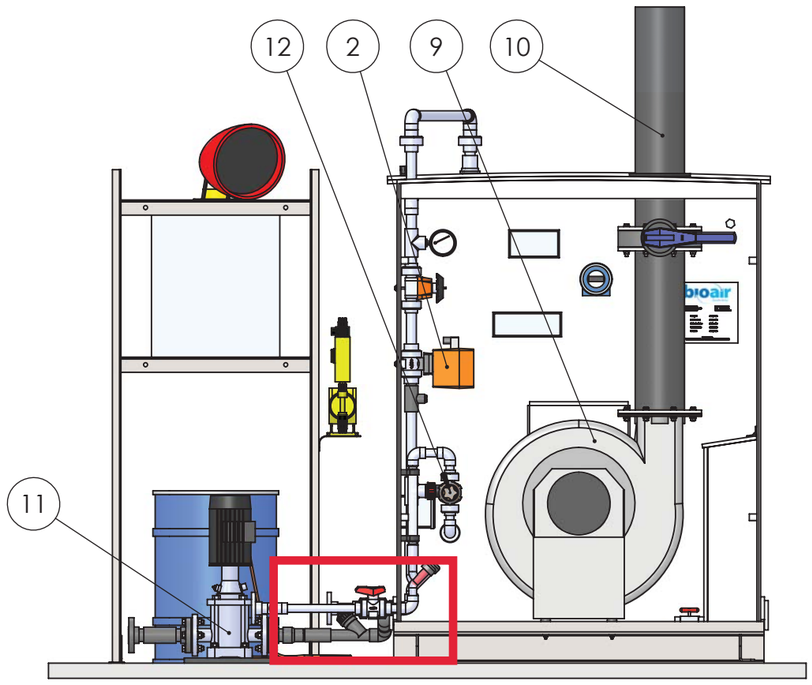
TIME

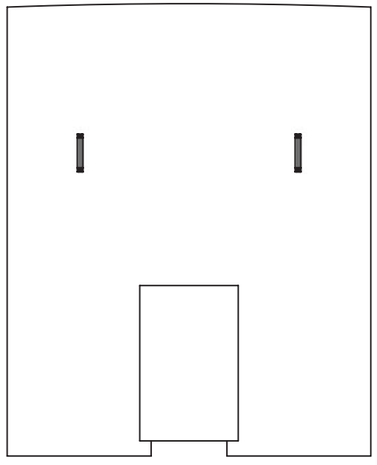
This report reflects the soil conditions at the time of investigation. If the report is not used in a reasonable amount of time, significant changes to the site may occur and additional reviews may be required.

REV.	DATE	ECN#	REVISION RECORD	DR	CK
A	08/11/2011			KZ	
E	10/12/2011		ELECTRICAL PANEL MATERIAL WAS FRP	KZ	
F	04/12/2012		RELOCATED FLAME DETECTOR TO PANEL STAND, ADDED ELECTRICAL CONNECTION DETAILS	TT	



This piping should be connected to a drain to allow process water to drain from the system





REMOVABLE CONTROL AREA COVER

ITEM	PART NUMBER	QTY	DESCRIPTION
1	RA451100_P1111	1	ECOPURE MINI REACTOR ASSEMBLY
2	WP1012000_P1111	1	IRRIGATION CONTROL SYSTEM Ø1" ANSI
4	CD1111	1	FRP ELECTRICAL PANEL
4	PS000100_P1111	1	316 SS PANEL STAND
5	NB150100	1	NUTRIENT TANK, 15GAL, HDPE
6	P031-297	1	LMI NUTRIENT PUMP WITH FM-PRO AND 4F VALVE
7	2350445	1	DRAEGER UV/IR FLAME 2300 FLAME DETECTOR
8	4543224	1	DRAEGER POLYTRON II XP EX IR COMBUSTIBLE GAS DETECTOR
9	BL000600	1	CAST ALUMINUM BLOWER
10	ST062900	1	HDPE EPM STACK Ø6"
11	RS000220	1	EPM STARTUP SYSTEM
12	MW000200	1	MAKE-UP WATER ASSEMBLY

MATERIAL: SEE TABLE

FINISH:

DRAWN BY	DATE	ENG APPR.	DATE	QC APPR.	DATE
KZ	08/11/2011				

PART NAME

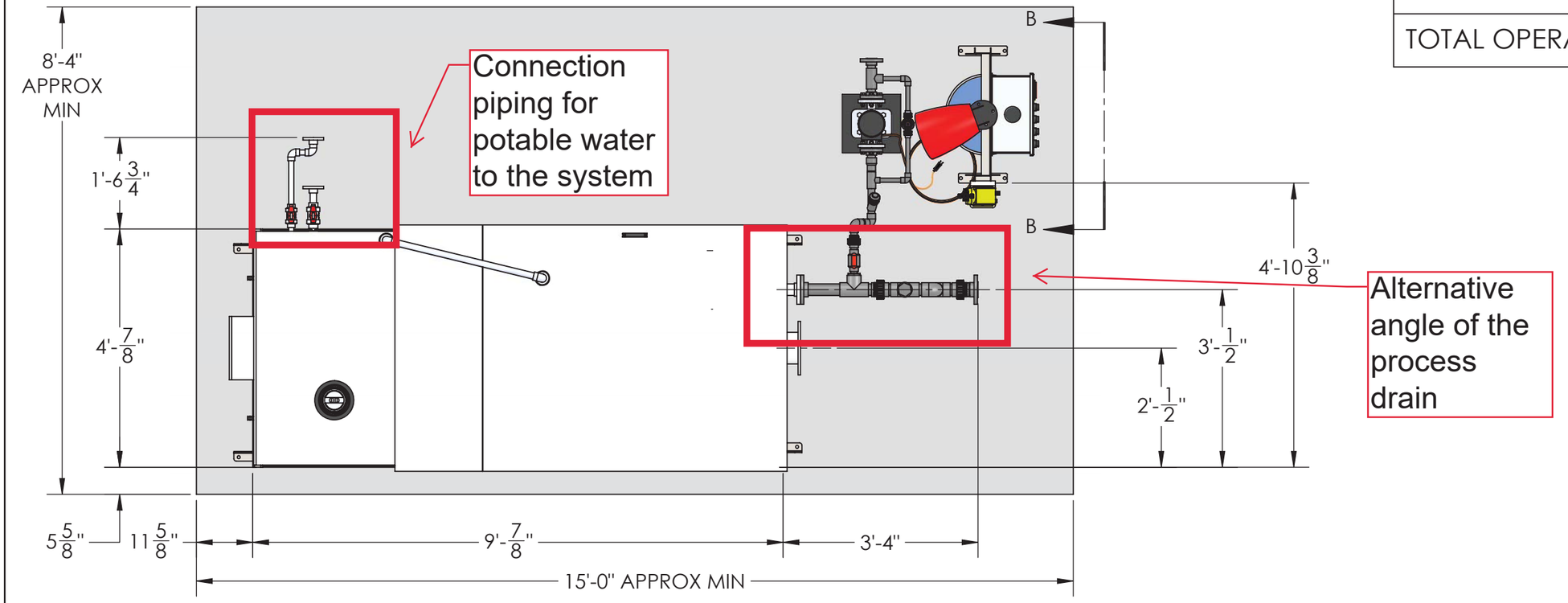
GENERAL ARRANGEMENT ECOPURE MINI START-UP OPERATION

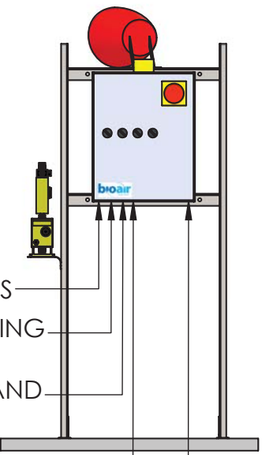
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
ANGULAR: ±1°
FRACTIONS: ±1/4
TWO PLACE DECIMAL: ±.060
THREE PLACE DECIMAL: ±.030

SIZE	DWG. NO.	REV
B	EPM451-P1111-SU-GA	F

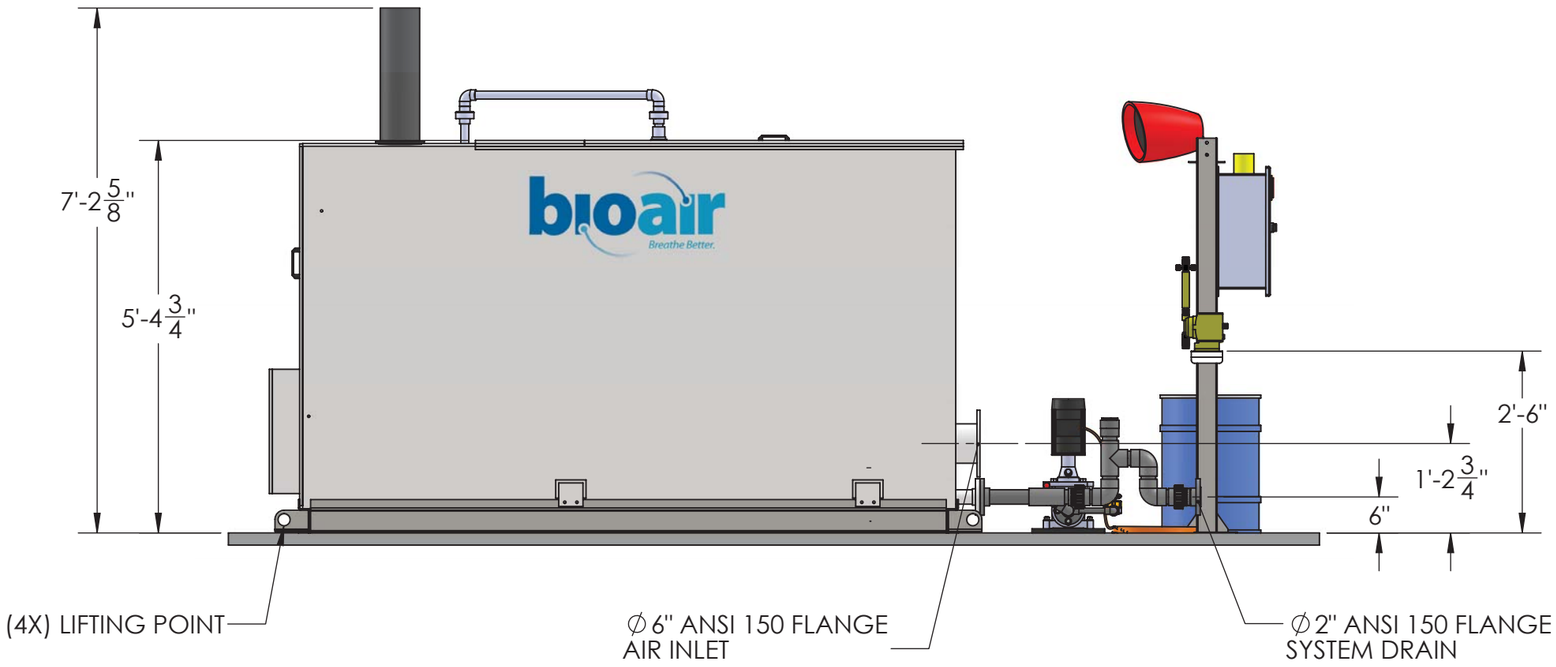
SCALE: 1 : 20 | SHEET 1 OF 3

TOTAL SHIPPING WEIGHT	1600 LBS
TOTAL OPERATING WEIGHT	2800 LBS





SECTION B-B
SCALE 1 : 25



CONTROL AREA COVER REMOVED FOR CLARITY

SIZE	DWG. NO.	REV
B	EPM451-P1111-SU-GA	F
SCALE: 1 : 25	SHEET 2 OF 3	