LEE COUNTY UTILITIES
WATER AND WASTEWATER TECHNICAL SPECIFICATIONS

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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

NOTE: Fill in the blanks and add additional work items under B as required.

1.2 DESCRIPTION OF WORK

A. General: The Work to be done under this Contract consists of the construction of a _____ facility as shown and specified in Contract Documents entitled _ _____.

B. 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 area and site 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.

C. 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.

D. 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.

NOTE: Use 1.3 if applicable.

1.3 CONSTRAINTS

A. The Contract Documents are intended to allow the CONTRACTOR flexibility in construction of the Work, however, the following constraints apply:

_____
_____
_____
_____
_____
_____
_____
_____

NOTE: Complete or delete as required.

1.4 WORK BY OTHERS

A. Work on the Project, which may take place concurrently with this CONTRACT and which is excluded from this CONTRACT, is as follows:

1.
2.
3.
4.

1.5 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.

1.6 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.

NOTE: Modify as necessary

1.7 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 within 10 days following 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 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. Required Copies: Submit three copies of each application on EJCDC Form No. 1910-8-E (1990) or approved equal. 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 MEASUREMENT AND PAYMENT

A. Payment shall be made on the basis of work actually performed completing each item in the Bid, such work including, but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, cleanup, and all other appurtenances to

complete the construction and installation of the work to the configuration and extent as shown on the drawings and described in the specifications. Payment for each item includes compensation for cleanup and restorations. Cleanup and surface restorations (including pavement replacement) will be considered as ten percent (10%) of each pay item and complete payment will not be made until cleanup, restorations and as-builts are completed.

NOTE: Edit as required.

1. Mobilization: Payment for mobilization will be made at the Contract lump sum price for the contractor's cost for mobilization, demolition, survey, insurance, audio-video tape of existing conditions, preparing a field office, identifying and securing a staging area and other applicable administrative charges as outlined in the Contract Documents and specified herein. Mobilization lump sum price shall not exceed two percent (2%) of the total Bid Amount. Payment for mobilization will be twenty-five percent (25%) of the lump sum amount to be included with the final payment request.

2. Performance and Payment Bond Premiums and Insurance: Performance and Payment Bond Premiums and Insurance lump sum price shall not exceed three percent (3%) of the total Bid Amount. Payment shall be divided equally over the number of pay request anticipated from the Notice to Proceed. No additional payments shall be made due to time extension.

3. Furnish and Install Utility Pipelines: Payment for furnishing and installing utility pipelines (various sizes and types) will be made at the Contract unit price per lineal foot for the pipe in place. This item includes all necessary fittings, connections to existing mains, labor, equipment and materials for the furnishing and laying of the pipe, signs, maintenance of traffic, dewatering, compaction, pipe bedding, backfilling, sheeting, restrained joint piping, mylar detectable tape, polyethylene sleeve, clamps, harnessing, plugs and caps, adapters, excavation of all material encountered including rock, backfill, replacement of grass, sod, clearing and grubbing, pavement, driveways, sidewalks, mailboxes, culverts, storm sewers, and other surface materials not specifically designated in the Bid, clean-up, sterilization, and tests. Measurement of the pipe shall be to the nearest foot along the centerline including the lengths of manholes, valves and fittings. Lineal footage measurement shall be horizontal. Cuts shall be measured from existing grade to the invert elevation of the sewer.

4. Furnish and Install Standard Precast Concrete Sanitary Sewer Manholes: Payment for furnishing and installing standard precast concrete sanitary manholes will be made at the unit price per manhole acceptably installed. This item includes all excavation, backfilling, compacted gravel or crushed stone bedding, sheeting, shoring, dewatering, concrete work and reinforcing, protection of adjacent facilities, manhole frames and covers, coatings and linings, manhole joints, bottom channels and sanitary sewer connections. All manholes shall conform to the Standard Sanitary Sewer Precast Manhole detail

shown on the Plans. This item does not include outside drop manholes or standard precast shallow manholes. Cuts shall be measured from existing grade to the invert elevation of the exiting sewer.

5. Furnish and Install Outside Drop Manholes: Payment for furnishing and installing outside drop manholes will be made at the unit price per drop manhole acceptably installed. This item includes all excavation, backfilling, compacted gravel or crushed stone bedding, sheeting. shoring, dewatering, concrete work and reinforcing, drop pipes and pipe connections, plugs for future connections, protection of adjacent facilities, manhole frames and covers, coatings and linings, manhole joints, bottom channels and sanitary sewer connections. All outside drop manholes shall conform to the Drop Manhole detail shown on the Plans. Cuts shall be measured from existing grade to the invert elevation of the exiting sewer.

6. Furnish and Install Valves and Boxes: Payment for furnishing and installing valves will be made at the appropriate Contract unit price per valve acceptably installed. This item includes the valve, box and all necessary labor, materials and equipment for installation, including valve stem and valve box extensions. This item also includes the installation of base material below the valve in accordance with the detail shown in the Plans.

7. Furnish and Install Fire Hydrant Assemblies: Payment for the furnishing and installing of fire hydrant assemblies will be made at the Contract unit price for each fire hydrant assembly acceptably installed. This item includes the tee installed on the utility main, all necessary fittings, joint restraint from the valve to the tee and necessary piping from the tee to the hydrant location with the installation of barrel section to meet finished grade. All piping shall be six-inch (6") ductile iron pipe from the tee to hydrant. The CONTRACTOR shall be responsible to set the hydrant to grade in accordance with the detail shown on the Plans.

8. Furnish and Install Permanent Blow-offs: Payment for furnishing and installing permanent blow-offs will be made at the appropriate Contract unit price per blow-off acceptably installed. This item includes the reinforced concrete thrust collar, piping, making pipe connections, valves, meter box, tie rods and all other work for a complete installation. All permanent blow-offs shall conform to the detail shown on the Plans.

9. Furnish and Install Tapping Sleeve and Valve: Payment for furnishing and installing tapping sleeves and valves will be made at the appropriate Contract unit price per tapping sleeve and valve acceptably installed. This item includes all piping, making pipe connections, tapping sleeve, valve and valve box, restrained joints, and all other work for a complete installation.

10. Furnish and Install Pump Station: Payment for the furnishing and installing the pump station will be made for at the Contract lump sum price for the pump

station acceptably installed. This item includes pumps, wet well structure, valve vault structure, fence, stainless steel hardware, aluminum wet well cover, aluminum valve vault cover, coatings, valves, pipe, fittings, water service, panel, electrical hardware, electrical connection, driveway, culvert, and all necessary materials and labor to complete the pump station in accordance with the project plans. Also included is the cost to connect electrical power to the pump station. The CONTRACTOR shall schedule with the local electrical company to place the pump station into service.

11. Furnish and Install 6-Inch Diameter Sanitary Sewer Services: Payment for furnishing and installing 6-inch diameter sanitary sewer services will be made at the appropriate Contract unit price per linear foot for P.V.C. and ductile iron pipe sewer service acceptably installed. This item includes all labor, equipment and materials for furnishing and installing all necessary pipe, fittings, connections, solids sleeves and adapters, protection of existing utilities and facilities, excavation, pipe bedding, sheeting, shoring, dewatering, compaction, cleanouts, service markers, plugs, detectable tape, removal and replacement of grass, sod, shrubs, pavement, driveways, culverts and storm sewers, mailboxes, sidewalks and other surface materials not specifically designated in the Bid, cleanup, testing, and all other work for a complete installation.

12. Furnish and Install 1-Inch Diameter Water Services: Payment for furnishing and installing 1-inch diameter water services will be made at the appropriate Contract unit price for each P.E. short side and long side service acceptably installed. This item includes all labor, equipment and materials for furnishing and installing all necessary pipe, fittings, connections, casing pipes, meter stops, meter box, tapping sleeves, protection of existing utilities and facilities, excavation, pipe bedding, dewatering, compaction, removal and replacement of grass, sod, shrubs, pavement, driveways, culverts and storm sewers, mailboxes, sidewalks and other surface materials not specifically designated in the Bid, cleanup, testing and all other work for a complete installation.

13. Remove and Replace Driveway: Payment for removing and replacing driveway will be made at the appropriate Contract Unit price per lineal foot of concrete or asphalt driveway shown on the Plans to be removed and replaced for water main construction. Driveways shall be replaced to match existing elevations and materials of construction. Surface restoration required for driveway removal and replacement shall be included in this item.

14. Remove and Replace Street Pavement Surface and Base: Payment for removing and replacing street pavement surface and base will be made at the appropriate Contract unit price per square yard for pavement surface and base installed in the work. All pavement surface and base shall be replaced in accordance with the detail shown on the Plans.

15. Furnish and Install Force Main Interconnection: Payment for furnishing and installing the force main interconnection will be made at the Contract lump sum

price for the interconnection acceptably installed. This item includes all labor, equipment and materials to install all necessary pipe, fittings, connections, tapping sleeve and valve with valve box, field measurements, protection of existing facilities, excavation, pipe bedding, dewatering, compaction, surface restoration, testing, cleanup and all other work for a complete installation.

16. Furnish and Install Unreinforced Concrete: Payment for furnishing and installing unreinforced concrete will be made at the Contract unit price per cubic yard for all unreinforced concrete installed as ordered in writing by the ENGINEER. All unreinforced concrete shall conform to the technical specifications. All unreinforced concrete installed in the work not shown on the Plans and not ordered by the ENGINEER in writing will not be measured for payment.

17. Special Pipe Bedding: Payment for special pipe bedding will be made at the Contract unit price per cubic yard of washed shell, gravel, or other acceptable material used in trench bottoms for pipe bedding where ordered in writing by the ENGINEER. If earth or sand is used for stabilizing the subgrade, no payment will be made under this item. Payment for earth or sand materials used in stabilizing the subgrade shall be included in the price for installing pipe.

18. Jack and Bore Crossing: Payment for furnishing and installing jack and bore in crossing will be made at the Contract unit price per lineal foot for the crossing place.

19. Maintenance of Traffic: Payment for maintenance of traffic will be made for at the Contract lump sum price.

END OF SECTION

SECTION 01 26 00

CHANGE ORDER AND FIELD DIRECTIVE CHANGE PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Definitions

B. Change Orders

C. Field Directive Change

1.2 DEFINITIONS

A. Change Order: Refer to the Change Order definition in Article 2 of the General Conditions.

B. Field Directive Change: Field Directive Change is a written directive to the CONTRACTOR issued on or after the effective date of the agreement; signed by the OWNER, recommended by the ENGINEER ordering an addition, deletion, or revision in the Work. A Field Directive Change will subsequently be followed by the issuance of a Change Order.

C. Overhead: Overhead is defined as the cost of administration, field office and home office costs, general superintendence, office engineering and estimating costs, other required insurance, materials used in temporary structures (not including form work), additional premiums on the performance bond of the CONTRACTOR, the use of small tools, scheduling costs, and all other costs incidental to the performance of the change or the cost of doing business.

1.3 CHANGE ORDERS

A. Initiation of Proposals:

1. From time to time, the OWNER or the ENGINEER may issue a Request for a Change Order Proposal. The Request will contain a description of the intended change with supplementary or revised Drawings and Specifications as applicable, and the projected time for accomplishing the change.

2. The CONTRACTOR may propose a change in the Work by submittal of a Change Order Request to the ENGINEER describing the proposed change with a statement of the reason for the change and the effect on the Contract time and price, along with supporting documentation.

B. Execution of Change Order Proposal:

1. When a Proposal is requested for changed work, submit proposal within 15 days following receipt of the Request from OWNER or ENGINEER. State the increase or decrease, if any, in Contract Completion time and Contract Price.

2. Explain proposal in sufficient detail to permit review by OWNER.

3. For Omitted Work the decrease in the Contract Price will be determined by the ENGINEER and will include appropriate amounts for profit and overhead.

4. The OWNER and ENGINEER will review the Proposal and may request additional information and documentation. Provide these items upon request.

5. If the OWNER decides to proceed with the change, the OWNER will issue a Change Order for signature first by the CONTRACTOR and then by the OWNER.

6. The CONTRACTOR will promptly complete the approved change in the Work on receipt of the executed Change Order.

   a. Failure to sign the Change Order does not relieve the CONTRACTOR from performing the Work if the Change Order is signed by the OWNER.

C. Compute the cost of both additive and deductive changes in the Work in accordance with Article 11 of the General Conditions and as follows:

1. Include, the costs of labor, crew foreman and general foreman performing or directly supervising the changed Work on the site. Include travel and subsistence, but only to the extent incurred.

2. To the labor cost add all net premium for Workman's Compensation, taxes pursuant to the Federal Social Security Act, and payments required under State and Federal unemployment laws.

3. Add necessary extra materials, delivered at the site.

NOTE: In Items 5 and 6 confirm percentages and edit as required.

4. Include Subcontractor's costs, determined by items 1 through 4 in the preceding subparagraphs, including a maximum of 10 percent overhead and 10 percent profit for the first $20,000; 7-1/2 percent overhead and 7-1/2 percent profit on the next $30,000; and 5 percent overhead and 5 percent profit on balance over $50,000.

5. For all subcontract work add 5 percent overhead and 5 percent profit to the subcontractor's costs as determined in paragraph 5. For work performed by the CONTRACTOR's own forces add a maximum of 10 percent overhead and 10 percent profit for the first $20,000; 7-1/2 percent overhead and 7-1/2 percent profit on the next $30,000; and 5 percent overhead and 5 percent profit on balance over $50,000.

1.4 FIELD DIRECTIVE CHANGE

A. Initiation by OWNER: OWNER may issue a Field Directive Change with a Notice to Proceed without a prior Request for a Change Order Proposal or the CONTRACTOR's signature.

B. Payment Determination: The OWNER will designate the method of determining the amount of compensation or credit, if any, based on one of the methods contained in Article 11 of the General Conditions.

C. Timing: Proceed with the change in the Work immediately upon receipt of the Field Directive Change.

D. Addition to Contract: The Field Directive Change will be incorporated into the Contract Documents via a Change Order at a later date.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS PAGE)

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. Maintenance of traffic shall be in accordance with Sections 01 55 26 and 33 05 02.

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 substructure 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 plant personnel that will be associated with the project. Representatives of regulatory agencies, subcontractors, and principal suppliers may also attend when appropriate.

D. Chair and Minutes: The preconstruction conference will be chaired by the Owner 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 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 subCONTRACTOR/VENDORs. Suppliers may be invited as appropriate. Minutes of the meeting will be maintained by CONTRACTOR/VENDOR and reviewed by ENGINEER prior to distribution by the CONTRACTOR/VENDOR. Distribute reviewed minutes to attendees within ___ calendar days after each meeting.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

NOTE: Review this section carefully. If Project Scope is relatively simple and straightforward this Specification is to be used. If Project is complex use Section 01 32 17.

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 work day 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. Structural steel erection

9. Wall and roof construction

10. Piping and equipment installation

11. Electrical work activity

12. Heating, ventilating, and air conditioning work activity

13. Plumbing work activity

14. Sewer installation

15. Connection to existing sewers

16. Water main installation

17. Miscellaneous concrete placement

18. Subcontractor's items of work

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

20. Final cleanup

21. Allowance for inclement weather

22. 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)

NOTE: Review this section carefully. If Project Scope is complex this Specification is to be used. If project is relatively simple and straightforward use Section 01 32 16.

SECTION 01 32 17

PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scheduling Responsibilities

B. Submittals

C. Network Requirement

D. Cost Loading

E. Progress of the Work

F. Schedule Updates

1.2 SCHEDULING RESPONSIBILITIES

A. Format: Use the Critical Path Method to schedule and monitor job progress. Provide all information concerning sequencing logic and duration of all activities as well as the initial CPM logic network diagram and tabulated report data.

B. Initial Submittal: Within 30 days after the Notice to Proceed, submit the initial logic network diagram to the ENGINEER for review. Within 60 days submit final network diagram.

C. Updates: On a monthly basis, furnish to the ENGINEER updated information on logic, percent complete, actual start and finish date and direction changes. Distribute copies at Progress Meetings.

D. Adherence: Schedule and direct forces in a manner that will allow for completion of the Work within the Contract time specified.

E. Accuracy: Provide initial schedule and subsequent update information to reflect the best efforts of the CONTRACTOR and all subcontractors as to how they envision the Work to be accomplished. Similarly, all progress information must be an accurate

representation of the CONTRACTOR's and subcontractor's actual performance. Complete Work under this Contract in accordance with the established CPM schedule.

F. Cost of Revisions: At no additional cost to the OWNER, revise schedule when in the judgement of the ENGINEER, it does not accurately reflect the actual prosecution of the Work.

1.3 SUBMITTALS

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

B. CPM Schedule:

1. Within 30 days after the date stated in the Notice to Proceed, submit to the ENGINEER prints of a proposed CPM network diagram and tabular reports for the first 90 days of the Work. Draw initial logic diagram as described herein and submit on sheets 24 inches by 36 inches. Include both procurement and construction activities. Schedule a review meeting with the ENGINEER and the OWNER (or OWNER's Consultants) within 2 weeks of its submission. Revise and resubmit the 90 day schedule until it is acceptable to the ENGINEER.

2. Within 60 Days after the Notice to Proceed, submit to the ENGINEER 3 sets of the proposed CPM logic diagram and tabular reports for the entire Contract duration. Include both procurement and construction activities. Sort these tabular reports by total float and activity number. Provide a predecessor/successor report, resource loading report, and project calendar. Draw logic diagram as described.

3. Schedule review meeting with the ENGINEER and the OWNER within 2 weeks of its submission. If a review of the submitted CPM Schedule indicates a work plan which will not complete the Work within the time requirements stated in the Contract, reallocate resources, revise the CPM Schedule and resubmit it until it is acceptable. Failure by the CONTRACTOR to submit an acceptable schedule may, at the OWNER's sole discretion, be cause for the withholding of any partial payment otherwise due under the Contract.

4. Review of the Schedule by the ENGINEER will not constitute ENGINEER's representation that the Work can be completed as shown on the Schedule.

C. Submittals Schedule: In addition to the above scheduling requirements, submit a complete and detailed listing of anticipated submittals during the course of the Contract. Coordinate these submittals with those of subcontractors and suppliers. Identify each submittal by Contract drawing number and Specification section number. Show the anticipated submission due date for each submittal along with the date on which its return is required. For planning purposes, <u>average</u> turn-around time for shop drawings will be 14 Calendar Days after receipt. Longer durations for review

may be required and will not be considered a basis for a claim for additional time or compensation. For submittals on the critical path, at the time of submission mark transmittal in red with the words "Critical Path".

1. Submit Submittal schedule within 10 Days from the Notice to Proceed. Revise as required and incorporate the dates and review durations into the CPM Schedule.

1.4 NETWORK REQUIREMENTS

A. Diagram: Show in the network diagram the order and interdependence of activities and the sequence in which the Work is to be accomplished. The purpose of the network analysis diagram is to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of succeeding activities. Follow a time scaled precedence format. Time scale the detailed network diagram showing a continuous flow from left to right.

B. Develop the schedule activities into two major groups; procurement activities; and construction activities:

1. Include the following procurement activities as a minimum:

a. Permits
b. Easements
c. Submittal items
d. Approval of submittal items
e. Fabrication and delivery of submittal items.

Tie each of the above procurement items logically to the correct construction activity in the overall CPM construction schedule.

2. Under construction activities section utilize physical work activities to describe how the job will be constructed.

C. Activity Durations: Break the work into activities with durations of 1 to 20 Days each, except for nonconstruction activities, such as procurement of materials and delivery of equipment, and other activities which may require longer durations. To the extent feasible, group activities related to a specific physical area of the project on the network for ease of understanding and simplification. The ENGINEER and OWNER will review the selection and number of activities.

1. For each activity on the network indicate the following:

a. A single duration, no longer than 20 Days (i.e., the single best estimate of the expected elapsed time considering the scope of work involved in the activity) expressed in Days. Include normal holidays and weather delay. Show critical path for the schedule.

b. Assign an activity I.D. number to each activity. The I.D. number will be numeric with a maximum of 5 digits.

c. Include a brief description of the activity. If this description is not definitive, a separate listing of each activity and a descriptive narrative may be required.

d. Cost load each activity, except for procurement activities, to indicate the total estimated costs of the activity. No activity shall exceed $60,000 except for equipment items. Assign material costs to delivery activities.

e. Load each activity with the estimated work hours to be expended on each activity.

D. Incomplete Schedule: Failure to include on the network any element of work required for the performance of this Contract does not excuse the CONTRACTOR from completing all Work required within the applicable completion time, notwithstanding the network review by the ENGINEER or the OWNER and OWNER's Authorized Representative.

1.5 COST LOADING

A. Schedule of Values: Allocate a dollar value to each activity on the construction schedule as specified. Include in dollar value the cost of labor, equipment, and material, and a pro rata contribution to overhead and profit. The sum of the activities cost shall be equal to the total contract price. In submitting cost data the CONTRACTOR certifies that it is not unbalanced and that the value assigned to each activity represents the CONTRACTOR's estimate of the actual costs of performing that activity.

B. Documentation: If, in the opinion of the ENGINEER, the cost data does not meet the requirements for a balanced Contract Price breakdown, present documentation to the ENGINEER substantiating any cost allocation. If an activity on the construction schedule has been assigned a disproportionate allocation of direct costs, overhead and profit the cost allocations will be considered unbalanced.

1.6 PROGRESS OF THE WORK

A. Delays to Critical Path: Whenever it becomes apparent from the current monthly CPM Schedule update that delays to the critical path have resulted and these delays are through no fault of the OWNER, and hence, that the Contract completion date will not be met, or when so directed by the OWNER, take one or more of the following actions to improve the Completion Date at no additional cost to the OWNER.

1. Increase construction labor in such quantities and crafts as will substantially eliminate the backlog of Work.

2. Increase the number of working hours per shift, shifts per day, or days per week; the amount of construction equipment; the forms for concrete work; etc., or any combination of the foregoing to substantially eliminate the backlog of Work.

3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities, and comply with the revised schedule.

4. Submit to the ENGINEER, the OWNER or OWNER's Authorized Representatives for review, a written statement of the steps proposed to be taken to remove or arrest the delay to the schedule. Failure to submit a written statement of the steps to be taken or failure to take such steps as required by the Contract, may result in the OWNER directing the level of effort in labor (trades), equipment, and work schedule (overtime, weekend and holiday work, etc.) to be employed by the CONTRACTOR in order to remove or arrest the delay to the critical path in the accepted schedule. Promptly provide such level of effort at no additional cost to the OWNER. In addition, should schedule delays persist, the CONTRACTOR's surety will be asked to attend meetings at which schedule is updated.

5. If the requirements of this provision are not complied with, the OWNER at the OWNER's sole discretion, will withhold, partially or in total, payments otherwise due for work performed under this Contract. Any withholding of monies is not a penalty for noncompliance, but is an assurance to the OWNER that funds will be available to implement these requirements should the CONTRACTOR fail to do so.

1.7 SCHEDULE UPDATES

A. Monthly Meetings: If determined by the OWNER, a monthly Schedule Update Meeting will be held 1 week prior to the progress meeting at the construction site to review and update the CPM Schedule. The Schedule Update Meeting will be chaired by the ENGINEER and attended by the OWNER and the CONTRACTOR. Actual progress of the previous month will be recorded and future activities will be reviewed. The duration of activities and their logical connections may be revised as needed. Decisions made at these meetings and agreed to by all parties are binding with the exception that no contract completion dates will be modified without formal written requests and acceptance as specified herein. In the event a monthly Schedule Update Meeting is not required by the ENGINEER, the CONTRACTOR shall submit the update information to the OWNER and the update worksheets provided with each previous update. In either case the CONTRACTOR must provide the following information for each update at a minimum:

1. Actual start and finished dates for all completed activities.

2. Actual start dates for all started but uncompleted activities including remaining durations.

B. Withholding of Payments: Failure to provide specified updated information or failure to attend progress meetings may result in the withholding of progress payments.

C. Time Extensions: If in accordance with the provisions of Article 12 of the General Conditions, the OWNER or ENGINEER finds that the CONTRACTOR is entitled to any extension of the Contract completion date under the provisions of the Contract, the OWNER's determination as to the total number of Days extension will be based upon the current accepted and updated CPM Schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. Actual delays in activities which, according to the CPM Schedule, do not affect any contract completion date shown by the critical path in the network, do not have any effect on the Contract completion date or dates and therefore, will not be the basis for a change in Contract completion time.

D. Schedule Adjustments: From time to time it may be necessary for the Contract schedule and completion time to be adjusted by the OWNER to reflect the effects of job conditions, acts or omissions of other contractors not directly associated with this Contract, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER or OWNER's representatives, and other unforeseeable conditions. Under such conditions, the OWNER will direct the CONTRACTOR to reschedule the Work to reflect the changed conditions and will grant, in writing, schedule extensions affecting the Contract completion time. No additional compensation will be made to the CONTRACTOR for such schedule adjustments.

E. Acceleration Costs: Additional compensation will be made to the CONTRACTOR in the event the OWNER requires the project completion prior to the completion date shown on the CONTRACTOR's accepted schedule. The OWNER, therefore, has the right to accelerate the schedule and the CONTRACTOR will be compensated for such acceleration as long as such acceleration is not required through fault of the CONTRACTOR. Available total float in the CPM Schedule may be used by the OWNER and OWNER's representatives as well as by the CONTRACTOR.

F. Float: Without obligation to extend the overall completion date or any intermediate completion dates set out in the CPM network, the OWNER may initiate changes to the Contract Work that absorb float time only. OWNER-initiated changes that affect the critical path on the CPM network shall be the sole grounds for extending (or shortening) said completion dates. CONTRACTOR initiated changes that encroach on the float time identified in the CPM network may be accomplished with the OWNER's concurrence. Such changes, however, shall give way to OWNER-initiated changes competing for the same float time.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS PAGE)

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. Submit 3 hard copies plus 1 PDF.

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 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 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 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 3 sets of samples in final submittal, 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 2 executed copies. Provide 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 2 copies. Provide 10 copies of final property survey (if any).

(2) Condition Surveys: Furnish 2 copies.

4. Certifications:

a. Refer to Specification sections for specific requirement on submittal of certifications. Submit 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

(NO TEXT FOR THIS PAGE)

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 2 through 16 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 the OWNER or his authorized Representatives or inspection bureaus without 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, reimburse the OWNER for expenditures incurred in making such tests.

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. Operate work or portions of work for a minimum of 100 hours or 14 days continuous service, whichever comes first. For those items of equipment which would normally operate on wastewater or sludge, plant effluent may be used if available when authorized by ENGINEER. If water can not properly exercise equipment, conduct 100-hour test after plant startup. Conduct test on those systems which require load produced by weather (heating or cooling) exercise only when weather will produce proper load.

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.

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 55 26

TRAFFIC REGULATION

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. General Requirements

B. Traffic Control

1.2 RELATED SECTIONS

A. Section 33 05 02 – Roadway Crossings by Open Cut

1.3 GENERAL REQUIREMENTS

A. 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.

B. 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.

C. 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 which are used by the CONTRACTOR and which interfere with the driving or walking public.

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

E. The requirements specified herein are in addition to the plan for Maintenance of Traffic as specified in Section 33 05 02.

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.

1.4 TRAFFIC CONTROL

A. The necessary precautions 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 provide at least 72 hours notification to the State, County, or municipal Department of Transportation of the necessity to close any portion of a roadway carrying vehicles or pedestrians so that the final approval of such closings can be obtained at least 48 hours in advanced. At no time will more than one (1) lane of roadway be closed to vehicles and pedestrians. With any such closings adequate provision shall be made for the safe expeditious movement of each.

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 port 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.

NOTE: When easements are required to accomplish the work, and such easements have been acquired by the OWNER, insert the easement provisions applicable to the Contractor's work in this section. Edit text as appropriate. Delete if there is no work on private property.

C. Work on Private Property: Work on this project will require operations on private property, rights of way or easements. The OWNER has secured the appropriate easements or rights of entry from the affected property owners. Comply with all easement or rights of entry provisions including the following:

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Conduct operations along rights-of-way and easements through private property to avoid damage to the property and to minimize interference with its ordinary use. Upon completion of the Work through such property, restore the surface and all fences or other structures disturbed by the construction as nearly as possible to the preconstruction conditions. Do not remove any material from private property without the consent of the property owner or responsible party in charge of such property.

Save the OWNER harmless from any claim or damage arising out of or in connection with the performance of work across and through private property.

D. 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.

E. 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. Properly 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

(NO TEXT FOR THIS PAGE)

SECTION 01 61 00

MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description

B. Substitutions

C. Manufacturer's Written Instructions

NOTE: Include "OWNER PROCURED EQUIPMENT" if OWNER procures equipment for installation by CONTRACTOR.

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.

NOTE: Add subsection on "OWNER PROCURED EQUIPMENT" specifying installation requirements if OWNER procures equipment for installation by CONTRACTOR.

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: Furnish to the ENGINEER 10 copies and a PDF of an Operation and Maintenance Manual for all equipment and associated control systems furnished and installed.

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 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.

NOTE: Edit if valves are not to be numbered.

6. One valve schedule giving valve number, 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 in Articles 6 and 13 of the General Conditions.

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 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 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

NOTE: Include training requirement in specification section for equipment and systems listed.

A. Training: Provide the services of knowledgeable, technically competent, factory trained specialists to instruct (Plant) (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 (Plant) (Pump Station) during regular hours on weekdays.

B. Provide training for the following:

NOTE: List each item of equipment for which training is required.

Specification	Equipment Name	Minimum Hours

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: The OWNER will provide reference points for the work as described in the General Conditions. 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.

1. Keep ENGINEER informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established, and any checking deemed necessary by ENGINEER may be done, with minimum inconvenience to the ENGINEER and at no delay to CONTRACTOR. It is the intention not to impede the Work for the establishment of control points and the checking of lines and grades set by the CONTRACTOR. However, when necessary, suspend working operations for such reasonable time as the ENGINEER may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.

2. 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 Mean Sea Level Datum Plane, 1988 General Adjustment, of the United States Coast and Geodetic Survey 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 bench marks 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.

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 02 83 00

LEAD ABATEMENT

PART 1 GENERAL

1.1 SUMMARY

A. This specification details the requirements for worker protection, containment, environmental protection, and waste disposal for the removal of lead paint when required by the Contract Documents before repainting or recoating. The CONTRACTOR shall implement programs and procedures which comply with the requirements of the specification and all applicable Federal, State and Local OSHA and EPA Standards and regulations. The CONTRACTOR shall perform the work with a minimal impact on the environment and protect all workers, OWNER and ENGINEER from lead and other safety and health hazards.

B. The CONTRACTOR shall obtain the services of a Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene in comprehensive practice. The Certified Industrial Hygienist shall:

1. Certify training.
2. Review and approve lead-containing paint removal plan for conformance to the applicable referenced standards
3. Inspect lead-containing paint removal work for conformance with the approved plan
4. Direct monitoring
5. Ensure work is performed in strict accordance with specifications and applicable codes and regulations at all times.
6. Ensure hazardous exposure to personnel and to the environment are adequately controlled at all times.

1.2 REFERENCES

A. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI Z88.2 1980 Respiratory Protection

B. CODE OF FEDERAL REGULATIONS

1. 29CFR 1910.134 Respiratory Protection
2. 29CFR 1910.1025 Lead
3. 29CFR 1910.1200 Hazard Communication
4. 29CFR 1926.55 Gases, Vapors, Fumes, Ducts, and Mists
5. 29CFR 1926.62 Lead Construction Industry Standard
6. 40CFR 260 Hazardous Waste Management Systems: General

7.	40CFR 261	Identification and Listing of Hazardous Waste
8.	40CFR 262	Regulations for Hazardous Waste Generators
9.	40CFR 263	Regulations for Hazardous Waste Transporters
10.	40CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
11.	40CFR 265	Interim Status Standards for Owner's and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
12.	40CFR 266	Standards for the Management of Specific Hazardous Waste and Specific types of Hazardous Waste Management Facilities

C. RESOURCE AND RECOVERY ACT (RCRA)

1. Hazardous Waste Characterization
2. Toxic Characteristic Leaching Procedure (TCLP)

D. NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY & HEALTH (NIOSH):

1. NIOSH Method 7082
2. NIOSH 81-123, Occupational Health Guidelines for Chemical Hazards

E. OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA):

1. OSHA CPL 2-2.20A, Chapter VIII: Sampling for Surface Contamination
2. OSHA Pub 3126 Working with Lead in the Construction Industry

F. STEEL STRUCTURES PAINTING COUNCIL (SSPC)

1. Guide 5 Guide to Maintenance Painting Programs
2. Guide 61 (CON) Guide for containing Debris Generated During Paint Removal Operation
3. Guide 71 (DIS) Guide for the Disposal of Lead Containment Surface Preparation Debris.

1.3 SUBMITTALS

A. PRE-JOB SUBMITTALS: These submittals shall be made at least two (2) weeks before the start of any field work. Approval of the plan must be obtained prior to the start of any paint removal work.

B. LEAD CONTAINING PAINT REMOVAL PLAN: Submit a detailed job-specific plan of the work procedures to be used in the removal of lead-containing paint. Obtain approval of the plan prior to the start of paint removal work. Prior to beginning work, the CONTRACTOR and CIH shall meet with the OWNER’s representative to discuss in detail the lead containing paint removal plan, including work procedures and precautions. The plan shall include:

1. location, size, and details of lead control area.
2. location and details of decontamination rooms, change rooms, shower facilities and mechanical ventilation system.
3. eating, drinking, smoking and restroom procedures, interface of trades.
4. sequencing of lead related work,
5. collected wastewater and paint debris disposal plan
6. air sampling plan
7. respirators, protective equipment
8. a detailed description of the method of containment of the operation to ensure that airborne lead concentrations of 30 micrograms per cubic meter of air are not exceeded outside of the lead control area.
9. air sampling, training and strategy, sampling methodology, frequency, duration of sampling, and qualifications of air monitoring personnel in the air sampling portion of the plan.

C. CONTRACTOR'S TEST LABORATORY: Submit name, address and telephone number of the CONTRACTOR's testing laboratory selected to analyze the representative samples of wash water and debris by TCLP as required. This submittal must be approved by the ENGINEER prior to the start of lead removal work.

D. HAZARDOUS WASTE MANAGEMENT PLAN: Submit a Hazardous Waste Management Plan for OWNER's approval. The Hazardous Waste Management Plan shall comply with applicable requirements of federal, state, and local hazardous waste regulations and address:

1. Identification of hazardous wastes associated with the work.
2. Estimated quantities of wastes to be generated and disposed of.
3. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA, state hazardous waste permits and EPA Identification numbers.
4. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.
5. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
6. Spill prevention, containment, and cleanup contingency measures to be implemented.
7. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.
8. Cost for hazardous waste disposal according to this plan.

E. MEDICAL EXAMINATION: Before exposure to lead-contaminated dust, provide workers with a comprehensive medical examination as required by 29 CFR 1910.1025 and 29 CFR 1910.1200. The examination will not be required if adequate records show that employees have been examined as required by 29 CFR 1910.1025 within the last year. Maintain complete and accurate medical records of employees

for a period of at least 40 years or for the duration of employment plus 20 years, which ever is longer.

F. STATEMENTS:

1. Qualifications of CIH
2. Lead containing paint removal plan
3. Hazardous waste management plan

G. POST JOB SUBMITTALS:

1. Completion Date and Certificate of Completion.
2. Hazardous waste manifests (within 20 days of shipment offsite).
3. Employee Listings: An alphabetical listing of each employee used on this project and the dates that each employee worked on this project.
4. Employee Air Monitoring Results: A notarized copy of employee air monitoring results relative to OSHA respiratory level compliance.
5. Daily Sign In/Out Logs: Copies of logs showing each person who entered the work area. These logs shall contain the date, name, social security number, company represented and reason for entry into the work area.

H. SOIL TESTING

1. Soil samples shall be taken at the site before any work is started. Four (4) samples shall be given to the OWNER, and four (4) to the CONTRACTOR for lead analysis. Following the abrasive blast cleaning and painting operations, four (4) additional soil samples shall be taken and analyzed for lead content. The ENGINEER shall determine the location of the soil samples. Soil samples shall be analyzed for lead content by a laboratory approved by the State of Florida and the ENGINEER. The cost of testing and analysis shall be borne by the CONTRACTOR including sampling and transporting.
2. Sampling and analysis shall be performed in accordance with a Florida Department of Environmental Protection approved comprehensive quality assurance plan.

I. DEFINITIONS

1. OSHA Occupational Safety and Health Administration.
2. NIOSH National Institute of Occupational Safety and Health.
3. CIH Certified Industrial Hygienist.
4. EPA United States Environmental Protection Agency
5. NESHAPS National Emissions Standard for Hazardous Air Pollutants.
6. TCLP Toxic Characteristic Leaching Procedure.
7. PEL Permissible Exposure Limit
8. *Abate or Abatement*: The elimination of exposure to lead-based substances that may result in lead toxicity or poisoning, by the removal of or encapsulation of

lead-containing substances, by thorough cleanup procedures, and by post-cleanup treatment of surfaces.

9. *Area Monitoring*: The sampling of airborne lead concentrations within the lead control area and outside the exclusion boundary which may reach the breathing zone of CONTRACTOR employees or other personnel.
10. *CONTRACTOR*: Any business entity, public unit, or person performing the actual abatement for a lead abatement project.
11. *Containment System*: A containment system includes the tarps, screens, supports, shrouds and scaffold utilized to enclose a paint removal tool or enclose the entire worksite. Ground covers are also utilized as part of a containment system. When an existing floor, concrete slab, or the ground serves as the base of the containment, it shall be completely covered with impervious material such as solid panels of plywood or flexible materials such as tarpaulins. The materials shall be maintained throughout the project to avoid loosing debris through rips, tears, or breaks in the coverings. When the structure being prepared serves as the floor (e.g. bottom interior of tank), it shall remain uncovered to provide access for surface preparation and painting. The purpose is to minimize or prevent abrasive blast debris from entering into the environment and contain the blast debris within for collection and proper disposal.
12. *Decontamination Unit*: A series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. For the purposes of this project, a decontamination unit shall consist of a free-standing enclosed room with hot and cold or warm running water suitably arranged for complete showering during decontamination which is in close proximity to the work area(s).
13. *Equipment Decontamination Enclosure System*: A decontamination enclosure system for materials and equipment, typically consisting of a washroom, an airlock, and a holding area.
14. *Enclosure*: Procedures necessary to completely enclose material containing lead-based paint behind airtight, impermeable, permanent barriers.
15. *Equipment Decontamination Enclosure System*: A decontamination enclosure system for materials and equipment, typically consisting of a washroom, an airlock, and a holding area.
16. *Equipment Room*: A contaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of contaminated clothing and equipment.
17. *HEPA filter:*A High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97 percent of non-dispersed particles greater than 0.3 microns in diameter.
18. *HEP Vacuum Equipment*: Vacuuming equipment equipped with a HEPA-filtration system.
19. *Lead Abatement Project*: Any work performed in order to abate the presence of a lead-containing substance.
20. *Lead-Containing Substance*: Any paint, or other surface coating material containing more than 0.06 percent lead by weight calculated as lead metal in the dried solid.

21. *Lead Control Area*: An area where lead paint removal operations are performed which is isolated by physical boundaries to prevent unauthorized entry of personnel thereby preventing the exposure to, or spread of lead. Physical boundaries shall be established and located such that the level of airborne lead shall not exceed 30 micrograms per cubic meter of air outside of the established boundary at any time.
22. *Lead Permissible Exposure Limit*: The exposure limit as required by 29 CFR 1910.1026 or 29 CFR 1926.55, as applicable.
23. *Removal*: The act of removing lead containing or contaminated materials from the structure under properly controlled conditions to a suitable disposal site.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 CONTRACTOR OPERATIONS

A. The CONTRACTOR will carry out the lead paint removal operations in strict accordance with the approved lead removal plan and the requirements of this contract.

3.2 TRAINING

A. CONTRACTOR and CONTRACTOR employees will be trained by the Certified Industrial Hygienist in the proper handling of lead; health hazardous and risks involved, including the illness possible from exposure to lead; use and limits of the respiratory equipment to be used; and the importance of engineering and other hazard control techniques and procedures used during lead removal. Personnel who will perform CONTRACTOR's personnel air monitoring required by this Contract shall be trained and qualified by the CIH to perform such monitoring.

B. Only properly trained personnel shall be permitted to enter the containment area.

3.3 WARNING AND CAUTION SIGNS

A. The CONTRACTOR shall provide signs posted at approaches to lead control areas. These signs shall be posted at such a distance that they may be read and necessary precautions taken prior to entering the control areas. Caution labels shall also be posted on lead waste disposal containers.

B. Warning signs shall comply to 29CFR 1910.145 paragraph (d) (4) and shall display the following legend:

WARNING
LEAD WORK AREA
POISON
NO SMOKING, EATING OR DRINKING

3.4 DISPOSAL OF USED ABRASIVE:

A. Test used abrasive in accordance with 40 CFR 261 to determine if it is a hazardous waste. Handle and dispose of hazardous waste in accordance with local State rules and regulations for Hazardous Waste Generation, Transportation, Treatment, Storage and Disposal, 40 CFR 260, 261, 262, 263, 264, 265, and 266.

3.5 DISPOSAL OF WASH WATER

A. Residual water from pressure washing operations shall be collected and filtered with a two stage filter. The first filter stage being a 100 micron unit and the second, a 1 micron unit. The filtered water shall be tested and disposed of properly according to the test results. The filtered out paint chips and debris shall be tested and disposed of as specified in section 3.4.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 11 00

CONCRETE FORMWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Provide concrete formwork for architectural concrete and structural concrete as specified to form concrete to profiles shown.

1. Architectural concrete is defined as concrete for the following exposed reinforced concrete surfaces:

a. Interior walls

b. Exterior walls to 6 inches below finish grade

c. Interior tank walls to 6 inches below normal operating water level

d. Beams

e. Columns

f. Undersides of floor slabs, roof slabs and stairs

2. Provide concrete with smooth rubbed finish.

3. Structural concrete is defined as all concrete that is not architectural concrete.

B. Related Work Specified in Other Sections Includes:

1. Section 03 20 00 - Concrete Reinforcement
2. Section 03 15 00 - Concrete Accessories
3. Section 03 30 00 - Cast-In-Place Concrete for Plant Work

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ACI 318 - Building Code Requirements for Reinforced Concrete

2. ACI SP-4 - Formwork for Concrete

3. ACI 303R - Guide to Cast-in-Place Architectural Concrete

4. ACI 347 – Guide to Formwork for Concrete

1.3 SUBMITTALS

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

1. CONTRACTORS Shop Drawings: Proposed form layout drawings and tie pattern layout drawings for Concrete. Review of these drawings does not relieve the CONTRACTOR of responsibility for adequately designing and constructing forms.

2. Samples: Pieces of each type of sheeting, chamfer strips, form ties, form liners and rustication strips

1.4 QUALITY ASSURANCE

A. Formwork Compliance: Use formwork complying with ACI SP-4, ACI 347 and ACI 303R.

B. Mock-Up Erection: Erect, on the site where directed, a full size mock-up of a cast-in-place wall or panel a minimum of 10 feet by 10 feet by 12 inches thick as shown. Conform mock-up to requirements of ACI 303R.

1. Reinforce the panel as shown. Use form ties the same as those approved and with the form tie pattern similar to that approved. Use one face of the panel for smooth architectural concrete including "reveal" rustication with form joints, and the opposite face for form liner concrete.

2. Plug the tie holes as specified to determine the correct mortar mixture to match the panel color. If required, remove and replace tie hole plugging mortar until an acceptable color match is obtained. After the sample panels have been approved, intentionally damage and patch portions of the finish surface of the panels for the purpose of determining the correct mixture for patching mortar and patching technique to match the original panel color and surface.

3. Leave the approved mock-up on the job during construction as the standard of workmanship for the project. Remove mock-up from the premises after completion of the work.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers are listed in the LCU Approved Materials List. Other manufacturers of equivalent products may be submitted.

2.2 MATERIALS

A. Structural Concrete: Provide structural concrete form materials as follows:

1. Obtain approval for form material before construction of the forms.

2. Use a barrier type form release agent.

3. Use form ties, hangers, and clamps of such type that, after removal of the forms, no metal will be closer than one inch from concrete surface. Wire ties will not be permitted.

4. Provide ties with swaged washers or other suitable devices to prevent seepage of moisture along the ties. Leave the ties in place.

5. Use lugs, cones, washers, or other devices which do not leave holes or depressions greater than 7/8-inch in diameter.

B. Architectural Concrete: Provide architectural concrete form materials as follows:

1. Construct forms using 3/4-inch thick, High Density Overlay (HDO) Plyform, Class 1 or 2, meeting the requirements of the American Plywood Association. Use surfacing materials having a minimum weight of 60-60.

2. Use form coating and use thinner as recommended by manufacturer of the form coating, to coat cut or raw edges.

3. Use she-bolts with water seals for form ties.

4. Use form liners (see LCU Approved Materials List) having one-inch deep relief, in a fractured rib pattern to match existing. Furnish form liners in full height lengths with no horizontal joints, except where shown. Use wood for forms to be used with form liners.

5. Use elastomeric vertical "V-groove" rustications in the concrete bands and the horizontal rustication joints shown in the form liner concrete of the profile shown.

6. Use a barrier type VOC compliant form release agent.

PART 3 EXECUTION

3.1 DESIGN

A. Design Responsibility: Be responsible for the design, engineering and construction of the architectural concrete formwork and the structural concrete formwork. Conform the work to the recommendations of ACI SP-4 and ACI 303R.

B. Setting Time and Slag Use: The presence of fly ash or ground granulated blast furnace slag in the concrete mix for architectural concrete and structural concrete will delay the setting time. Take this into consideration in the design and removal of the forms.

C. Responsibility During Placement: Assume and take sole responsibility for adequate design of all form elements for support of the wet concrete mixtures specified and delivered.

D. Consistency: Design forms to produce concrete members identical in shape, lines and dimensions to members shown.

3.2 CONSTRUCTION DETAILS FOR FORMWORK

A. Structural Concrete Details: Follow the following details for all structural concrete:

1. Provide forms which are substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subjected. Make forms sufficiently tight to prevent leakage of concrete.

2. Determine the size and spacing of studs and wales by the nature of the work and the height to which concrete is placed. Make forms adequate to produce true, smooth surfaces with not more than 1/8-inch variation in either direction from a geometrical plane. Provide horizontal joints which are level, and vertical joints which are plumb.

3. Supply forms for repeated use in sufficient number to ensure the required rate of progress.

4. Thoroughly clean all forms before reuse and inspect forms immediately before concrete is placed. Remove deformed, broken, or defective forms from the work.

5. Provide temporary openings in forms at convenient locations to facilitate cleaning and inspection.

6. Coat the entire inside surfaces of forms with a suitable form release agent just prior to placing concrete. Form release agent is not permitted on the reinforcing steel.

7. Assume and take responsibility for the adequacy of all forms and remedying any defects resulting from their use.

B. Architectural Concrete Details: Follow the following details for all Architectural Concrete:

1. Conform all construction details for formwork to "Construction Details for Formwork," subsections A1, A2, A3, A4, A6 and A7 and the requirements of this section.

2. Thoroughly clean and lightly recoat HDO plywood panels before each additional use. Do not use forms more than three times.

3. Install form liners and rustication strips in strict accordance with the manufacturer's written instructions and recommendations. Clog the ends of the form liner pattern and tape all form joints and edges using 1/8-inch thick by 3/4-inch wide foam tape centered on the joints, then caulk in accordance with the manufacturer's recommendations each time forms are set. Have a representative of the manufacturer present at the site to supervise the installation of the form liner for the entire project.

4. Install forms for smooth concrete in such a manner that there will be no horizontal form joints, and align the forms so that vertical joints occur only at "V-Groove" rustications. Space form ties in a uniform pattern vertically and horizontally. Position form ties in smooth concrete bands and in panels between "reveal" rustications, if any.

5. Erect beam and girder soffits with a camber of 1/2-inch in 20 feet and sufficiently braced, shored, and wedged to prevent deflection. Clamp column sides in accordance with this specification with metal column clamps, spaced according to the manufacturer's directions.

6. Provide external angles of walls, beams, pilasters, columns, window openings and girders with 3/4-inch bevel strips.

7. Give surfaces of concrete panel forms one thinned coat of form film.

8. Apply the release agent in strict accordance with the manufacturer's instructions.

3.3 FORM REMOVAL

A. Structural Concrete Form Removal: Do not remove forms for structural concrete until the concrete has hardened sufficiently to support its own load safely, plus any superimposed load that might be placed thereon. Leave the forms in place for the minimum length of time indicated below or until the concrete has reached the minimum strength indicated as determined by testing, whichever time is reached first.

1. The times indicated represent cumulative days or hours, not necessarily consecutive, during which the air surrounding the concrete is above 50 degrees F. These times may be decreased if reshores are installed.

		Minimum Time	Minimum Strength (psi)
a.	Columns	12 hrs.	1300
b.	Columns	12 hrs.	1300
c.	Side forms for girders and beams	12 hrs.	1300
d.	Walls	12 hrs.	1300
e.	Bottom forms of slabs		
	Under 10 feet clear span	4 days	2300
	10 to 20 feet clear span	7 days	2700
	Over 20 feet clear span	10 days	2900
f.	Bottom forms of beams and girders		
	Under 10 feet clear span	7 days	2700
	10 to 20 feet clear span	14 days	3000
	Over 20 feet clear span	21 days	3500

2. Increase form removal times as required if concrete temperature following placement is permitted to drop below 50 degrees F or if fly ash or ground granulated blast furnace slag is used in the concrete mix.

3. Withdraw the removable portion of form ties from the concrete immediately after the forms are removed. Clean and fill holes left by such ties with grout as specified in Cast-In-Place Concrete, Subsection Structural Concrete Surfaces.

4. Plug tie holes flush with the surface using portland cement mortar. Prewet tie holes with clean water and apply a neat cement slurry bond coat. Densely tamp mortar of a dry-tamp consistency into the tie holes exercising care so as not to smear mortar onto the finished concrete surface. Include sufficient white cement in the mortar mix to cause the plugged holes to blend in with the adjacent surfaces. Make sample patches with different mixes to assure that this requirement is met.

B. Architectural Concrete Form Removal: Remove forms for architectural concrete in accordance with the above subsection 3.3 A, except that do not remove forms for vertical surfaces sooner than 12 hours nor longer than 36 hours after placement of concrete.

3.4 RESHORING

A. Reshoring Method: Develop a system for reshoring and early removal of forms, in the event early stripping of forms becomes necessary. Include details and schedules in this system for each element which is to be reshored.

B. Construction Load Support: Do not support construction loads upon any unshored portion of the structure exceeding the structural design loads.

3.5 TOLERANCES

A. Tolerance Limits: Design, construct and maintain concrete form and place the concrete to provide completed concrete work within the tolerance limits set forth in ACI SP-4.

3.6 SURVEY OF FORMWORK

A. Field Survey: Employ an engineer or surveyor to check by instrument survey the lines and levels of the completed formwork before concrete is placed and make whatever corrections or adjustment to the formwork are necessary to correct deviations from the specified tolerances.

B. Placement Surveying Requirements: Check formwork during the placement of the concrete to verify that the forms, braces, tie rods, clamps anchor bolts, conduits, piping, and the like, have not been knocked out of the established line, level or cross section by concrete placement or equipment.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing concrete accessories shown and specified herein such as waterstops, dovetail anchor slots, cast-in-place reglets, inserts, joint filler, preformed joint seal, joint sealant and neoprene pads.

B. Products Installed: Waterstops, dovetail anchor slots, cast-in-place reglets, inserts, joint filler, preformed joint seal, joint sealant and neoprene pads.

C. Related Work Specified in Other Sections Includes:

1. Section 03 11 00 - Concrete Formwork

2. Section 03 20 00 - Concrete Reinforcement

3. Section 03 30 00 - Cast-in-Place Concrete for Plant Work

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. AASHTO - Standard Specifications for Highway Bridges

2. ASTM A 240 - Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

3. ASTM A 536 - Standard Specifications for Ductile-Iron Castings

4. ASTM D 412 - Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

5. ASTM D 3545 - Test Methods for Alcohol Content and Purity of Acetate esters by Gas Chromatography

6. ASTM D 3575 - Test Methods for Flexible Cellular Materials Made From Olefin Polymers

7. CRD-C513 - Specifications for Rubber Waterstops

8. CRD-C572 - Specifications for Polyvinyl Chloride Waterstop

9. Fed. Spec. TT-S-00227 - Sealing Compound, Elastomeric Type, Multicomponent (for Calking, Sealing, and Glazing in Buildings and Other Structures)

10. Fed. Spec. TT-S-00230 - Sealing Compound, Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures)

1.3 SUBMITTALS

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

B. Product Data and Information:

1. Manufacturer's Data and Specifications: Submit printed manufacturer's data and specifications for each item used on this project.

2. Samples: Provide one sample of each item used.

3. Joint Sealant and Preformed Joint Seal: Indicate special procedures, surface preparation and perimeter conditions requiring special attention. All products in contact with potable water, shall be "NSF Standard 61" certified. Submit certified material records indicating approval for use with potable water.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers are listed in the LCU Approved Materials List. Other manufacturers of equivalent products may be submitted.

2.2 MATERIALS

A. Extruded Waterstops: Provide waterstops made of extruded polyvinyl chloride unless otherwise shown or specified.

1. Do not use any reclaimed plastic material in their manufacture.

2. Provide plastic waterstops meeting the requirements of CRD-C572, except as modified herein. Provide a Shore A/10 durometer hardness between 73 and 79, the tensile strength not less than 1850 psi, and specific gravity not more than 1.38.

3. Unless otherwise shown, use waterstops for construction joints which are flat, at least 6 inches wide, and not less than 3/8-inch thick at the thinnest section. Provide these waterstops with ribbed longitudinal strips.

4. Unless otherwise shown, provide waterstops for expansion joints at least 9 inches wide and not less than 1/4-inch thick at the narrowest point and not less than 3/8-inch thick immediately adjacent to the center of the waterstop. Provide the waterstop with ribbed longitudinal strips with a 3/4-inch inside diameter hollow bulb center. Limit joint movement to 1/4-inch under a tensile force of not more than 500 pounds per lineal inch.

B. Stainless Steel Waterstops: Provide stainless steel waterstops where shown or specified.

1. Fabricate stainless steel waterstops from ASTM A 240 Type 316, 20 gauge stainless steel, conforming to the dimensions and profiles shown.

2. Prefabricate and miter corners and intersections for all stainless steel waterstops. Make only butt joints in the field.

C. Rubber Waterstops: Provide rubber water stops where shown or specified.

1. Provide rubber water stops of either the molded or extruded type, fabricated from a high grade tread type compound, either SBR or natural rubber, conforming to CRD-C513.

2. Provide water stops for construction joints at least 6 inches wide and 3/8-inch thick and with solid end bulbs 3/4-inch in diameter.

3. Provide water stops for expansion joints 9 inches wide and 3/8-inch thick and with solid end bulbs 1-inch in diameter and a hollow center bulb 1-1/2 inches in diameter with a 3/4-inch diameter center cavity.

D. Expansion Joint Filler: Use joint filler for all expansion joints.

1. Provide a closed cell polyethylene or PVC joint filler of the thickness shown.

E. Joint Sealant Requirements: Finish expansion joints with a joint sealant where shown or specified.

1. Joint sealant materials may be either a single component urethane compound meeting the requirements of Fed. Spec. TT-S-00230C, or a 2-component urethane compound meeting the requirements of Fed. Spec. TT-S-00227E, except as modified in this specification.

2. Provide the urethane sealant of 100 percent polymer, non-extended, containing no solvent, lime, or coal tar. Color as selected by the ENGINEER, but not black. Conform sealant properties to the following:

	Property	Value	Test Method
a.	Maximum final cure	3 days	--
b.	Minimum tensile strength	140 to 200 psi	ASTM D 412
c.	Minimum elongation	400%	ASTM D 412
d.	Modulus at 100% elongation	40-60 psi	ASTM D 412
e.	Shore A hardness	25-40	ASTM D 2240
f.	Solid content	98-100%	--
g.	Peel strength	20-40 lb/in.	Fed. Spec. TT-S-00230C Fed. Spec. TT-S-00227E
h.	Minimum recovery	80-90%	Fed. Spec. TT-S-00230C Fed. Spec. TT-S-00227E
i.	Initial tack-free cure	24-48 hrs.	Fed. Spec. TT-S-00230C Fed. Spec. TT-S-00227E

3. Provide primer as recommended by the manufacturer of the sealant, subject to approval.

4. Provide fillers and backup materials in contact with sealant which are nonimpregnated and free from asphalt, creosote, oil or extractable

plasticizers. Use a backup material of a closed cell polyethylene foam rod with a diameter 1/4-inch larger than the joint width.

F. Preformed Joint Seal: Provide a preformed joint seal where shown or specified.

1. Provide joint material which is resilient, non-extrudable, impermeable, closed-cell, cross-linked, ethylene vinyl acetate, low density, polyethylene copolymer, nitrogen blown material which is ultraviolet light, weather and wear resistant, and which is concrete beige in color.

2. Conform material properties with the following:

	Property	Value	Test Method
a.	Density, pcf	2.8 to 3.4	ASTM D 3575 Suffix: W, Method A
b.	Water Absorption total immersion 3 months	0.02% by volume	ASTM D 3575 Suffix: L
c.	Tensile Strength	125 psi	ASTM D 3575 Suffix: T
d.	Elongation before breaking	255%	ASTM D 3575 Suffix: T
e.	Working Temperature	-94 to 160 F	--

G. Neoprene Pads: Use neoprene pads as shown or required where slabs or beams must be prevented from bonding to footings, walls, columns or other rigid parts of the structure.

1. Use neoprene pads of a structural grade meeting the requirements of Section 25, Division 2 of the AASHTO Standard Specifications for Highway Bridges.

2. Do not use neoprene pads thinner than 1/4-inch.

H. Wedge Inserts: Make wedge inserts for 5/8-inch and 3/4-inch bolts of ductile iron conforming to ASTM A 536.

I. Dovetail Anchors: Provide dovetail anchors of one of the following types:

1. Dovetail anchors having a 3/16-inch by 1-inch by 1/2-inch stainless steel dovetail section with 3/16-inch diameter stainless steel wire.

2. Dovetail anchor slots of 24 gauge galvanized steel 1-inch by 1-inch by 5/8-inch throat. Fill anchor slots.

J. Flashing Reglets: Provide flashing reglets of 24 gauge galvanized steel foam filled reglets.

PART 3 EXECUTION

3.1 INSTALLING OF WATERSTOPS

A. Assembly of Extruded Waterstops: Prefabricate corners and intersections for all waterstops. Make only butt joints in the field. Miter and assemble corners and intersections with approved equipment, as described for field joints.

1. Make field joints by cutting the ends of the sections to be spliced so they will form a smooth even butt joint. Heat the cut ends with the splicing tool until the plastic melts. Press the two ends together until the plastic cools. Do splicing in a way that limits damage to the continuity of the ribbed strips.

2. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.

B. Prefabricated Stainless Steel Waterstops: Prefabricate corners and intersections for all stainless steel waterstops. Make only butt joints in the field. Miter and weld corners and intersections.

1. Provide field joints having a nominal 1-inch lap joint, with the exposed edge welded or brazed on each side.

2. Make field joints with PVC waterstops as shown.

3. At expansion joints, seal the base of the expansion section of the waterstop with at least one layer of 2-inch wide duct tape.

4. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.

C. Splices: Use splices made in the manufacturer's plant where possible for rubber waterstops.

1. Use a preformed rubber union or fitting and splicing cement as recommended by the manufacturer when splices are made.

2. Carry waterstops in the walls into lower slabs and join them to the waterstops in the slabs. Make all waterstops continuous. Set waterstops accurately to the position and line shown. Hold edges securely fixed in position at intervals of not more than 24 inches so that they will not move during the placing of the concrete. Do not drive nails through the waterstops.

D. Joint Filler Placement: Place joint filler for expansion joints against the completed portion of the work before the concrete for the next section is placed.

1. Fasten the filler to the hardened concrete with a compatible adhesive in accordance with manufacturer's instructions. Extend the filler through the thickness of the wall or slab and make it flush with the finished surface, except where a preformed joint seal or joint sealant is shown.

2. In joints having a waterstop, fit the filler accurately on each side of the waterstop to prevent the intrusion of concrete.

E. Preparation of 2-Component Sealants: Mix 2-component joint sealant using a slotted paddle and slow speed mixer for 5 to 8 minutes, continually working paddle from top to bottom until the sealant color is uniform. Scrape down the side of the container and paddle blade several times during the mixing operation to ensure uniform mixing.

1. Properly prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are structurally sound, clean, dry, and free of all oil, grease, wax, waterproofing compounds or form release materials prior to the application of primer and sealant.

2. Prime all concrete joint surfaces and all surfaces exposed to water prior to sealing, with no exceptions. Prime all other surfaces as recommended by the manufacturer of the sealant. Provide the prime as recommended by the manufacturer of the sealant, subject to approval. Apply the primer by either brushing or spraying on the joint surfaces. Apply and install the sealant within 2 to 24 hours after the application of primer.

3. For horizontal joints, install the sealant by pouring directly from a suitable shaped can or by flowing from a bulk-loading gun.

4. Fill vertical joints from a gun, starting from the bottom, to avoid bridging and the formation of air voids.

5. Fill overhead joints from a gun, by laying a bead along each side of the joint and then filling the middle. Immediately after installation, tool in the sealant in order to establish firm contact with joint surfaces and to provide a smooth sealant surface. Tool in accordance with the manufacturer's instructions.

6. Control joint depth with the use of joint fillers and backup materials. Make joint widths and sealant depths as shown. Do not exceed 1/2-inch for sealant depth.

F. Preformed Joint Seal Surface Preparation: Properly prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are structurally sound, clean, dry, and free of all oil, grease, wax, water-proofing compounds or form release materials.

1. Blast clean or saw cut all existing concrete surfaces to expose a clean bare concrete surface. Allow new concrete to be well cured, and attain a minimum of 80 percent of the specified strength before installing sealant.

2. Apply bonding adhesive, as recommended by the manufacturer to the concrete surfaces in strict compliance with the manufacturer's recommendations. Install the joint material under a compression of 25 percent and in one continuous operation, in accordance with manufacturer's recommendations. Do all splices and directional changes using heat welding method as recommended by the manufacturer.

G. Unbonded Joints: Use unbonded horizontal joints as shown or required where slabs of beams must be prevented from bonding to footings, walls, columns or other rigid parts of the structure.

1. Prevent bonding by use of structural grade neoprene pads placed over the bearing surface of the footing, wall or other supporting part of the structure so as to isolate it from the new concrete being placed.

H. Encasing Inserts: Encase wedge inserts, flashing reglets and dovetail anchor slots in the concrete as shown. Take special care to place and maintain them to the proper lines and grades and to compact concrete thoroughly around them to prevent the passage of water. Set these items before placing concrete and thoroughly brace them to prevent movement during the progress of the work. Provide dovetail anchor slots spaced not more than 16 inches apart for all concrete walls faced with masonry.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing concrete reinforcement as shown and specified herein. Reinforcement includes all steel bars, wire and welded wire fabric as shown and specified.

B. Related Work Specified in Other Sections Includes:

1. Section 03 11 00 - Concrete Formwork
2. Section 03 30 00 - Cast-In-Place Concrete for Plant Work
3. Section 03 40 00 - Precast Concrete Structures

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1.	ACI SP66	-	ACI Detailing Manual
2.	ACI 318	-	Latest edition "Building Code Requirements for Reinforced Concrete"
3.	ASTM A 185	-	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
4.	ASTM A 615/A615M	-	Deformed and Plains Billet-Steel Bars for Concrete
5.	ASTM A 706/A706M	-	Low Alloy Steel Deformed Bars for Concrete Reinforcement
6.	ASTM A 775/A775M	-	Epoxy Coated Reinforcing Steel Bars
7.	AWS D1.4	-	Structural Welding Code - Reinforcing Steel
8.	ACI 315	-	Guide to Presenting Reinforcing Steel Design Details
9.	CRSI	-	Recommended Practice for Placing Reinforcing Bars

1.3 SUBMITTALS

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

1. Product Data and Information: Submit manufacturers literature with product data, and material description of fusion bonded epoxy coating for reinforcement and reinforcement accessories, including manufacturer's recommendations for field touch-up of mars and cut ends when epoxy coated reinforcement is specified to be used.

2. CONTRACTORS' Shop Drawings: Submit checked Working Drawings, including bar lists, schedules, bending details, placing details and placing plans and elevations for fabrication and placing reinforcing steel conforming to "ACI Detailing Manual SP-66".

    a. Do not bill wall and slab reinforcing in sections. Show complete elevations of all walls and complete plans of all slabs, except that, when more than one wall or slab are identical, only one such elevation or plan is required. These plans and elevations need not be true views of the walls or slabs shown. Bill every reinforcing bar in a slab on a plan. Bill every reinforcing bar in a wall on an elevation. Take sections to clarify the arrangement of the steel reinforcement. Identify all bars, but do not bill on such sections.

    b. For all reinforcing bars, unless the location of a bar is clear, give the location of such bar or bars by a dimension to some structural feature which will be readily distinguishable at the time bars are placed.

    c. Make the reinforcing steel placing drawings complete for placing reinforcement including the location of support bars and chairs, without reference to the design drawings.

    d. Submit Detailer certification that every reinforcing steel placing drawing and bar list is completely checked and corrected before submittal for approval.

    e. If, after reinforcing steel placing drawings and bar lists have been submitted for approval, a review reveals that the drawings and lists obviously have not been checked and corrected they will be returned for checking and correcting by the Detailer.

3. Samples: Submit the following samples when epoxy coated reinforcement is specified to be used.

    a. 12-inch long epoxy-coated steel reinforcing bar, of any size typical to this Project

    b. One of each type of epoxy-coated reinforcement accessory used on this Project

c. 12-inch long, nylon coated tie wire

4. Certificates: Test certificates of the chemical and physical properties covering each shipment of reinforcing steel bars.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

1. Delivery Requirements: Have reinforcing steel delivered to the work in strongly tied bundles. Identify each group of both bent and straight bars with a metal tag giving the identifying number corresponding to the reinforcing steel placing drawings and bar lists.

2. Storage: Properly store all bars in an orderly manner, with all bars completely off the ground. Keep bars clean after delivery to the site of the work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed in the LCU Approved Materials List. Other manufacturers of equivalent products may be submitted.

2.2 MATERIALS

A. Steel Bars: Use new billet steel bars, deformed bars, meeting the requirements of ASTM A 615/A625M Grade 60 for reinforcing steel bars.

1. Roll all reinforcing steel bars with special deformations or identifying marks indicating the ASTM Specification and Grade.

2. Use bars free from defects, kinks and from bends that cannot be readily and fully straightened in the field.

3. Supply reinforcing bars in lengths which will allow convenient placement in the work and provide the required lap of joints as shown. Provide dowels of proper length, size and shape for tying walls, beams, floors, and the like together.

B. Epoxy Coating: Conform fusion bonded epoxy coated reinforcing steel bars to ASTM A 775/A775M when used. Leave portions of the reinforcing steel bars uncoated where mechanical connections are shown.

C. Welded Wire Fabric: Use welded wire fabric of the electrically welded type, with wires arranged in rectangular patterns, of the sizes shown or specified and meeting the requirements of ASTM A 185.

D. Supports and Accessories: Provide bar supports and other accessories and, if necessary, additional supports to hold bars in proper position while concrete is being placed.

1. Use side form spacers against vertical or sloping forms to maintain prescribed side cover and cross position of bars.

2. Use individual hi-chairs with welded cross ties or circular hoops to support top bars in slabs thicker than 8 inches.

3. Bolsters, chairs and other accessories:

a. Use hot-dipped galvanized or provide plastic coated legs when in contact with forms for surfaces of concrete other than architectural surfaces.

b. Use stainless steel when in contact with forms for architecturally exposed surfaces.

c. Use epoxy coated bolsters, chairs and accessories including wire ties for epoxy coated reinforcing bars.

d. Use chairs of an approved type and space them properly to support and hold reinforcing bars in position in all beams and slabs including slabs placed directly on the subgrade or work mat. Do not use continuous hi-chairs for supporting of top bars in slabs over 8 inches in thickness.

E. Mechanical Connections: Provide mechanical connections that develop at least 125 percent of the specified yield strength of the bar in tension.

F. Stirrups and Ties: Provide stirrups and ties as shown and specified and meeting the requirements of ASTM A 185.

2.3 FABRICATION

A. Drawing Review Prior to Fabrication: Do not fabricate any material before final review and approval of shop drawings.

B. Bending and Cutting: Cut bars to required length and bend accurately before placing. Bend bars in the shop unless written approval for field bending is obtained. If field bending is permitted, do it only when the air temperature, where the bending operation is performed, is above 30 degrees F. Do not field bend bars which have been partially embedded in concrete.

C. Splices: Use lapped splices for tension and compression splices unless otherwise noted.

D. Cleaning: Clean and bend reinforcement in accordance with ACI 315 and ACI 318.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement: Place all bars in accordance with CRSI "Recommended Practice for Placing Reinforcing Bars".

B. Tolerances: Place bars used for top reinforcement in slabs to a vertical tolerance of plus or minus 1/4-inch. Place all other reinforcement to the tolerances given to ACI 318.

C. Cleaning: Have reinforcing steel delivered without rust other than that accumulated during transportation to the work. At all times, fully protect reinforcing steel from moisture, grease, dirt, mortar and concrete. Before being placed in position, thoroughly clean reinforcing steel of all loose mill scale and rust and of any dirt, oil, grease coatings, or other material that might reduce the bond. If there is a delay in depositing concrete, inspect and satisfactorily clean the steel immediately before the concrete is placed.

D. Bar Positioning: Place bars in the exact positions shown with the required spacing and cross wire bars securely in position at intersections to prevent displacement during the placing of the concrete. Fasten the bars with annealed wire of not less than 17 gauge or other approved devices.

E. Bar Extension Beyond Formwork: On any section of the work where horizontal bars extend beyond the length of the forms, perforate the form or head against which the work ends or at the proper places to allow the bars to project through a distance at least equal to the lap specified.

F. Unacceptable Materials: Do not place reinforcing steel with damaged, unsuitably bonded epoxy-coating or rusting. If approved, mars, exposed threads of mechanical connections and cut ends may be field coated with approved epoxy coating material.

G. Review of Placement: Have reinforcing placement reviewed by the ENGINEER before concrete is placed.

H. Welding - Not Approved: Do not use reinforcing bar assemblies made by welding of any kind, or accessories of any kind which require field welding to reinforcing bars.

I. Welding - Approved: Where welding of reinforcing steel is shown, AWS D1.4 "Structural Welding Code - Reinforcing Steel" applies.

J. Tension and Compression Lap Splices: Conform tension and compression lap splices to ACI 318 with all supplements. Avoid splices at points of maximum tensile

stress wherever possible. Provide temperature bars with the clear spacing shown. Stagger all bar splices in hoop tension bars in circular tanks with not more than 50 percent of the bars spliced in any one direction. Have welded splices made by certified welders in accordance with AWS D1.4.

K. Welded Wire Fabric: Place welded wire fabric in the positions shown, specified or required to fit the work. Furnish and place suitable spacing chairs or supports, as specified for bars, to maintain the fabric in the correct location. Where a flat surface of fabric is required, provide flat sheets, when available. Otherwise reverse roll the fabric or otherwise straighten to make a perfectly flat surface before placing. Obtain approval for the length of laps not indicated.

L. Concrete Cover: Place reinforcing steel and welded wire fabric and hold in position so that the concrete cover, as measured from the surface of the bar or wire to the surface of the concrete, is as shown or specified.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE FOR PLANT WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Providing cast-in-place structural concrete as specified herein to form concrete to profiles as shown on the plans including the following work:

1. Setting of anchor bolts, base plates, floor grating and plate, frames, stop log grooves, and other steel and aluminum members embedded in concrete as indicated

2. Furnishing and setting of sleeves, inserts and other embedded accessories for mechanical and electrical equipment.

3. Grouting of base plates

B. Related Work Specified in Other Sections Includes:

1. Section 03 11 00 - Concrete Formwork
2. Section 03 20 00 - Concrete Reinforcement
3. Section 03 15 00 - Concrete Accessories

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ACI 212 - Report on Chemical Admixtures for Concrete
2. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete
3. ACI 305R - Hot Weather Concreting
4. ACI 308 - Practice for Curing Concrete
5. ACI 309 - Guide for Consolidation of Concrete
6. ACI 318 - Building Code Requirements for Structural Concrete
7. ACI 503R - Use of Epoxy Compounds with Concrete
8. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
9. ASTM C 33 - Standard Specification for Concrete Aggregates
10. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
11. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

12. ASTM C 94 - Standard Specification for Ready-Mixed Concrete
13. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
14. ASTM C 138 - Standard Test Method for Density, Yield, and Air Content of Concrete
15. ASTM C 143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
16. ASTM C 150 - Standard Specification for Portland Cement
17. ASTM C 171 - Specification for Sheet Materials for Curing Concrete
18. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete
19. ASTM 173 (3.3E)
20. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
21. ASTM C 191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle
22. ASTM C 260 - Standard Specification of Air-Entraining Admixtures for Concrete
23. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
24. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete
25. ASTM C 596 - Test Method for Drying Shrinkage of Mortar Containing Portland Cement
26. ASTM C 618 - Standard Specification for Coal Fly Ash or Calcined Natural Pozzolan for Use in Concrete
27. ASTM C 827 - Test Method for Early Volume Change of Cementious Mixtures
28. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
29. ASTM C 1107- Hydraulic Cement Grout (Non-shrink) Dry Package
30. ASTM D 1155- Standard Test Method for Roundness of Glass Spheres
31. ASTM E 1155- Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

1.3 SUBMITTALS

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

1. Notarized certificates of manufacture as evidence that the cement, fly ash and ground granulated blast furnace slag conform to the specified requirements. Include in these certificates the mill-test reports on the cement.

2. Concrete mix designs for each type of concrete.

3. Independent laboratory tests showing that grout is nonshrink at various ages in accordance with ASTM C 1107, showing no expansion after set (ASTM C 287), developing 3,000 psi with a trowelable mix within 24 hours (ASTM C 109) and having a placement time based on initial set of not less than 60 minutes (ASTM

C 191). Include test results showing that, in projects of similar scope and size, the effective bearing area (EBA) is between 95 and 100 percent. Provide grout exposed to the weather free of discoloration without the necessity of special surface treatments.

4. Air content tests in accordance with ASTM C 138 or C 173 with mix design data.

5. Detailed field report records of ready-mixed-concrete.

6. Manufacturers' Literature: Material description and application or installation instructions for curing compound, vapor barrier, floor hardener, floor sealer, epoxy adhesives, synthetic fibers, admixtures, polymer modified nonsag mortar, and corrosion-resistant coatings.

1.4 QUALITY ASSURANCE

A. Codes: The following specific codes and standards apply:

1. ACI 318 - Latest Edition, "Building Code Requirements for Reinforced Concrete".

2. ASTM C 1107 relating to nonshrink grout.

3. ASTM - as referred to in the various subsections herein.

B. Testing Requirements: Testing laboratory provided by COUNTY is responsible for conducting tests as required in Division 1.

C. Testing Assistance: Cooperate with the laboratory personnel, provide access to Work, and manufacturer's operations. Provide and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used which require testing.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

1. Cement: Store cement delivered in bulk to the batching plant in weathertight bins and batch using an appropriate weighing device, in accordance with ASTM C 94.

a. Store cement in weathertight buildings, bins or silos which will exclude moisture and contaminants. Do not use cement that has deteriorated from storage. Retest, before use, cement stored for a period longer than 6 months after the previous testing and reject it if it fails to meet all of the

specified requirements. Do not use accepted cement that has been in storage for more than one year from the time of original acceptance.

2. Aggregates: Keep aggregates clean and free from all other materials during transportation and handling. Keep them separated from each other until measured in batches and placed in the mixer.

    a. Stockpile aggregates in a manner to prevent segregation unless finish screening is provided at the batch plant.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement Requirements: Provide a cement which is a domestic product from an approved source. Use standard portland cement meeting the requirements of ASTM C 150 Type I or Type II. Use Type I cement for concrete not in contact with sewage. Use Type II or Type I with sulfide resistant properties equal to Type II for concrete in contact with sewage.

B. Cementitious Material Requirements:

1. Fly Ash Requirements: Provide fly ash with a uniform light color from a source approved by the CONSULTANT and will cementitious properties conforming to the requirements of ASTM C 618 Class C or F, with the following exceptions:

2. Use water-reducing and set-retarding admixtures only after obtaining written permission. Provide test data indicating that the concrete containing the admixtures has improved workability and does not show any abnormal behavior such as premature stiffening or slump loss for at least 30 minutes after mixing has been completed, or any other abnormal differences when compared with concrete made without the admixture. Base such test data on fresh concrete from the proposed supplier, using batching equipment proposed for use on the project.

C. Fine Aggregate Requirements: Provide fine aggregate of natural sharp sand meeting the requirements of ASTM C 33 for normal weight concrete, except as modified herein. Provide fine aggregate subjected to the test for organic impurities that will not produce a color darker than standard.

1. Provide fine aggregate meeting the requirements of the soundness test set forth in Paragraph 7.1 of ASTM C 33. The exceptions stated in Paragraphs 7.2 and 7.3 do not apply.

D. Coarse Aggregate Requirements: Provide coarse aggregate consisting of crushed stone meeting the requirements of ASTM C 33 for normal weight concrete.

1. The limits for deleterious substances and physical property requirements given in Table 3 of ASTM C 33 apply for each concrete class designation without exception.

2. Grade coarse aggregate according to Size No. 467 or No. 57 in Table 2 of ASTM C 33 for Class C concrete and Size No. 57 for Class B concrete.

E. Admixture Use: Limit the use of admixtures to the following:

1. Air-entraining admixture conforming to ASTM C 260

2. Water-reducing admixture conforming to ASTM C 494 Type A

3. Water reducing set retarders conforming to ASTM C 494 Type D

4. Do not use admixtures containing calcium chloride, thiocyanates or more than 0.05 percent chloride ion. Obtain written conformance to the above requirements and the chloride ion content of each admixture from the admixture manufacturer prior to mix design review.

5. When more than one admixture is used, dispense each admixture separately into the mix, and at different times during mixing, in accordance with the recommendation of ACI Committee 212. After system approval, make no changes in batching equipment or concrete constituents without approval.

F. Water: Use clean water in mixing concrete which does not contain deleterious amounts of acids, alkalies or organic materials, furnished only from water from approved sources.

G. Curing Covers: Provide water curing quilted covers consisting of an outer covering of burlap or cotton or other approved material, and needled, punched or sandwiched inner layer of cotton batting or other approved material, in all weighing not less than 20 ounces per square yard.

H. Waterproof Paper and Film: Provide waterproof paper or polyethylene film both meeting the requirements of ASTM C 171 for use as sheet material curing covers and vapor barriers.

1. For curing provide waterproof paper consisting of one ply of an approved type of fiber, reinforced waterproof building paper, consisting of cross fibers embedded in asphalt, between two layers of waterproof building paper, the whole being combined under heat and pressure to form a monolithic sheet.

2. For curing and vapor barriers provide polyethylene film consisting of white opaque sheeting manufactured from virgin resin and containing no scrap or additives. Do not use a film of less than 4 mils in thickness.

I. Clear Curing Compounds: Provide a compound of a clear styrene acrylate type, 30 percent solids content minimum, and have test data from an independent testing laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 square feet per gallon (see LCU Approved Materials List).

J. Nonshrink Grout: Provide a flowable, prepackaged, nonshrink grout without dependence on gas expansion forces or enlargement of metal particles for its nonshrinking characteristics (see LCU Approved Materials List). Allow no shrinkage below placement volume under ASTM C 827 and no drying shrinkage under ASTM C 1107.

1. In the event that grout contains water reducers, accelerators or fluidizers, provide a grout having shrinkage no greater than the equivalent sand cement and water mix, as tested under ASTM C 596.

K. Epoxy Adhesives: Provide epoxy adhesives as follows:

1. Sidadur 32, Hi-Mod by Sika Corporation, Richmond, VA or Euco 452 MV by Euclid Chemical Co., Cleveland, OH, Rescon 649 by Rescon Technology Corporation or equal. Use a two component, solvent-free, moisture insensitive, structural epoxy adhesive, conforming to ASTM C 881, Type I and II, Grade 2, Class B and C, epoxy resin adhesive.

2. Sidadur 31, Hi-Mod Gel by Sika Corporation, Richmond, VA or Euco No. 452 Gel by Euclid Chemical Co., Cleveland, OH, Rescon R306 by Rescon Technology Corporation or equal. Use a 2-component solvent-free, moisture insensitive, high modulus, high strength, structural epoxy paste adhesive, conforming to ASTM C 881, Type I and II, Grade 3, Class B and C, epoxy resin adhesive .

2.2 DESIGN MIX

A. Concrete Mix Classifications: Furnish and place concrete of the type divided into various classes according to use and compressive strength.

1. Use Class A concrete for all precast concrete units.

2. Use Class B concrete for all architectural and structural reinforced concrete structures designed for high strength and watertightness; and for columns, walls, beams, slabs, stairs, and, in general, wherever formwork other than simple forms are required.

3. Use Class C concrete for all reinforced concrete structures designed for high strength and watertightness; and for bottoms of structures, electrical duct encasement, and, in general, where concrete is deposited directly on the bottoms of slopes of excavations and where only simple forms are requires.

4. Use Class D concrete for low-strength concrete, plain or reinforced, used for work mats beneath structures, soil stabilization, pipe cradles and encasement, filling, and other similar purposes. Clean boulders or fragments of rock excavated during construction may be embedded in large volumes of Class D concrete to provide added bulk. Use care in placing the boulders or rock fragments so that there will be no voids in the concrete.

B. Compressive Strength: Provide, as a minimum, the specified compressive strength of concrete in pounds per square inch for the classes previously described as follows. Designate the 28-day strength as f'_c.

Class	7-Day Test	28-Day Test
A	3,400	5,000
B	2,700	4,000
C	2,700	4,000
D	1,300	2,000

1. Proportion and produce concrete to provide an average 28-day compressive strength in excess of the specified compressive strength, f'_c. Base the required proportions on tests of cylinders made, cured and tested as specified.

2. Prepare mix designs for each type of concrete required and submit for approval. Concrete which will be placed by pumping methods will require a separate mix design and mix design approval, as described herein, in addition to the mix design approval required for other placement methods.

C. Concrete Proportions: Select concrete proportions to provide the required strength and durability and to provide workability and consistency so that the concrete can be worked into forms and around reinforcement without segregation or excessive bleeding.

1. Provide concrete for all structures which is watertight. Do not allow the maximum water-cementitious material ratio to exceed 0.45 by weight of the total cementitious constituent. Measure the quantity of water to be the total quantity, including free surface moisture contained in the aggregates.

2. Do not allow the amount of fly ash to be less than 100 or to exceed 150 pounds per cubic yard while maintaining a minimum cement content of 350 pounds per cubic yard.

3. Do not allow the amount of ground granulated blast furnace slag contained in Class B and C concrete to be less than 150 or to exceed 190 pounds per cubic yard, while maintaining a minimum cement content of 445 pounds per cubic yard.

4. Establish concrete proportions including the water-cementitious material ratio on the bases of field experience or trial mixtures with the materials to be used in accordance with Section 5.3 of ACI 318.

D. Air Entrainment:

1. Provide air entrained Class B and C concrete with an average total air content of 5 percent. Allow a tolerance of plus or minus 1.5 percent on air content as delivered.

2. Air entrain architectural concrete with a total air content of at least 4-1/2 percent. Allow a tolerance of plus or minus 1 percent on air content as delivered. Furnish mix proportions for architectural concrete to provide a workable mixture of the proper strength. Do not allow the maximum water-cementitious material ratio to exceed 0.50 by weight and provide a consistent ratio from batch to batch. Do not allow the slump for architectural concrete to exceed 5 inches, nor the temperature at the time of placement to exceed 80 degrees F. Retarding admixtures may be used in architectural concrete subject to prior approval.

E. Slumps: When tested in accordance with ASTM C 143, provide a concrete mix design with slumps within the following limits:

Concrete Placement	Minimum and Maximum Slump in Inches	
	Class B and C	Class D
Normal	3 to 4	3 to 5
Pumped	4 to 6	4 to 6

1. Base the mix design slump on the concrete mix with water reducing admixture. For production concrete, allow no more than 1-inch increase in slump by use of specified water reducing admixtures. Measure slump at the end of the hose for pumped concrete.

2. Grade the combined aggregates for the design mix such that when a sample of the mix is separated on No. 4 standard sieve, the weight passing the sieve is not less than 30 percent nor greater than 40 percent of the total, unless otherwise specified.

F. Chloride Ion Concentration: Provide a maximum water soluble chloride ion concentration, percent by weight of cementitious materials, with two 28 day tests of design mix hardened concrete as follows:

1. Cast-in place concrete, 0.10 exposed to moisture, water or sewage in service.

2. Cast-in-place concrete that will be dry or protected from moisture in service 1.00.

G. Measurement and Mixing: Measure and mix concrete in accordance with the recommendations of ACI 304R, as modified.

1. Measure cement, and fine and coarse aggregates separately by weight by equipment providing an accuracy within one percent of the net load weighed. Measure cement and water within 1 percent accuracy by weight. Measure aggregates within 2 percent accuracy. Measure admixtures within 3 percent accuracy by weight.

2. Use weighing equipment meeting the requirements of the United States Bureau of Standards. Make available standard testing weights and other necessary equipment at all times for testing the equipment.

3. Mix concrete in a rotary, batch-type mixer of adequate design to produce a thorough mix, homogeneous in composition and uniform in color. Mix each batch of one cubic yard or less not less than 1-1/2 minutes after the last of the ingredients have been added to the mixer. Increase the mixing time 15 seconds for each cubic yard or fraction thereof.

2.3 READY MIX CONCRETE

A. Ready Mix Requirements: For ready-mixed concrete meet the requirements of ASTM C 94, except as modified in the following paragraphs, and subject the mix to all provisions herein relative to materials, strength, proportioning, consistency, and testing. Article 18 of ASTM C 94, however, does not apply. In the event of low strengths, procedures outlined in Section 3.01 "Low Concrete Strength Test Results" apply.

B. Delivery: Provide the rate of delivery of the mixed concrete such that the interval between placing of fresh concrete in contact with concrete already placed from previous batches does not exceed 45 minutes. Do not allow the elapsed time between the introduction of mixing water to the cement and aggregates and depositing concrete in the work to exceed 60 minutes, including mixing and agitating time.

C. Agitation: Do not deliver concrete in nonagitating equipment.

D. Field Records: Prepare a detailed concrete field record in which the following information is identified:

1. Number of concrete batches produced.

2. Proportions of materials used.

3. Approximate location of final deposit of each batch in the structure.

4. Time and date of mixing and placing.

PART 3 EXECUTION

3.1 PLACING CONCRETE

A. General: Place concrete only in the presence of the CONSULTANT. Where the procedure is not specified, place concrete in accordance with the recommendations of ACI 304R.

B. Continuous Operation: Place no concrete after its initial set has occurred, and do not use retempered concrete under any conditions. Make concreting operations continuous until the section, panel, or scheduled placement is completed. Should the concreting operations be unavoidably interrupted, provide construction joints formed at proper locations as specified.

C. Minimum Handling: Convey and place concrete with minimum handling and deposit the concrete in the forms as close as possible to its final position and in no case more than 5 feet in a horizontal direction therefrom. Do not rehandle concrete.

D. Horizontal Layers: Place concrete in horizontal layers shallow enough so that the previous layer is still soft when the next layer is added and the two layers can be vibrated together. Do not exceed 18 inches in depth for each layer.

E. Use of Chutes: Deposit wall and column concrete through heavy duck canvas or galvanized steel chutes equipped with suitable hopper heads. Provide chutes of variable lengths so that the free fall of concrete does not exceed 3 feet. Provide illumination where required, inside the forms so that the concrete is visible from the deck and runways at the point of deposit.

F. Protection Against Elements: Protect freshly placed exposed concrete against damage from the elements or other sources.

G. Hot Weather Placement: For placement of concrete during hot weather, follow the recommendations of ACI 305R.

1. Place no concrete if the temperature of the concrete at the time of placement exceeds 90 degrees F.

2. When the temperature of the concrete at the time of placement is consistently above 75 degrees F and a noticeable decrease in slump or an increase in mixing water demand occurs, use a retarding admixture, after obtaining written permission to do so.

3. Protect unformed surfaces of concrete placed during hot weather from drying by continuous moist curing for at least 24 hours. Start curing as soon as the concrete has hardened sufficiently to withstand surface damage. If moist curing is not carried beyond 24 hours, cover the surface while damp with a suitable heat-reflecting plastic membrane or spray exterior surfaces with a white pigmented dissapting curing compound in accordance with Section 3.5 Curing.

4. Protect formed surfaces of concrete placed during hot weather from drying as recommended in ACI 305 R.

H. Cold Weather Placement: For placement of concrete during cold weather, follow the recommendations of ACI 306R, except that set-accelerators will not be permitted.

1. Before placement of concrete, completely remove all ice, snow and frost from all surfaces to be in contact with the concrete. Do not place concrete on a frozen subgrade. Heat surfaces to be in contact with the concrete to a temperature as near as practical to that of the concrete being placed.

2. When mean daily temperatures at the site are below 40 degrees F provide concrete at a temperature, as placed, of not less than 50 degrees F, except for mass concrete provide a temperature of the concrete as placed of not less than 45 degrees F. Heat aggregates or mixing water or both to obtain these placement temperatures. Do not permit the concrete temperatures as mixed to exceed the placement temperature by more than 10 degrees F for air temperatures of 0 degrees to 30 degrees F, nor by more than 15 degrees F for air temperatures below 0 degrees F.

3. Maintain concrete in place at a temperature of 50 degrees F by keeping forms in place, covering with insulated blankets, heated enclosures or combinations of these for the following minimum time intervals, except that forms shall not be removed in less than the time specified in Section 03 11 00.

   a. Footings and walls below grade and slabs on grade — 2 days

   b. Exposed walls and columns carrying no load — 3 days

   c. Exposed floor slab, beams and girders above

grade and partially loaded 6 days

4. Protect exposed surfaces of new concrete from drying out. When dry heating is used for protection against low temperatures, cover exposed concrete surfaces with an approved sheet material or membrane as specified in Section 03 11 00 subsection "Curing". Use water curing only if icing problems can be avoided. During periods of very cold weather, continue the protection against low temperature for an extended curing period as required to prevent freezing of the concrete.

5. Permit concrete which is to be exposed to freezing temperatures to undergo some drying just prior to and during the period of adjustment to ambient cold-weather conditions. When protection against low temperatures is removed, do not allow the resulting temperature drop in any part of the concrete to exceed 5 degrees per hour nor 40 degrees F for the first 24 hour period.

I. Concrete Embedments:

1. Encase pipes, anchor bolts, sleeves, steps, castings, floor drains, manhole frames, cast-in reglets, dovetail anchor slots, and other inserts in concrete as shown. Take special care to place and maintain them to the proper lines and grades and to compact concrete thoroughly around them to prevent the passage of water. Insofar as possible, set them before placing concrete and thoroughly brace to prevent movement during the progress of the work.

2. Space dovetail anchor slots vertically not more than 16 inches apart on all concrete walls faced with masonry.

3.2 VIBRATING CONCRETE

A. Use of Vibrators: Consolidate all concrete by means of mechanical internal vibrators applied directly into the concrete in a vertical position in accordance with the recommendations of ACI 309.

B. Vibrator Size: Provide a sufficient intensity and duration of vibration to cause concrete to combine with previously placed concrete, to fill corners, to compact thoroughly and to embed reinforcement, pipes, conduits, and similar work completely. Insert vibrators into and withdraw from the concrete vertically at close intervals. Do not use vibrators to move concrete laterally.

C. Spare Units: Have on hand a sufficient number of vibrators to assure that the incoming concrete can be properly compacted within 15 minutes after placing. Provide reserve vibrators for use when others are being serviced. Do not start the placement of any concrete unless more than one vibrator is available.

3.3 CONCRETE TESTS

A. Compression Testing: Test concrete test cylinders in compression at the laboratory designated.

B. Samples: Take samples for strength tests of laboratory cured cylinders for tests of each class of concrete placed each day consisting of four cylinders from the same batch of concrete. Test two cylinders at 7 days and two at 28 days. When approved by ENGINEER one cylinder may be tested at an extended time period not to exceed 45 days. Determine concrete strength by the average of the two cylinder strengths determined at either age. Take samples not less than once a day nor less than once for each 50 cubic yards of concrete, or 5,000 square feet of area.

C. Field Curing: Take samples for field cured cylinders to determine concrete compressive strength for form removal time as required.

D. Laboratory Curing: Sample fresh concrete in accordance with ASTM C 172. Mold and laboratory cure cylinders for strength tests in accordance with ASTM C 31.

E. Slump Tests: Perform slump tests in accordance with ASTM C 143, at the same time cylinders are made. Make tests to determine air content of fresh concrete twice daily, at least 4 hours apart, in accordance with either ASTM 173 or with an approved testing device. Concrete with excessive slump or improper air content will be rejected. Deliver no additional concrete until the cause of the deficiency is determined and corrected.

F. Test Requirements: Test cylinders in accordance with ASTM C 39 for both the 7-day and the 28-day compressive strength.

G. Successful Testing Requirements: Consider the strength level of the concrete mix for each individual class of concrete satisfactory when:

1. The average of all sets of three consecutive 28-day strength tests (average of two cylinders) equal or exceed the specified compressive strength (f'_c).

2. No individual 28-day strength test (average of two cylinders) falls below f'_c by more than 500 psi.

3. If either of these requirements are not met, make changes in the mix proportions immediately to achieve the required strength.

3.4 LOW CONCRETE STRENGTH TEST RESULTS

A. Test Cores: If it is determined that the serviceability of the concrete is significantly reduced by low concrete strength test results, take test cores from the area in question. Drill and test cores in accordance with ASTM C 42 except as noted. Take three cores for each strength test more than 500 psi below the specified f'_c.

B. Acceptable Levels of Strength: Concrete in the area represented by core tests will be accepted if the average of three cores is equal to or greater than 0.85 f'_c and no single core is less than 0.75 f'_c.

C. Unacceptable Concrete: Remove and replace concrete which does not meet the core test requirements or strengthen the concrete to the satisfaction of the CONSULTANT.

3.5 CURING

A. General: Generally follow the recommendations of ACI 308 for curing concrete.

B. Protection: Protect concrete surfaces normally exposed to the atmosphere against too rapid drying by curing for a minimum period of 7 days. For hot weather concreting and cold weather concreting follow the recommendations of ACI 305R and ACI 306R for curing concrete. Commence the curing period immediately following the placing of the concrete. Accomplish curing by one of the following methods. Should there be any delay in the application of the method of curing used, cover the concrete with moistened burlap held in complete contact with the surface or kept wet by continuous sprinkling.

1. Accomplish water curing by the use of quilted covers wetted and applied to the concrete surface as soon as the forms have been removed, or in the case of slabs, as soon as the concrete has set up sufficiently to prevent marring of the surface. Maintain the covering material in a thoroughly saturated condition and maintain the presence of free water between the mat and the surface of the concrete at all times throughout the curing period.

2. Accomplish sheet material curing by use of waterproof paper or polyethylene film applied to the concrete surface as soon as it has set sufficiently hard to prevent marring. First, thoroughly wet the concrete surface, and then place the sheet materials in direct contact and anchor thereto in a manner to assure continuous contact throughout the curing period. Lap the sheet materials a minimum of 3 inches with the seams taped, cemented, or glued. Discoloration is objectionable on floors which have been steel troweled to a hard finish. Do not use polyethelene film on these floors.

3. Use clear curing compound membranes on floor surfaces without overlays of concrete, tile or paint. Accomplish membrane curing immediately after removal of forms or in the case of unformed surfaces, immediately after final finishing. Coat the entire exposed surface with a clear curing compound meeting the requirements of ASTM C 309 Type I applied uniformly by means of an approved pressure spray distributor at the rate of 200 square feet per gallon of material. Apply the material so that the concrete surface is completely coated and sealed with one application. Do not apply the membrane to faces of construction joints or other surfaces against which additional concrete will be placed. Keep such surfaces continuously wet by other means.

4. Use dissipating resin type curing compounds on exterior surfaces exposed to sunlight.

    a. Provide maximum coverage of 400 square feet per gallon on floated or broomed surfaces for the curing/sealing compound. Provide maximum coverage for the dissipating resin compound of 300 sq. ft./gal. on steel-troweled surfaces and 200 sq. ft./gal. on floated or broomed surfaces.

3.6 JOINTS AND BONDING

A. Joints: Make construction joints where shown or permitted. Locate such joints to ensure stability, strength, and watertightness, and provide a waterstop where shown. Build all corners monolithically, and continuously concrete on either side to points shown.

B. Timing Between Placement: Provide at least 2 hours of elapsed time after placing concrete in the columns or walls before depositing concrete in beams, girders, or slabs supported thereon. Consider beams, girders, brackets, column capitals, and haunches as part of the floor system and place them integrally with the floor.

C. Horizontal Keyways: Build horizontal keyways to permit flushing water to escape from the keyways.

D. Keyway Description: Provide continuous, straight, and regular keys or grooves in joints. Bring exposed concrete surfaces to a true level line at the top of every horizontal construction joint. Provide the exposed construction joints with a row of form ties located in the concrete at from 4 to 6 inches from the joint to tighten the forms for subsequent sections. Set reinforcement to extend into subsequent sections of construction, as shown. If required, provide water stops having watertight splices and corner intersections and meet the requirements as specified. Remove all bulkheads or other joint forming material before placing adjacent concrete.

E. Continuous Placement Procedure: Carry on continuous placing of concrete between the construction joints shown. If for any reason it becomes necessary to stop the placing of concrete at locations other than those indicated, such locations and the manner of making the joint are subject to approval.

F. Grout Use Between Surfaces: Thoroughly clean and wet concrete surfaces against which the new concrete is to be placed. Just prior to placing new concrete, slush horizontal surfaces and joints with at least 2 inches of cement grout of the same mixture as the concrete but with coarse aggregate omitted. Use special care in placing and puddling concrete at vertical joints to ensure a bond with existing concrete. Do not make vertical construction joints in watertight construction, unless shown or approved in writing.

G. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts 1/8" x 1/4 slab depth or inserts 1/4" wide x 1/4 of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.

a. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.

2. If no joint pattern is shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

3.7 CONCRETE FLOOR SURFACES

A. Floor Surfaces: Construct the concrete floor surfaces monolithicly with the structural slab which consists of the structural concrete, being finished as indicated in the following schedule, unless otherwise shown or as specified:

1. Tank bottoms and other surfaces not to be used as walkway areas - screeded, wood floated, steel troweled.

2. Walking areas - screeded, wood floated, steel troweled, broomed.

3. Exterior sidewalks - screeded, wood floated, divided into panels, steel troweled, broomed.

B. Panel Construction: Construct panels, where required, approximately 10 feet square using an edger to form dummy joints 1/4-inch deep.

C. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if the area is small or inaccessible to power units. For nonsloping level surfaces check and level the surface plane to tolerances of F_F 18 and as determined by ASTM E 1155. For sloping surfaces check the surface planes to a tolerance of F_F 18 as determined by ASTM D 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to

a uniform, smooth, granular texture. Check the floors flatness (F_F) and levelness (F_L) on an area of 400 square feet for level floors and 400 square feet of sloping floors or tanks to be selected by the CONSULTANT.

D. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. For nonsloping level surfaces check and level the surface plane to tolerances as determined by ASTM E 1155. Cut down high spots and fill low spots. For sloping surfaces check the surface planes to a tolerance of F_F = 20 as determined by ASTM E 1155. Check the floor flatness (F_F) and levelness (F_L) on an area of 400 square feet for level floors 400 square feet for sloping floor or tanks to be selected by the CONSULTANT. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances specified. Grind smooth surface defects which would telegraph through applied floor covering system.

E. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere, where indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with the CONSULTANT before application.

F. Protection: Cover all finished floors, walkways, and slabs with boards, canvas, heavy paper or similar covering to protect them from damage.

3.8 STRUCTURAL CONCRETE SURFACES

A. Beveling Edges: Finish top edges of walls and equipment pads with a 1/2-inch beveled edge, unless other details are shown, and rub off any burrs remaining upon removal of the forms.

B. Form Removal Inspection: Immediately after stripping the forms, inspect all concrete surfaces. Remove all fins, offsets, burrs, ridges, or other unsightly marks from the exposed concrete.

C. Patching: Patch tie holes, placement joints, voids, stone pockets, or other defective areas before the concrete is thoroughly dry. Chip away defective areas to a depth of not less than 1 inch with all edges perpendicular to the surface. Wet the area to be patched, including at least 5 inches of the adjoining surface, prior to placing the patching mortar. Then scrub onto the surface a grout of equal parts of cement and sand mixed to a brushing consistency followed immediately by the patching mortar.

Make the patch of the same material and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. For exposed concrete, substitute white cement for part of the gray cement so that the patch will match the color of the surrounding concrete. Determine the proportion of white and gray cement by making a trial patch. Use as little water as consistent with requirements of handling and placing.

D. Mortar: Do not retemper mortar. Thoroughly compact and screed off the mortar so as to leave the patch slightly higher than the surrounding surface. Then leave it undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. Finish the patch to match the adjoining surface and cure as specified for the original concrete.

3.9 CONCRETE STAIR TREADS AND LANDINGS

A. Tread and Landing Application: Construct treads and landings of all exterior and interior concrete stairs by applying a nonslip surface which is applied as an integral cement finish before the initial set of the slab has taken place, unless abrasive nosings or other finish is indicated. Compound and apply the finish consisting of 1/2-inch layer of stiff, thoroughly mixed mortar comprising 1 part cement and 2 parts sand to which is added carborundum grit in the amount of 1/4 to 1/2 pound per square foot of finished surface. Screed and trowel the mortar to a smooth and even surface.

3.10 GROUTING

A. Grout Placement: Place grout under column setting plates, under equipment bases, in conjunction with the setting of anchors or dowels in holes drilled in concrete, and elsewhere as required. Grout base plates and foundations using specified nonshrink grout. Use nonmetallic grout for exposed conditions, unless otherwise indicated.

B. Discoloration Requirements: Where grout will be exposed to the weather, make it free of discoloration without the necessity of special surface treatments.

C. Manufacturers Instructions: Mix and place all grout in accordance with manufacturer's instructions.

3.11 EPOXY ADHESIVE

A. Epoxy Adhesives for Bonding: Use epoxy adhesive for bonding fresh concrete to existing concrete where shown and grouting dowels into vertical holes.

B. Recommendations: Mix and apply epoxy adhesive in accordance with the manufacturer's recommendations and in accordance with the requirements of the "Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive - ACI 503R.

C. Surface Preparation: Roughen existing concrete, by sandblasting. Provide all surfaces free of standing water and clean as required.

3.12 EPOXY GEL

A. Epoxy Gels for Dowels: Use epoxy gel for grouting dowels into horizontal holes.

B. Application: Apply epoxy gels in accordance with the manufacturer's recommendations.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place, and cure concrete as specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide a monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing machines and equipment.

D. Grout: Grout base plates and foundations using specified nonshrink grout. Use nonmetallic grout for exposed conditions, unless otherwise indicated.

E. Manufacturer's Field Services: Furnish the services of a qualified representative of the grout manufacturer to provide instruction on proper grout preparation and grouting procedures.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 30 53

CONCRETE FOR NON-PLANT WORK

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. The extent of concrete work is shown on the drawings.

1.2 CODES AND STANDARDS

A. ACI 347 "Recommended Practice for Concrete Formwork"; ACI 304 "Recommended Practice for measuring, Mixing, Transporting, and Placing Concrete"; comply with applicable provisions.

B. Reference to standard specifications herein shall be construed as to be in reference to the latest revision or edition.

1.3 STORAGE

A. Immediately upon receipt at the site, cement that is to be site mixed shall be stored in a dry, weather tight building, properly ventilated and with provisions for prevention of moisture absorption.

B. Reinforcing shall be protected from the weather.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: Cement shall conform to standard specifications for "Portland Cement", ASTM C150, Type I for concrete not exposed to sewage and ASTM C150, Type II or ASTM C150, Type I with sulfide resistant properties equal to Type II for concrete exposed to sewage.

B. Aggregate: Concrete aggregate shall conform to the current specifications for "Concrete Aggregate", ASTM Designation C33.

C. Water: Water used in mixing concrete shall be fresh, clean, and free from injurious amounts of oil, acid, alkali or organic matter.

D. Ready-Mix Concrete: Ready-mixed concrete may be used at the option of the CONTRACTOR provided that such concrete meets the requirements of these specifications and of ASTM Designation C94 for "Ready-Mixed Concrete".

E. High-Early-Strength Concrete: Concrete made with high-early-strength Portland cement shall be used only when specifically authorized by the ENGINEER. The 7-day compressive strength of concrete made with high-early-strength cement shall be at least equal to the minimum 28-day compressive strength specified. All provisions of these specifications shall be applicable to high-early-strength concrete except the cement shall conform to ASTM Designation C150, Type III.

2.2 RELATED MATERIALS

A. Reinforcing: Deformed Reinforcing Bars, ASTM A615; Grade 60 unless otherwise indicated.

B. Welded Wire Fabric: ASTM A185.

C. Liquid Membrane-Forming Curing Compound: ASTM C309, Type I.

D. Form Materials:

1. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

2. Exposed Concrete Surfaces: Suitable material to suit project conditions.

E. Waterstops: To be used in joints shall be #10 gage steel sheet, 4" wide, welded continuous through the joint, unless detailed otherwise.

F. Chemical Floor Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gallon.

1. Apply to exposed concrete slabs not indicated or scheduled to receive subsequent finishes.

2.3 QUALITY

A. Strength: The minimum 28-day compressive strength of reinforced concrete shall be 4,000 psi, unless shown otherwise on the drawings.

1. Each cubic yard of 4,000 psi concrete shall contain no less than 517 lbs. of cement. The total water content per bag of cement shall not exceed 6.0 gallons.

B. Strength: The minimum 28-day compressive strength of non-reinforced concrete shall be 2,500 psi, unless shown otherwise on the drawings.

Each cubic yard of 2,500 psi concrete shall contain no less than 440 lbs. of cement. The total water content per bag shall not exceed 7.5 gallons.

C. Mix Proportions: All concrete materials shall be proportioned so as to produce a workable mixture with a slump between 2" and 4".

D. Tests:

1. The CONTRACTOR shall provide, for test purposes, one set of three cylinders taken from each day's pour or each 50 cubic yards placed, whichever is least or as directed by the ENGINEER. The CONTRACTOR at his expense shall supply test samples and an independent testing laboratory at the CONTRACTOR's expense will make tests. Sampling and testing of concrete shall be made in accordance with ASTM C-143 and ASTM C-31. The standard age of test shall be at 7 days and 28 days; and, when approved by the ENGINEER, a 45 day test may be used. If the test strength of the cylinders falls below the minimum allowable compressive strength, the ENGINEER shall have the right to order the CONTRACTOR to remove and renew that day's pour of concrete or the CONTRACTOR shall accept such deductions in the final payment as the OWNER may deem reasonable.

2. Sampling and testing of concrete materials shall be made in accordance with ASTM Designations. The CONTRACTOR at his expense shall supply test samples, and an independent testing laboratory at the CONTRACTOR's expense shall make tests. The source from which concrete aggregates are to be obtained shall be selected by the CONTRACTOR well in advance of the time when they will be required in the work; and suitable samples, as they are to be used in the concrete, shall be furnished in advance of the time when the placing of the concrete is expected to begin.

PART 3 EXECUTION

3.1 FORMING AND PLACING CONCRETE

A. Formwork: Construct so that concrete members and structures are of correct size, shape, alignment, elevation and position, complying with ACI 347.

Clean and adjust forms prior to concrete placement. Apply form release agents for wet forms, as required. Retighten forms during and after concrete placement if required to eliminate mortar leaks.

3.2 REINFORCEMENT

A. Position, support and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters, spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

B. Install welded wire fabric in lengths as long as possible, lapping at least one mesh.

C. Installation of Embedded Items: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates and instructions provided by others for locating and setting.

3.3 CONCRETE PLACEMENT

A. Comply with ACI 304, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

B. Consolidate placed concrete using mechanical vibrating equipment with hand rodding and tamping, so that concrete is worked around reinforcement and other embedded items and into all parts of the forms.

C. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing. Concrete shall not be placed when the surrounding air temperature is below 40^{o}F. and dropping.

1. In cold weather comply with ACI 306.

2. In hot weather comply with ACI 305.

3.4 CONCRETE FINISHES

A. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete and sidewalks.

1. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with the ENGINEER before application.

3.5 BONDING AND GROUTING

A. Before depositing new concrete on or against concrete that has set, existing surfaces shall be thoroughly roughened and cleaned of glaze, foreign matter, and loose particles. An epoxy coating shall be applied for bonding the new concrete to the old.

3.6 CURING

A. Concrete shall be kept continuously (not periodically) wet for a period of at least five consecutive days by covering with water or with an approved water saturated covering. Water for curing shall be clean and free from any elements, which might cause staining, or discoloration of the concrete surface.

B. Sidewalks and floor slabs may be cured by spraying with a Membrane-Forming curing compound, applied as per manufacturer's recommendations. This material shall not be used on any interior slabs to which an applied finish is to be bonded.

3.7 PATCHING

A. Any concrete which is not formed as shown on the drawings, or is out of alignment or level or shows a defective surface, shall be considered as not conforming with the intent of these specifications and shall be removed from the job by the CONTRACTOR at his expense, unless the ENGINEER grants permission to patch the defective area. This shall be done in accordance with the procedures above. Honeycomb consisting of 1/2" diameter holes or greater shall be considered a defective surface. Permission to patch any such area shall not be considered a waiver of the ENGINEER's right to require complete removal of the defective work if the patching does not, in his opinion, satisfactorily restore the quality of the concrete and appearance of the surface.

B. As the forms are removed, fins, rough edges, and offsets shall be ground smooth. Holes to 1/2", slight honeycomb, and minor defects shall be wet and filled with a 1:2 mix of cement mortar, matching color of surrounding concrete, and then troweled to a uniform plane. As soon as they have been troweled, the patched areas shall be sprayed with a curing compound, which will not destroy future bonding properties. Three days after application of curing compound, the entire surface shall be finished by wetting and applying a 1:2 mix of cement mortar with a cement brick. Using the brick, mortar shall be rubbed into pits or indentations and excess mortar rubbed off to provide a uniformly textured surface. When the surface has dried, all loose sand and dust shall be removed and the surface then hosed down with water.

3.8 TOLERANCES

A. Tolerances for concrete work shall be in accordance with ACI 347.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 40 00

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all materials, labor, and equipment and construct manholes, wet wells, valve pits, meter pits, and accessory items, consisting of precast sections as shown on the Drawings and as specified herein.

B. The forms, dimensions, concrete, and construction methods shall be approved by the ENGINEER in advance of construction.

C. These specifications are intended to give a general description of what is required, but do not purport to cover all of the structural design details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, shop testing, delivery, and complete installation of all precast structures whether specifically mentioned in these specifications or not.

D. The supplier of the precast manholes, wet wells, valve pits, meter pits, and accessory items shall coordinate his work with that of the CONTRACTOR to the end that the unit will be delivered and installed in the excavation provided by the CONTRACTOR, in accordance with the CONTRACTOR's construction schedule.

E. Coordinate the precast structures fabrication with the equipment supplied to achieve the proper structural top slab openings, spacings, and related dimensions for the selected equipment frames and covers. The top slabs, frames, covers, and subsurface structures shall be capable of supporting a live load of 150 pounds per square foot.

1.2 SUBMITTALS

A. Submit to the ENGINEER, as provided in the General Conditions, shop drawings showing details of construction, reinforcing and joints.

B. Shop Drawings

1. Content

a. Dimensions and finishes
b. Estimated camber
c. Reinforcing and connection details
d. Anchors

e. Lifting and erection inserts
f. Other items cast into members

2. Show location of unit by same identification mark placed on member.

3. Include design calculations.

C. Manufacturer's Literature: Manufacturer's recommended installation instructions.

D. Manufacturer's certificates of material conformance with specifications.

E. Test Reports: Reports of tests on concrete.

F. Testing

1. Certification: The supplier shall provide the certified results of testing (7 day, 28 day) for the test cylinders stated herein. Random test cylinders may be taken at any time by the ENGINEER at the OWNER's expense.

1.3 INSPECTION

A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the ENGINEER, or other representatives of the OWNER. Such inspection may be made at the place of manufacture, or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be repaired, if permitted and accepted by ENGINEER, or removed and replaced, entirely at the CONTRACTOR's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with ASTM C478 designation and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C. Imperfections may be repaired, subject to the approval of the ENGINEER, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days, Epoxy mortar may be utilized for repairs subject to the approval of the ENGINEER.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE WET WELLS AND VALVE VAULTS

A. Precast submersible pump station wet wells shall consist of precast base, precast wet well sections, and top cover slab. Precast valve vaults shall consist of precast base, sidewalls and top slab. Concrete shall be air entrained at the time of delivery and shall have a minimum compressive strength of 4,000 psi at the end of 28 days.

B. Joints between precast concrete sections shall be set by plastic shims and fitted with non-metallic non-shrink grout as shown on the drawings.

C. The top slab sections shall be fitted with water tight hatches. The frames and covers will be sized for the openings shown on the drawings.

D. The various precast sections should have the inside dimensions and minimum thickness of concrete as indicated on the drawings. All precast and cast-in-place concrete members shall conform to the Building Code Requirements for Reinforced Concrete ACI 318.

E. A vent pipe shall be furnished and installed as shown on the drawings.

F. Fillets shall be provided and installed in the wet wells as shown on the drawings.

G. Precast structures shall be constructed to the dimensions as shown on the drawings and as specified in these Specifications.

H. Type II cement shall be used except as otherwise approved.

I. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.

J. Sections shall be cured by an approved method and shall not be shipped until the minimum 7-day compressive strength has been attained.

K. Each pre-cast section manufactured in accordance with the drawings shall be clearly marked to indicate the intended pump station installation location. The CONTRACTOR shall be responsible for the installation of the correct pre-cast sections in their designated pump station locations.

L. Paint all exterior surfaces with two coats of coal tar bitumastic, each coat to be 9 mils each. All interior surfaces of valve vaults shall be coated with two coats of coal tar epoxy (9 mils each).

2.2 PRECAST CONCRETE SECTIONS FOR CIRCULAR WET WELLS

A. Wet wells shall meet the requirements of ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections, with the exclusion of Section 10(a), except as modified herein. Cement shall meet the requirements of ASTM C150-74, Specification for Portland Cement, Type II. Concrete shall meet the minimum requirement for 4000 psi concrete. Minimum wall thickness shall be 8 inches or 1/8 the inside manhole diameter as shown, whichever is greater. The required minimum strength of concrete shall be confirmed by making and testing three standard cylinders at seven days. Rings shall be custom made with openings to meet indicated pipe alignment conditions and invert elevations. Submit shop drawings, consisting of manufacturers' standard details of various sections for approval prior to placing order for wet wells. Drawings of individual wet wells showing invert elevations, pipe sizes and similar details will not be required.

B. Joints

Form joint contact surfaces with machined castings. Surfaces shall be exactly parallel with nominal 1/16 inch clearing and the tongue equipped with a proper recess for the installation of a rubber gasket. Gaskets shall meet the requirements of Specification for Joint for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets. An approved sealing compound (see LCU Approved Materials List) conforming to Federal Specification S-SS-210 (GSA-FSS), Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints may be used in lieu of rubber gaskets. If joints are sealed with an approved sealing compound the recess in the tongue for a gasket may be omitted.

C. Wet Well Liners and Coatings

Coat or line the interior of all wet wells with OWNER approved system as shown in the LCU Approved Materials List.

Furnish, install, test and inspect liners and coating in accordance with manufacturer’s recommendations. Extend coating and liner and seal onto wet well hatch frame, around pipe openings and other protrusions to prevent contact of wet well surface with corrosive sewer gases.

2.3 PIPE CONNECTIONS AT STRUCTURES

A. Where pipes are to extend into or through structures from the exterior, flexible connections (mechanical or push-on type joints) shall be provided at the exterior wall face.

B. For pipes passing through structural walls, wall pipes with water stops shall be installed where the location is below the surface of the ground or at any point where fluid levels will exceed that elevation. Neoprene sleeves with watertight caulking and 316 Series SS stainless steel clamps will be suitable at other locations.

PART 3 EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall be responsible for control of ground water to provide firm, dry subgrade for the structure, shall prevent water rising on new poured in place concrete or grouted joint sections within 24 hours after placing, and shall guard against flotation or other damage resulting from ground water or flooding.

B. A minimum of a 12 inch layer of crushed stone or shell as specified under Section 31 23 23 shall be placed as a foundation for the wet well base slabs, valve pits, and meter pits.

C. Backfill material around the wet well and above the pipe bedding shall be selected material as specified in Section 31 23 23.

D. Precast bases, conforming to all requirements of ASTM C478 and above listed requirements for precast sections, may be used. The base shall be set in place on a thoroughly compacted crushed stone sub-base and adjusted in grade for the correct structure elevation.

E. The station shall not be set into the excavation until the installation procedure and excavation have been approved by the ENGINEER.

F. The base may be cast-in-place concrete as specified in Division 3, placed on a thoroughly compacted crushed stone sub-base. The tops of the cast-in-place bases shall be shaped to mate with the precast barrel section, and shall be adjusted in grade so that the top slab section is at the approximately correct elevation.

G. Precast concrete structure sections shall be set so as to be vertical and with sections in true alignment with a 1/4 inch maximum tolerance to be allowed. The outside and inside joint shall be filled with a non-shrink grout and finished flush with the adjoining surfaces. Allows joints to set for 24 hours before backfilling. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with lead wool to the satisfaction of the ENGINEER. Install the precast sections in a manner that will result in a watertight joint.

H. Holes in the concrete sections required for handling or other purposes shall be plugged with a non-shrinking grout or by grout in combination with concrete plugs.

I. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done by core drilling prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.

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 05 51 00

METAL STAIRS, LADDERS, AND WALKWAYS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Technical requirements for metal stairs, ladder, and walkways.

1.2 REFERENCES

A. General: References to standards, specifications, manuals, or codes of any technical society, organization or association, or to the Laws or Regulations of any government authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. ANSI Standards

1. ANSI A14.3 Safety Requirements for Fixed Ladders

C. ASTM Standards

1. ASTM A36 Specification for Structural Steel

2. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

3. ASTM A123 Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products

4. ASTM A193 Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

5. ASTM A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

D. AWS Standards

1. AWSD1.l Welding in Building Construction

2. AWSA5.5 Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding

1.3 SYSTEM DESCRIPTION

A. Furnish and install metal stairs, ladders, and walkways required to complete work show and specified

B. Furnish and install metal stairs, ladders, and walkways as shown on the Drawings and specified in this Section.

1.4 SUBMITTALS

A. Shop Drawings.

1. Show stair, ladder and walkway fabrication and construction details.

2. Including necessary plans, sections and elevations to show Life Safety features.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements

1. Design, fabrication and construction of stairs, ladders and walkways shall comply with SBC, OSHA and NFPA 101 Life Safety code.

2. Stairs, ladders and walkways for utility facilities shall conform to "industrial occupancy" accessible to the public, unless otherwise indicated on the Drawings

PART 2 – PRODUCTS

2.1 MATERIALS FOR METAL STAIR, LADDERS, AND WALKWAYS

A. Steel

1. Steel bars, plates, shapes, and connections for steel stairs and walkways shall meet the requirements of ASTM A36.

2. Structural steel tubing for steel walkways shall meet the requirements of ASTM A500, Grade B. Wall thickness shall be as shown on the Drawings.

3. Steel pipe for steel walkways shall meet the requirements of ASTM A53, Schedule 40.

4. Steel fabrications shall be galvanized by the hot dip method, after fabrication, in accordance with the requirements of ASTM A1 23.

B. Aluminum

1. Aluminum bars, plates, rods, and shapes for aluminum stairs, ladders, and walkways shall be Alloy 6061 -T6, unless otherwise shown or specified.

2. Aluminum bars, plates, rods, and shapes shall have standard mill finish.

C. Welding Electrodes

1. Welding electrodes for structural steel shall conform to AWS A5.5, E70XX.

2. Use 4043 filler metal for aluminum.

3. Use type E308 electrode where the base metal is type 304 stainless steel and type E309 where the base metal is type 316 stainless steel or where stainless steel is welded to carbon steel.

4. Field welding of galvanized steel shall not be acceptable.

D. Anchor Bolts and Fasteners

1. Anchor bolts and fasteners shall meet the requirements of ASTM A193, Grade B8M.

2. Anchor bolts and fasteners for metal stairs, ladders, and walkways shall be wedge or adhesive anchors, unless otherwise noted. Adhesive anchors shall consist of a self-contained vinylester adhesive cartridge and anchor rods. See LCU Approved Materials List for acceptable wedge and adhesive anchors.

2.2 METAL STAIRS

A. General

1. Fabricate metal stairs to meet the requirements of SBC, OSHA, NFPA 101 and the standard practice for stairs of the National Association of Ornamental Metal Manufacturers.

2. Size of various members and number of parts indicated on the Drawings are minimum, and shall be increased as necessary to meet the requirements of this Section.

3. Stair members shall be constructed to support dead loads and additional live working stresses permitted for materials in Standard Building Code.

B. Aluminum Stairs

1. Aluminum Stairs, General

a. Fabricate aluminum stairway frame of aluminum structural shapes. Frame for each run of aluminum stairway shall be continuous, without joints.

b. Provide aluminum stairways with aluminum treads and aluminum handrail and guard railing.

2. Aluminum Stairway Connections

a. Connections between aluminum stairway members shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 3 16 stainless steel.

b. Connections between aluminum stairway sections and aluminum fabrications, such as landings, walkways, and platforms, shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 316 stainless steel.

c. Connections between aluminum stairway and concrete shall be fabricated of AISI 3 16 stainless steel.

d. Connections between aluminum stairway and steel fabrications, such as landings, walkways, and platforms, shall be fabricated of AISI 3 16 stainless steel.

3. Aluminum Stair Treads

a. Aluminum stair treads shall be same pattern and alloys as aluminum walkway grating.

b. Aluminum stair treads shall be a minimum of 1-1/2 inches thick, unless otherwise indicated on the drawings.

c. Aluminum stair treads shall have 1-1/4-inch wide abrasive nosing.

4. Aluminum Handrail and Guard Railing: Aluminum handrail and guard railing shall meet the requirements of Section 05 52 00 Aluminum Handrails and Railings.

2.3 METAL LADDERS

A. Metal Ladders, General

1. Ladders and cages shall be designed and fabricated in accordance with Part 19 10 of the Occupational Safety and Health Standards and ANSI A14.3.

2. Provide ladder with safety cage or safety climbing device if ladder height is such that safety cage or safety climbing device is required to meet OSHA requirements. Provide safety cage unless safety-climbing device is specifically shown or noted on the Drawings.

B. Aluminum Ladders, Cages, and Supports

1. Aluminum Ladders

a. Ladder frame, or uprights, shall be 3/8-inch by 2-inch aluminum bars. Ladder uprights shall be spaced 18 inches apart.

b. Ladder rungs shall be aluminum rods. Rungs shall be not less than 1 inch in diameter. Rungs shall be smooth. Rungs shall be spaced 12 inches on centers. Ends of rungs shall be fitted into, and welded to, the uprights.

2. Aluminum Cages: Fabricate aluminum cages of aluminum bars bent to shape.

3. Supports for Aluminum Ladders and Cages

a. Supports shall be 3/8-inch by 2-inch aluminum bars bent to shape.

b. Supports shall be spaced not more than 5 feet apart.

c. Supports shall be welded to uprights.

2.4 METAL, WALKWAYS

A. Metal Walkways, General

1. Fabricate metal walkways to meet the requirements of SBC, OSHA, and NFPA 101.

2. Size of various members and number of parts indicated on the Drawings are minimum, and shall be increased as necessary to meet the requirements of this Section.

3. Walkway members shall be constructed to support dead loads and additional live working stresses permitted for materials in Standard Building Code.

B. Aluminum Walkways

1. Aluminum Walkways, General

a. Fabricate aluminum walkway frame of aluminum structural shapes and bars. Frame for each section of walkway between supports shall be continuous, without joints.

b. Provide aluminum walkways with aluminum grating floor plates as indicated on the Drawings. Provide aluminum walkways with aluminum guard railing.

2. Aluminum Walkway Connections

a. Connections between aluminum walkway members shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 316 stainless steel.

b. Connections between aluminum walkway sections and aluminum supports shall be aluminum bars, plates, and shapes or fabricated of AISI 304 or AISI 316 stainless steel.

c. Connections between aluminum walkway and concrete shall be fabricated of AISI 316 stainless steel.

d. Connections between aluminum walkway and steel fabrications, such as supports, landings, walkways, and platforms, shall be fabricated of AISI 3 16 stainless steel.

3. Aluminum Walkway Floor

a. Aluminum walkway floor grating shall meet the requirements of Section 05 53 00 Metal Grating, Trench Covers, and Floor Plates. Aluminum walkway floor grating shall be a minimum of 1-1/2 inches thick, unless otherwise indicated on the drawings.

b. Aluminum walkway floor plate shall meet the requirements of Section 05 53 00 Metal, Grating, Trench Covers, and Floor Plates. Aluminum walkway floor plate shall be a minimum of 1/4 inch thick, unless otherwise indicated on the drawings.

4. Aluminum Handrail and Guard Railing: Aluminum handrail and guard railing shall meet the requirements of Section 05 52 00 Aluminum Handrails and Railings.

PART 3 –EXECUTION

3.1 INSPECTION

A. Take field measurements prior to preparation of shop drawings.

B. Inspect structures, members, and surfaces on which stairs, ladders, and walkways are to be mounted. Correct defects prior to installation of metal stairs and walkways.

3.2 PREPARATION

A. Clean and strip primed items to bare metals where site welding is required.

B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide anchors, plates, angles, hangers and struts required for connecting stairs to structure.

C. Ladders shall be installed in accordance with the requirements of ANSI A14.3 and Part 1910 of the Occupational Safety and Health Standards. Ladders shall be rigidly supported not less than 7 inches from adjacent surfaces. Ladders shall be secured to concrete block wall by AISI Type 3 16 stainless steel toggle bolts embedded in the CMU wall. Ladder shall be secured to cast-in-place concrete wall by AISI Type 316 stainless steel anchor bolts and adhesive anchors.

D. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

E. Field weld components indicated on Drawings. Perform field welding in accordance with AWS D1.l.

F. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws wherever possible.

G. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

H. Obtain Engineer's approval prior to site cutting or making adjustments not scheduled.

I. Fabrication and Erection: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "manual of Steel Construction".

3.4 PREVENTION OF ELECTROLYSIS

A. Aluminum in contact with dissimilar metals shall be separated with 1/8" thick layer of neoprene backing pad of full abutting area.

B. Install corrosion barriers between aluminum and concrete.

1. Isolate surface mounted aluminum with one of the following systems:

a. Coat bottom of surface mounted aluminum railing posts and aluminum clip angles as specified in Section 09961 Protective Coating for Embedments.

b. Install vinyl or neoprene barrier pad between bottom of surface mounted aluminum railing post, or angle clip, and concrete.' Area of pad shall equal area of aluminum surface.

2. Coat aluminum embedded in concrete or grout as specified in Section 09961 Protective Coating for Embedments.

3.5 WELDING

A. Welding shall be by the metal-arc method or gas-shielded a& method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

B. In assembly and during welding, component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS Code. Upon completion of welding, remove weld splatter, flux, slag and burrs left by attachments. Repair welds to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp comers of material, which is to be painted or coated, shall be ground to a minimum of 1/32 inch on the flat.

3.6 CLEANING

A. A. Clean paint spatter, concrete slobbers, grease, oil, or any other debris from exterior surfaces of metal stairs, ladders, and walkways.

END OF SECTION

SECTION 05 52 00
ALUMINUM HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for aluminum handrails, railings, and accessories.

1.2 DEFINITIONS

A. Guardrail (OSHA): A barrier secured to uprights and erected along the exposed sides and ends of platforms to prevent falling of persons.

B. Handrail: A single bar or pipe supported on brackets from a wall or partition, as on a stairway or ramp, to provide persons a handhold in case of tripping.

C. Railing (OSHA): A vertical barrier erected along exposed sides or stairways and platforms to prevent falls of persons. The top member of railing usually serves as a handrail.

D. Stair Railing (OSHA): A vertical barrier erected along exposed sides of a stairway to prevent falls of persons.

E. Toeboard (OSHA): A vertical barrier at floor level erected along exposed edges of a floor opening, wall opening, platform, runway, or ramp to prevent falls of materials.

1.3 SYSTEM DESCRIPTION

A. General: Furnish and install aluminum handrail, railings, and appurtenances as shown on the Drawings and specified in this Section.

B. Type: Two rail system permitted by SBC, Group F, Industrial Occupancy, inaccessible to the public.

1.4 SUBMITTALS

A. Submit the following prior to handrail and railing fabrication:

1. Shop drawings and product data.

2. Detailed layout of handrail and railing system with sufficient plans, sections, and elevations for the complete field installation.

3. Dimensions and details demonstrating compliance with OSHA and Life Safety requirements.

4. Note stating design load standard.

5. Physical characteristics of handrail and railing, joints, and anchors.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements

1. Design and construction of guardrails and stair handrails shall comply with SBC Code, OSHA Standards, and NFPA 101, Life Safety Code.

2. Plant structures and buildings shall be considered Group F, Industrial Occupancy, inaccessible to the public.

3. Workmanship: Aluminum railing fabrication shall be performed by craftsmen experienced in the fabrication of architectural metal work.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. See LCU Approved Materials List for manufactures.

2.2 ALUMINUM RAILING SYSTEM FOR INDUSTRIAL OCCUPANCY

A. Type: Mechanically jointed, pipe rail.

B. Configuration: Two pipe rails and one toeboard.

C. Fittings

1. Type

a. Mechanically fastened, component.
b. Components that are glued or epoxied will be rejected.

2. Fastener Material: Stainless steel.

D. Design Load

1. Standard: Building Code or OSHA, whichever is more restrictive.

2. Vertical Post Minimum Spacing: Five feet.

E. Railing and Posts

1. Material: Aluminum alloy 6061-T6.

2. Rail and Post Size

a. Nominal Diameter: 1 - 1/2"
b. Minimum Wall Thickness

(1) Rails: Schedule 40.
(2) Posts: Schedule 80.

3. Post Reinforcement: As required to meet design load standards.

F. Toeboards

1. Requirement: Provide on railing along exposed edges of floor openings, wall openings, platforms, runways, and ramps.

2. Material: Aluminum alloy 6061-T6.

3. Minimum Thickness: 1/4"

4. Maximum Projection into Walkway Area: 1-1/4"

5. Gap Between Walkway Surface and Toeboard

a. Minimum: 1/8"
b. Maximum: 1/4"

6. Vertical Height from Top Surface of Walkway to Top of Toeboard

a. Minimum: 4"
b. Maximum: 6"

7. Connection to Vertical Posts

a. If Detailed on Drawings: As shown on Drawings.
b. If Not Detailed on Drawings: As shown on approved shop drawings.

G. Wall Brackets

1. Material: Aluminum alloy, or AISI 3 16 stainless steel.

2. Design

a. Manufacturer's standard design as shown on approved shop drawings.
b. End wall mounted handrail at line of first nosing.

H. Vertical Post Supports

1. Material: Aluminum alloy, or AISI 3 16 stainless steel.

2. Type

a. Top surface mount or side mount as indicated on the Drawings.
b. Posts that are grouted or epoxied in sleeves or cored openings will be rejected.

I. Mounting Bolts

1. Material: AISI 3 16 stainless steel

2. Type: Wedge bolts furnished by railing manufacturer.

J. Aluminum Finish

1. Type: Clear anodized.

2. Standard: Aluminum Association MlO-C22-A41 (215-Rl).

2.3 PROTECTION

A. Type: Plastic wrap.

B. Maintenance

1. Remove plastic wrap only as required to cut and connect rails and posts

2. Maintain plastic wrap until substantial completion.

PART 3 – EXECUTION

3.1 INSPECTION

A. Field Measurement and Coordination

1. Take field measurements prior to preparation of shop drawings.

2. Coordinate and furnish setting drawings, diagrams, templates, instructions, and directions for installation of railing.

B. Mounting Surfaces

1. Inspect mounting surfaces.

2. Correct defects prior to installation of railing.

C. Railing Components

1. Check railing components prior to installation.

2. Check railing components for damage and fit.

3.2 INSTALLATION

A. Install guardrails and handrails in accordance with applicable requirements of SBC, OSHA, and NFPA 101.

B. Provide anchors and plates required for mounting railing.

C. Perform cutting and fitting required for installation of railing.

1. Cut and fit railing as shown on shop drawings.

2. Do not make alterations not shown on shop drawings without approval of Design Engineer.

D. Install rails level and vertical posts plumb, accurately fitted, and free from distortion or defects.

1. Precision fit joints, junctions, miters, and butting sections

2. Provide tight, hairline joints.

E. Install corrosion barriers between aluminum and concrete and between aluminum and dissimilar metals.

1. Isolate surface mounted aluminum with one of the following systems:

   a. Coat bottom of surface mounted aluminum railing posts and aluminum clip angles as specified in Section 09961 Protective Coating for Embedments.
   b. Install vinyl or neoprene barrier pad between bottom of surface mounted aluminum railing post, or angle clip, and concrete. Area of pad shall equal area of aluminum surface.

2. Coat aluminum embedded in concrete or grout as specified in Section 09961 Protective Coating for Embedments.

3.3 EXPANSION BOLTS

A. Space anchor bolts ten diameters apart and five diameters edge distance for no reduction in pullout strength.

B. Provide a safety factor of four on expansion bolt pullout and shear values published by the manufacturer.

3.4 CLEANING

A. Clean installed railing.

B. Remove paint, adhesives, concrete slobbers, grease, oil, and other substances from railing and exposed fasteners.

C. Exposed surfaces of railing shall be free from burrs.

D. Exposed surfaces of railing shall be free from gouges, scratches, grazes, or other blemishes.

END OF SECTION

SECTION 05 53 00
METAL GRATING, TRENCH COVERS, AND FLOOR PLATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Technical requirements for metal grating, trench covers, and floor plates.

1.2 REFERENCES

A. General: References to standards, specifications, manuals, or codes of any technical society, organization or association, or to the Laws or Regulations of any government authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. ANSI/NAAMM Standards

1. ANSI/NAAMM MGB 53 1 Metal Bar Grating Manual

1.3 SYSTEM DESCRIPTION

A. Furnish and install metal grating, trench covers, floor plates, and appurtenances required to complete work shown and specified.

B. Furnish and install metal grating, trench covers, floor plates, and appurtenances as shown on the Drawings and specified in this Section.

C. New aluminum grating shall be same type as existing aluminum grating.

1.4 SUBMITTALS

A. Submit the following:

B. Product data for manufactured products.

C. Shop drawings showing plans, elevations and details of sections and connections. Show type and location of fasteners.

PART 2 PRODUCTS

2.1 GRATING

A. Grating, General.

1. Grating bar section, depth and spacing shall be based upon a uniformly applied load of 200 pounds per square foot over the full span unless a greater loading is noted on the Drawings. Grating deflection shall not exceed L360 or 1/4 inch whichever is less. Provide stiffener angles as required to meet load requirements specified in this Section.

2. Bearing bars and cross bars shall be continuous.

3. Exposed ends of grating bearing bar and cut outs shall be banded with a bar of the same depth and thickness as the main bearing bars. When welded construction is used, weld cut bar to band bar. When crimped or swaged construction is used, limit protrusion of bars at edges to 1/16-inch, maximum, and peen or grind protruding bars to a smooth surface.

4. Provide cutouts in grating for valve operators, conduits, pipes, and other penetrations. Band edges of cutouts.

5. Grind rough weld beads and sharp metal edges smooth.

6. Punch bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. Whenever needed, because of metal thickness, sub-punch and ream holes, or drill holes.

7. Fabricate grating in sections, which do not exceed *75* pounds each.

B. Aluminum Grating

1. Aluminum Grating Manufacturers listed in LCU Approved Materials List.

2. Aluminum Grating Material

   a. Aluminum grating bearing and crossbars shall be 6063-T6 aluminum alloy.

   b. Aluminum grating shall have mill finished.

3. Aluminum Grating Fabrications

a. Aluminum grating fabrications and tolerances shall meet the requirements of NAAMM Metal Bar Grating Manual.

b. Maximum allowable deflection for aluminum grating specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch.

c. Grating depth shall be not less than the depth indicated on the Drawings. In no case shall aluminum grating depth be less than 1-1/2 inches.

4. Aluminum I-Bar Grating

a. Aluminum I-Bar grating shall have extruded aluminum I-shaped bearing bars with square cross bars swage-locked at right angles to bearing bars.

b. Bearing bars and cross bars shall be spaced as follows, unless otherwise shown on the Drawings.

(1) Bearing Bar Spacing: 1-3/16 inches center-to-center.

(2) Cross Bar Spacing: 4 inches center-to-center.

c. Surface shall have a no skid finish.

5. Aluminum Rectangular Bar Grating

a. Aluminum rectangular bar grating shall be pressure backed grating with rectangular bearing bars and square, or rectangular, cross bars swage-locked at right angles to bearing bars.

b. Bearing bars and cross bars shall be spaced as follows, unless otherwise shown on the Drawings.

(1) Bearing Bar Spacing: 1-3/16 inches center-to-center.

(2) Cross Bar Spacing: 4 inches center-to-center.

c. Surface shall have a no skid finish.

6. Aluminum Grating Frame

a. Aluminum grating set in concrete floor shall be furnished with aluminum grating frame. Aluminum grating manufacturer shall furnish angle frame.

b. Grating frames shall be mitered and welded flush at comers for a finish appearance.

c. Furnish angle frames with AISI 316 stainless steel anchor straps.

7. Aluminum Grating Accessories

a. Provide saddle clips and grating clamps necessary to secure grating.

b. Clamps and bolts used for attaching the grating to supporting members shall be stainless steel, and as recommended by the manufacturer.

2.2 TRENCH COVERS

A. Trench Covers, General

1. Trench covers shall be designed for a uniformly applied load of 300 pounds per square foot over the full span unless a greater loading is noted on the Drawings.

2. Trench cover deflection shall not exceed L/360 or ¼-inch whichever is less.

3. Provide stiffener angles as required to meet load requirements specified in this Section.

B. Aluminum Trench Covers

1. Aluminum Trench Cover Material

a. Aluminum trench covers shall be 6063-T6 aluminum alloy, unless otherwise shown or specified.

b. Aluminum trench covers shall have mill finished, unless otherwise shown or specified.

2. Aluminum Trench Covers, General

a. Maximum allowable deflection for aluminum trench covers specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch. Trench cover thickness shall be as shown on the Drawing, but in no case shall trench covers be less than 1/4-inch thick.

b. Aluminum trench covers shall be aluminum checkered plate equal to ALCOA C-102 aluminum tread plate and Reynolds diamond tread plate.

c. Punch or drill bolt holes in aluminum trench covers for fasteners that secure trench cover to trench cover frame. Punch or drill bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. If holes are punched, sub-punch and ream holes whenever needed because of metal thickness. Counter sink bolt holes for flat head bolts or screws.

3. Aluminum Trench Cover Frame

a. Aluminum trench covers shall be furnished with fabricate-' aluminum frames.

b. Trench cover frames shall be mitered and welded flush at comers for a finish appearance.

c. Furnish trench cover frames with AISI 3 16 stainless steel anchor straps.

4. Aluminum Trench Cover Accessories

a. Provide fasteners necessary to trench covers to trench cover frames.

b. Fasteners used for attaching aluminum trench covers to trench cover frame shall be AISI 316 stainless steel

2.3 FLOOR PLATES

A. Floor Plates, General

1. Floor plates shall be designed for a uniformly applied load of 200 pounds per square-foot over the full span unless a greater loading is noted on the Drawings. Floor plate deflection shall not exceed L/360 or ¼-inch whichever is less. Provide stiffener angles as required to meet load requirements specified in this Section.

2. Provide cutouts in floor plates for valve operators, conduits, pipes, and other penetrations.

3. Grind sharp metal edges smooth.

4. Punch bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. Whenever needed, because of metal thickness, sub-punch and ream holes, or drill holes.

5. Fabricate floor plates in sections, which do not exceed 75 pounds each.

B. Aluminum Floor Plates

1. Aluminum Floor Plate Material

a. Aluminum floor plates shall be 6063-T6 aluminum alloy: unless otherwise shown or specified.

b. Aluminum floor plates shall have mill finished, unless otherwise shown or specified.

2. Aluminum Floor Plates, General

a. Maximum allowable deflection for aluminum floor plates specified in this Section shall be based on an allowable stress of 12,000 pounds per square inch. Floor plates thickness shall be as shown on the Drawing, but in no case shall floor plates be less than 1/4-inch thick.

b. Aluminum floor plates shall be aluminum checkered plate equal to ALCOA C-102 aluminum tread plate and Reynolds diamond tread plate.

c. If aluminum floor plates are to be secured to supporting members or frame, punch or drill bolt holes in floor plates for fasteners that secure floor plate to supporting members or frame. Punch or drill bolt holes 1/16-inch larger than nominal size of bolts, unless otherwise specified. If holes are punched, sub-punch and ream holes whenever needed because of metal thickness. Counter sink bolt holes for flat head bolts or screws.

3. Aluminum Floor Plate Frame

a. Aluminum floor plate set in concrete floor shall be furnished with fabricated aluminum frame.

b. Floor plate frame shall be mitered and welded flush at comers for a finish appearance.

c. Furnish floor plate frames with AISI 316 stainless steel anchor straps.

4. Aluminum Floor Plate Accessories

a. If Drawings indicate floor plate is to be secured to supporting members or frame, provide fasteners necessary to secure floor plate. If code, Laws, or Regulations require floor plate to be secured to supporting members or frame, provide fasteners necessary to secure floor plate.

b. Fasteners used for attaching aluminum floor plate to supporting members or frame shall be AISI 3 16 stainless steel.

PART 3 – EXECUTION

3.1 INSPECTION

A. Field Measurements

1. Take field measurement prior to preparation of shop drawings.

2. Verify opening locations, opening sites, and dimension tolerances are acceptable.

B. Grating and Floor Plates

1. Verify grating, trench cover, and floor plate dimensions.

2. Check grating, trench covered, and floor plates for damage.

C. Mounting surfaces, supports, and Anchors

1. Inspect surfaces, supports, and anchors on which grating, trench covers, and floor plates are to be mounted and secured.

2. Verify supports and anchors are properly located and oriented.

3. Correct defects prior to installation of grating, trench covers, and floor plates.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions.

B. Place frames in correct position, plumb and level.

C. Set perimeter closure flush with top of grating and surrounding construction.

D. Secure grating to prevent movement.

3.3 CLEANING

A. Clean paint spatter, concrete slobbers, grease, oil, or any other debris from exterior surfaces of grating, trench covers, and floor plates.

END OF SECTION

SECTION 05 56 00

METAL CASTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Miscellaneous ferrous and nonferrous castings.

1. This classification includes wheel guards, valve boxes, manhole frames and covers, manhole steps, stop plank grooves, brackets and supports for piping and gutter inlets, floor drains, cleanouts and special malleable iron castings and inserts.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 27/A27M - Specification for Steel Castings, Carbon for General Applications
2. ASTM A 47 - Specification for Ferric Malleable Iron Castings
3. ASTM A 48 - Specifications for Gray Cast Iron Castings
4. ASTM A 148/A148M - Specifications for Steel Castings
5. ASTM A 536 - Specifications for Ductile Iron Castings
6. ASTM B 26/B26M - Aluminum
7. ASTM B 148 - Aluminum Bronze Sand Castings
8. ASTM B 138 - Manganese Bronze

PART 2 PRODUCTS

2.1 WORKMANSHIP

A. Provide castings accurately made to the approved dimensions, and plane or grind castings where marked or where otherwise necessary to secure flat and true surfaces. Make allowance in the patterns so that the specified thickness is not reduced. Provide manhole covers which conform to the details shown and which are true and seat at all points. Supply castings showing the name of the manufacturer

and the country of manufacture. No plugging or welding of defective castings will be permitted.

2.2 WEIGHTS

A. Reject castings with a weight which is less than the theoretical weight based on required dimensions by more than 5 percent. Provide facilities at the site for weighing castings in the presence of the ENGINEER, or furnish invoices showing true weights, certified by the supplier.

PART 3 EXECUTION

3.1 INSTALLATION

A. Erect all castings to accurate grades and alignment, and when placing in concrete carefully support castings to prevent movement during concreting.

3.2 PAINTING

A. Clean metal castings thoroughly before painting. Give manhole frames and covers and valve boxes one coat of primer and two coats of an approved asphaltum varnish or other approved coating at the point of manufacture. Deliver all other castings to the job site unpainted. Paint all other castings as specified in Section 09 90 00.

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.

C. Surface Cleanliness: Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS 1 (ASTM D2200), and as described herein. The CONTRACTOR shall furnish the photographic standards. To facilitate inspection, the CONTRACTOR shall, on the first day of abrasive blasting operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8.5 inches by 11 inches. Panels meeting the requirements of the Specifications shall be initialed by the CONTRACTOR and the OWNER's representative and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as a comparison standard throughout the project. The CONTRACTOR shall provide SSPC-VIS 1 Surface Preparation Standards for use during the abrasive blasting operations.

D. Surface Profile: The blast abrasive shall be suitable to achieve the blast profile as required for the coating system used. The CONTRACTOR shall furnish for the ENGINEER's use, a Keane-Tator Surface Comparator No. 372 or approved equal.

E. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" (SSPC-PA2), using a magnetic-type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, Positector 2000 or approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least eight (8) hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

F. Holiday Testing: The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, or other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Areas which contain holidays shall be marked and repaired or

recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. Coatings With Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Coatings With Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M-1 non-destructive type holiday detector, K-D Bird Dog or approved equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal shall be added to the water prior to wetting the detector sponge.

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 work day.

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. To establish equality under Section 01 60 00 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

    a. Minimum and maximum recoat times
    b. Minimum and maximum cure time for immersion
    c. Abrasion resistance per ASTM D4060 using CS17 Wheel
    d. Maximum and minimum dry film thickness per coat
    e. Compatibility with other coatings

f. Suitability for the intended service
g. Resistance to chemical attack
h. Temperature limitations during application and in service
i. Type and quality of recommended undercoats and topcoats
j. Ease of application
k. Ease of repairing damaged areas
l. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.2 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. System 1 - Alkyd Enamel

1. Materials

Primer	Manufacturer's recommendation
Finish Coat	1 component alkyd enamel
Type	high quality alkyd, medium long enamel
Demonstrated suitable for	ferrous and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance
VOC Content, max	420 grams per liter

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	Finish Coat (DFT = 2 to 4 mils)	Total System DFT
PPG Amercoat 5105	**Amercoat 5450**	4 to 8 mils
Tnemec Series L69	**Tnemec Series 2H**	
Devoe Devprime 1401	**Devoe Devlac 1431**	
Carboline Carbocoat 150	**Carbocoat 45**	
Sherwin Williams Kem Bond HS	**S-W Industrial Enamel HS**	

D. System 2 - Aluminum Silicone

1. Material

Type	High heat silicone with aluminum
Demonstrated suitable for	Ferrous surfaces, continuous temperatures of 1000 deg F
VOC Content, max	637 grams per liter

2. Application and manufacturers

Total System DFT = 3 mils
Carboline Thermaline 4700 - Aluminum, 2 coats
International Intertherm 50, 2-3 coats
Sherwin William Hi-Temp Coatings 1000V, 2 coats.

E. System 3 - Epoxy/Polyurethane

1. Materials

Primer type	rust-inhibitive, 2 component epoxy
VOC Content, max	285 g/L
Finish type	2 component aliphatic polyurethane
VOC Content, max	300 g/L
Demonstrated suitable for	ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 3 - 4 mils)	TOTAL SYSTEM DFT
PPG- Amerlock 400/2	**PPG- Amershield**	6 - 9 MILS
Carboline Carboguard 893	**Carboline Carbothane 134 HG (2 coats)**	
Devoe Devran 224V	**Devoe Dethane 379H**	
Tnemec Hi-Build Epoxoline II Series L69	**TNEMEC SERIES 750UVX**	
Sherwin Williams Macropoxy 646	**Sherwin Williams Hi-Solids Polyurethane**	

F. System 4 - Inorganic Zinc/Epoxy/Polyurethane

1. Material

Prime Coat	Inorganic zinc silicate, water or solvent based, 2 component
zinc content in dry film	83 percent, minimum
VOC Content, max	325 grams per liter
Demonstrated suitable for	Ferrous metal, providing superior corrosion, chemical, and abrasion resistance, recommended for use as primer under epoxy
Intermediate Coat	2 component epoxy, high build, recommended by manufacturer for application over inorganic zinc primer
VOC Content, max	276 grams per liter
Demonstrated suitable for	Outstanding chemical, corrosion, and abrasion resistance
Finish Coat	2 component aliphatic or acrylic polyurethane
VOC Content, max	315 grams per liter
Demonstrated suitable for	Superior color and gloss retention, resistance to chemical fumes and severe weathering, abrasion resistance

2. Application and manufacturers

Surface preparation for primer	SSPC SP 6
Anchor profile for primer	per manufacturer

Prime Coat (DFT = 2 - 4 mils)	Intermediate Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 2 - 4 mils)	Total System DFT
PPG- Dimetcote 9HS or Dimetcote 21-5	**Amercoat 385**	**Amercoat 450H**	7 - 13 mils
Carboline Carbozinc 11HS or 11WB	**Carboguard 890**	**Carbothane 134HG**	
Devoe Cathacote 302H	**Devran 224V**	**Devthane 379H**	
Tnemec Tneme-Zinc 94H20	**Tnemec Series L69**	**Tnemec Series 750 UVX**	
Sherwin Williams Zinc Clad II Plus	**S W Macropoxy 646**	**S W Hi-Solids Polyurethane**	

G. System 5 - Inorganic Zinc, Water Based

1. Material

Type	water based zinc silicate, 2 component
Percent Zinc in dry film	83, min
VOC Content, max	0 grams per liter
Demonstrated suitable for	Severe weathering and moderate chemical fumes, continuous temperatures of 750 deg F

2. Application and manufacturers

Product (2 coats at 2 - 4 mils each)	Total System DFT
PPG- Dimetcote 21-5	4 - 8 mils
Devoe Cathacoat 305	
Carboline Carbozinc 11 WB	
Sherwin Williams Zinc Clad XI	

H. System 6 - Acrylic Latex

1. Material

Primer	Product, surface preparation, and DFT as recommended by manufacturer for the surface
Finish Type	Single component, water based acrylic latex, with fungicide
VOC Content, max	180 grams per gallon
Demonstrated suitable for	PVC piping, weather and mild chemical resistance, excellent color and gloss retention

2. Application and manufacturers

Finish (at least 2 coats required)	Total System DFT
PPG- Amercoat 220	primer plus 6 mils
Carboline Carbocrylic 3359	
Tnemec Series 1028 Enduratone	
Sherwin Williams Metalatex	
Devoe Devcryl 530	

I. System 7 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy, recoatable up to one year
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330

2. Application and manufacturers

Prime Coat (DFT = 4 to 6 mils)	FINISH COAT (DFT = 3 TO 4 MILS)	TOTAL SYSTEM DFT
PPG-Amerlock 400	**Amerlock 400**	7 to 10 mils
Tnemec Series L69	**Tnemec Series L69**	
Devoe Devran 224V	**Devran 224V**	
Carboline Carboguard 888	**Carboguard 888**	
Sherwin Williams Macropoxy 646	**S W Macropoxy 646**	

J. System 8 - Inorganic Zinc/Epoxy, Equipment

1. Materials

Primer type	Water or solvent-based inorganic, self-curing zinc silicate
Zinc content in dry film, min	84 percent
VOC content, g/L, max	323
Demonstrated suitable for	Superior corrosion, chemical and abrasion resistance, recommended as primer under epoxy
Finish type	2 component polyamide epoxy available in many colors
VOC content, g/L, max	250
Demonstrated suitable for	Good resistance to chemical attack, weathering, splash, washdown, and condensation

2. Application

Prime Coat (DFT = 3 to 4 mils)	Finish Coats (2 or more) (DFT = 4 to 8 mils each)	Total System DFT
PPG- Dimetcote 9 HS	**Amerlock 400**	11 to 20 mils
Carboline Carbozinc 11HS	**Carboguard 890**	
Tnemec Hydro-Zinc 94H2O	**Tnemec Series L69**	
Sherwin Williams Zinc Clad II Plus	**S W Macropoxy 646**	
Devoe Cathacote 302H	**Devoe Devran 224V**	
International Interzinc 22HS	**International Interseal 670HS**	

K. System 9 - Acrylic, Concrete

1. Materials

Filler-Sealer Type	Epoxy or acrylic masonry sealer, for concrete and CMU, for wet and dry conditions
Primer	as recommended by manufacturer
VOC Content, g/L, max	75
Finish Type	single component waterborne acrylic, industrial grade, high molecular weight
VOC Content, g/L, max	180
Demonstrated suitable for	concrete under mild to moderate exposure conditions, splash but not immersion

2. Application and manufacturers

Prime Coat (Filler-Sealer)	Finish Coat (DFT = 5 - 7 mils) (2 or more coats)	Total System DFT
Tnemec EnviroFill 130	**Tneme-Crete 180 Series**	5 - 7 mils plus primer
PPG- Amerlock 400BF and Amercoat 114A	**Amercoat 220P**	
Carboline Sanitile 500	**Carbocrylic 3359DTM**	
Sherwin Williams Cement Plex 875 (acrylic) and Kem Cati Coat (epoxy)	**S W Metalatex**	
Devoe Tru-Glaze 4015	**Devoe Devcryl 1449**	

L. System 10 - Polyurethane, Fiber Glass

1. Materials

Primer Type	as recommended by manufacturer
Finish Type	2 component aliphatic polyurethane
Demonstrated suitable for	Fiberglass, superior color and gloss retention, resistance to acid and alkali splash, fumes, and severe weathering, no immersion
VOC content, g/L max	300

2. Application and manufacturers

Prime Coat	Finish Coats	Total System DFT

(3 to 4 mils)	(4 to 6 mils)	
PPG- Amerlock 400	**Amershield**	7 to 10 mils
Tnemec Series 750 UVX	**Tnemec Series 750 UVX**	
Carboline Carbocrylic 120 (2 coats)	**Carbothane 134 HG (2 coats)**	
SHERWIN WILLIAMS MACROPOXY 646	**S-W Hi-Solids Polyurethane**	
DEVOE DEVRAN 224V	**Devoe Devthane 379H**	

2.5 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	high build, amine cure epoxy
VOC content, g/L max	220
Demonstrated suitable for	steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 133	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891HS	
International Bar-Rust 233H	
Tnemec Epoxoline Series L69	
Sherwin Williams Macropoxy 646 PW	

B. System 101 - Polyamide Epoxy

1. Materials

Type	high build polyamide cure epoxy
VOC content, max, g/L	366
Demonstrated suitable for	long term immersion in water and wastewater, resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 370	11 - 13 mils
Tnemec Pota-Pox Series 20	
Carboline Carboguard 61	
Sherwin Williams Macropoxy 646 PW for water and Dura-Plate 235 for wastewater	
Devoe Bar-Rust 233H	

C. System 102 - Epoxy, Steel Reservoirs

1. Materials: In accordance with AWWA D102 - Coating Steel-Water Storage Tanks, System ICS-2.

Type	2 component epoxy, polyamide or amine-cure type
Demonstrated suitable for	Steel, long term immersion in potable water
VOC content, g/L max	366
Certification required	NSF 61

2. Application and manufacturers

First Coat (2 - 4 mils)	Second Coat (3 - 5 mils)	Finish Coat (4 - 6 mils)	*Total System DFT*
PPG- Amerlock 2	**Amerlock 2**	**Amerlock 2**	9 - 15 mils
Carboline Carboguard 891	**Carboguard 891**	**Carboguard 891**	
Tnemec Pota-Pox L140F	**Tnemec L140F**	**Tnemec L140F**	
Sherwin Williams Macropoxy 646 PW	**S-W Macropoxy 646 PW**	**S-W Macropoxy 646 PW**	
Devoe Bar Rust 233H	**Devoe Bar-Rust 233H**	**Devoe Bar-Rust 233H**	

3. All lap roof plate edges, both sides, shall be pre-coated. If necessary, primer exposed on exterior of roof may be removed prior to welding. Pre-coating shall extend at least 6-inches from plate edges.

4. Touch-up coating shall be done for areas damaged during erection, or areas not pre-coated. The CONTRACTOR shall spot sandblast to SSPC SP-5 - White Metal Blast Cleaning, before application of coating. Material used for touch-up shall be the indicated material or a compatible primer recommended by the manufacturer.

5. All edges, nuts, bolts, lap joints, weld seams, and the roof rim angle shall receive one brush-applied coat prior to the application of the first complete spray coat.

6. Curing Period: Prior to immersion, the completed system shall be subjected to at least 240 hours of curing time with the metal temperature at a minimum of 70 degrees F, or 480 hours at a minimum of 60 degrees F, both conditions at a maximum relative humidity of 50 percent and under the forced ventilation conditions required by the paragraph entitled Curing of Coatings. More curing time or a higher temperature shall be provided if recommended by the epoxy coating manufacturer. If the environmental conditions do not provide the necessary minimum temperature, use heated air to provide the necessary heat for curing. Other combinations of curing time and temperature may be used if the coating manufacturer presents satisfactory documentation and test results to substantiate that the degree of curing is equal or greater than curing for 240 hours at 70 degrees F.

D. System 103 - Fusion Bonded Epoxy

1. Material

Type	100 percent solids fusion bond epoxy
Demonstrated suitable for	fluidized bed or electrostatic spray application, recommended for pumps, valves, pipe appurtenances, tanks, pipe hangers, flow meters, and hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

E. System 104 - Polyurethane, Concrete

1. Materials

Filler-sealer type	epoxy material with portland cement and aggregate
Primer type	Phenolicamine or polyamidoamine epoxy
VOC content, g/L max	250
Finish type	aromatic elastomeric polyurethane
Demonstrated suitable for	concrete and concrete block masonry, long term immersion in water and wastewater and service where subject to splash and spill of water and wastewater treatment chemicals
VOC content, g/L max	250
Certification requirement, where coating will be in contact with potable water	NSF 61

2. Application and manufacturers

Filler-Sealer	**Primer** DFT = 3 - 7-mils	**Finish Coat** DFT = 100 - 125-mils, 75 mils for potable water

Tnemec MortarClad 218	**Tnemec Pota-Pox L140** (potable water) **Epoxoprime 201** (wastewater)	**Elasto-Shield 406 (max 75 mils for potable water)**
PPG-Amerlock 400/BF	**Amerlock 400/2**	**Amerlock 490**
Sherwin Williams Steel Seam FT 910	**S-W Dura-Plate 235**	**S-W Sherflex (Max 100 mils for potable water)**
International Ceilcote 400 Corocrete	**Polibrid 670-S**	**Polybrid 705**

F. System 105 - Epoxy, Concrete

1. Materials

Filler-sealer type	Epoxy material with portland cement and aggregate
Primer type	100% solids epoxy
VOC content, g/L max	100
Finish type	Amine cure epoxy/aggregate-filled epoxy
Demonstrated suitable for	Sewer manhole & wastewater facility, long term immersion in wastewater service where subject to chemical and bacteriological attack found in municipal sanitary sewer system
VOC content, g/L max	100

2. Application and manufacturers

Filler-Sealer	**Primer** DFT = 5 – 10 mils	**Finish Coat** DFT = 125 – 150 mils
RLS Raven 210	**RLS Raven 155**	**Raven 405 FS**
Sauereisen Filler Compound 209 or 209FS	**Per Sauereisen**	**SewerGard 210**
		Warren Environmental

2.6 SPECIAL COATING SYSTEMS

A. System 200 - Acrylic, Wood and Gypsum Board

1. Materials

Primer type	as recommended by manufacturer
Finish type	single component, water based, acrylic, fungicide added
VOC content, max, g/L	250
Demonstrated suitable for	wood, mild to moderate exposure inside and outside building, and gypsum board, inside

2. Application and manufacturers

Prime Coat (1.5 to 2.5 mils)	Finish Coat (4 to 6 mils) (2 coats)	Total System DFT
PPG- Amercoat 220P	**Amercoat 220P**	5.5 to 8.5 mils
Carbocrylic 120	**Carbocrylic 3359**	
Tnemec Series 115 Unibond	**Tnemec Series 1028 Enduratone**	
Sherwin Williams PrepRite ProBlock	**S-W Metalatex**	
Devoe Devcryl 520	**Devoe Devcryl 1449**	

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 STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this Specification:

1. Solvent Cleaning (SSPC-SP1): The method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces through the use of solvent, vapor, emulsion, alkaline, and/or steam.

2. Hand Tool Cleaning (SSPC-SP2): The method for removing all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter through the use of non-power hand tools.

3. Power Tool Cleaning (SSPC-SP3): The method for removing all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter through the use of power assisted hand tools.

4. White Metal Blast Cleaning (SSPC-SP5): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint.

5. Commercial Blast Cleaning (SSPC-SP6): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, mill scale, and previously applied paint may remain on no more than 33% of the surface.

6. Brush-off Blast Cleaning (SSPC-SP7): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface.

7. Near-White Blast Cleaning (SSPC-SP10): The method of preparing steel surfaces which, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, and paint. Evenly dispersed very light shadows, streaks, and discolorations caused by stains of rust, mill scale, and previously applied paint may remain on no more than 5% of the surface.

3.7 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.

3.8 NEW FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as specified in the coating system schedules included at the end of this section. Where there is a conflict between these Specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers (NACE) Standard TM-01-70.

C. All oil, grease, welding fluxes and other surface contaminants shall be removed by alkaline cleaning per SSPC-SP1 prior to blast cleaning.

D. All sharp edges shall be rounded or chamfered and all burrs, surface defects and weld splatter shall be ground smooth prior to blast cleaning.

E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. CONTRACTOR shall submit data and samples for approval on abrasives to be used on the Project. Abrasives that are used shall be designed for the specific purpose of blast cleaning. Abrasives shall be free of contaminants and chlorides. Ordinary builder's sand shall not be considered to be approved abrasive material. ENGINEER will periodically sample abrasives used at the job site for comparison with approved submitted materials.

F. The abrasive shall not be reused unless otherwise approved by the ENGINEER. For automated shop blasting systems, clean oil and moisture-free abrasives shall be maintained.

G. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil/moisture separators which remove all contaminants.

I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or other approved method prior to painting.

J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

K. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.

L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, the SSPC-SP2, Hand Tool Cleaning, or SSPC-SP3, Power Tool Cleaning, will be permitted.

M. Shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by Solvent Cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.

N. Shop primed equipment shall be alkaline cleaned in the field before finish coats are applied.

3.9 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. All installation and erection caused blemishes to galvanized surfaces shall be touched up in accordance with ASTM A780 prior to coating.

B. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

3.10 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL TANK OR TREATMENT UNIT INTERIORS (IN ADDITION TO REQUIREMENTS IN PARAGRAPHS 3-05 AND 3-06).

A. General: All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The

CONTRACTOR shall determine the generic type of the existing coatings by laboratory testing, at no additional cost to the OWNER.

B. Abrasive Blast Cleaning: The CONTRACTOR shall provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6, Commercial Blast Cleaning. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, Brush-Off Blast Cleaning, with the remaining thickness of existing coating not to exceed 3 mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings, the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the specified abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

3.11 SURFACE PREPARATION FOR REPAINTING EXISTING STEEL

A. The entire structure is to be completely pressure washed at 3,000 to 5,000 psi with potable water.

B. All areas shall be cleaned/sandblasted to the surface preparation standards as specified herein, or superseded by the bid form.

C. All cleaned areas are to be primed the same work day that they are cleaned and blasted.

3.12 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.

3.13 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.

3.14 PLASTIC, FIBERGLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and Fiberglass surfaces shall be sanded or Brush Off Blast Cleaned, SSPC-SP7, prior to solvent cleaning with a chemical compatible with the coating system primer. If blast cleaned, use 60-80 mesh abrasive.

B. Non-ferrous metal surfaces shall be Solvent Cleaned, SSPC-SP1, followed by sanding or Brush Off Blast Cleaning, SSPC-SP7.

C. All surfaces shall be clean and dry prior to coating application.

3.15 WOOD SURFACE PREPARATION

A. Clean wood surfaces to be painted of all dust, dirt, grease, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, with either manual or mechanical means, as applicable, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of the priming coat. After priming, fill holes and

imperfections in finish surfaces with putty or plastic woodfiller. Sandpaper smooth when dried and dust off.

B. Prime or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood.

3.16 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.

3.17 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.

3.18 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.

3.19 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.

3.20 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.

3.21 COATING SYSTEM SCHEDULES

A. COATING SYSTEM SCHEDULE, FERROUS METAL - NOT GALVANIZED (FM):

	Item	**Surface Prep.**	**System No.**
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(1) alkyd enamel or (3) epoxy/ polyurethane
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Near white metal blast cleaning SSPC SP 10/NACE 2	(4) inorganic zinc/epoxy/polyurethane
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Manufacturer recommendation	(6) acrylic latex
FM-2	Surfaces in chlorination room, chlorine storage room.	Commercial blast cleaning SSPC SP 6/NACE 3	(100) amine cure epoxy
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-4	Surfaces exposed to high temperature (between 150 and 600 degrees F).	Near white metal blast cleaning SSPC SP 10/NACE 2	(5) inorganic zinc, water-based
FM-5	Surfaces exposed to high temperature (between 600 and 1000 degrees F).	Near white metal blast cleaning SSPC SP 10/NACE 2	(2) aluminum silicone
FM-6	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged	White metal blast cleaning SSPC SP 5/NACE 1	(101) polyamide epoxy

	valves.		
FM-7	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-8	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(103) fusion bond epoxy
FM-9	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC SP 5/NACE 1	(101) polyamide epoxy
FM-10	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC SP 10/NACE 2	(100) amine cure epoxy
FM-11	External surfaces of buried steel tanks.	White Metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-12	Indoor architectural sheet metal, flashings, doors, frames, and exposed ducts	Commercial Blast Cleaning SSPC SP 6/NACE 3	(1) Alkyd Enamel
FM-13	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(7) epoxy, equipment

B. COATING SYSTEM SCHEDULE, FERROUS METAL - GALVANIZED (FMG): All galvanized surfaces except for the following items shall be coated unless required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

	Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1	(1) alkyd enamel or (3) epoxy/polyurethane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC SP 1	(100) amine cure epoxy
FMG-3	Indoor architectural sheet metal, flashings, doors, frames, and exposed ducts	Solvent cleaning SSPC SP 1	(1) Alkyd Enamel
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high-water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC SP 1 followed by brush-off grade blast cleaning SSPC SP 7/NACE 4	(100) amine cure epoxy

C. COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBERGLASS (NFM): Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1	(1) alkyd enamel or (4) epoxy/polyurethane
NFM-2	Chlorination room, chlorine storage room.	Solvent cleaned SSPC SP 1	(100) amine cure epoxy
NFM-3	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC SP 1	(6) acrylic latex

D. COATING SYSTEM SCHEDULE - CONCRETE AND CONCRETE BLOCK MASONRY (C):

	Item	Surface Prep.	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.13	(9) acrylic, concrete or (104) polyurethane, concrete
C-2	Surfaces submerged in water or wastewater, including (a) between 2-feet above high water elevation and 2-feet below low water elevation in an open structure and (b) all surfaces above 2-feet below low water elevation in an enclosed structure.	Per paragraph 3.13	(104) polyurethane, concrete
C-3	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.13	(104) polyurethane, concrete
C-4	Walls, floors, exposure to chemical splash, washdown, where indicated	Per paragraph 3.13	(104) polyurethane, concrete
C-5	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes indicated.	Per paragraph 3.13	(105) epoxy, concrete

E. COATING SYSTEM SCHEDULE – MISCELLANEOUS SURFACES (MS):

	Item	Surface Prep.	System No.
MS-1	Wood, indoors and outdoors, and gypsum board indoors.	Per manufacturer's printed instructions	(200) acrylic

3.22 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 work day. 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.

3.23 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.

3.24 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.

3.25 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 or approved equal. Installation shall be performed by workers experienced in the application of the coating to be used.

PART 2 PRODUCTS

2.1 IET COATING SYSTEM

A. The IET Coating System shall be as distributed by Integrated Environmental Technologies, Santa Barbara, CA, or equal.

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 22 13 29

SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for furnishing and installing submersible sewage pumping units, together with base elbows, guide rail systems, variable frequency drives, liquid level controls, control panels, access covers and all appurtenances necessary for a complete installation.

B. Related Work Specified in Other Sections Includes:

1. Section 09 90 00 - Painting

1.2 REFERENCES

A. Codes and standards referred to in this section are:

1. ASTM A 48 - Specification for Grey Iron Castings
2. Hydraulic Institute Standards
3. IEEE 82 - Test Procedure for Impulse Voltage Tests on Insulated Conductors
4. NEC - National Electric Code
5. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings
6. ABMA 10 - Specifications for Metal Balls

1.3 SYSTEM DESCRIPTION

A. General: Provide pumps of the vertical, centrifugal, heavy duty, nonclog, close-coupled, submersible type, each driven by submersible electric motor mounted as an integral part of the pump. Design the pumping units to pump raw unscreened sewage. Arrange the pumping equipment guide rails and base elbow for installation in the spaces shown without appreciable revision of the piping or structure. Design the pumping units for continuous and intermittent duty with ten starts per hour per pump.

B. Operating Conditions: Provide pumps to operate at the capacities and heads and over the range of operating conditions specified without overloading, cavitation, and vibration. Furnish the pumps in accordance with the following requirements:

Items	Requirements	
	Pump 1	Pump 2
Capacity at rating point, gpm	_____	_____
Total head at rating point, feet	_____	_____
Overall efficiency, wire to water, at rating point, minimum, percent	_____	_____
Shutoff head, feet		
Maximum	_____	_____
Minimum	_____	_____
Capacity at secondary rating point, minimum, gpm	_____	_____
Total head at secondary rating point, feet	_____	_____
Overall efficiency, wire to water, at secondary head, minimum, percent	_____	_____
Capacity at reduced speed rating point, gpm	_____	_____
Total head at reduced speed rating point, feet	_____	_____
Diameter of sphere that will pass through pump, minimum, inches	_____	_____
Pump discharge diameter, minimum, inches	_____	_____
Pump speed, maximum, rpm	_____	_____
Low water elevation for continuous operation, feet	_____	_____
Wet well floor elevation, feet	_____	_____
Motor horsepower, hp		
Minimum	_____	_____
Maximum	_____	_____
Motor efficiency at full load, minimum, Percent	_____	_____
Motor power factor at full load, minimum,	_____	_____
Locked rotor kVa/hp, maximum, (Motor) (NEMA) code letter B	_____	_____

C. Pump Curve: Design each pump to have a continuously rising characteristic curve from the rating point to shutoff which passes through the rating point, and which meets or exceeds the specified heads and capacities, all within the Hydraulic Institute tolerances.

D. Provide submersible units capable of sustaining full reverse runaway speed without damage.

1.4 SUBMITTALS

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

B. Shop Drawings: Submit working drawings, including arrangement and erection drawings of the equipment and equipment operating characteristics. Include the following:

1. Pump performance curves. Draw the curves for the specified conditions including those at reduced speed. Plot head, input kilowatts, and overall efficiency, as a function of capacity from zero to maximum capacity.

2. General arrangement drawing of pumping unit, base elbow and guide rail system. Include equipment weight and anchor methods and materials.

3. Cross section drawing of pumping unit.

4. Parts list with materials of construction identified.

5. Motor performance characteristics.

6. Spare parts list.

7. Painting procedure.

C. Quality Control Submittals: Submit 2 certified copies and 1 PDF of the Shop Test results.

D. Operation and Maintenance: Submit the Operation and Maintenance manuals for the pumping equipment.

1.5 PUMP WARRANTY

A. The pump manufacturer shall warrant the pumps being supplied against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear on a progressive schedule of cost for a period of five (5) years; parts included are the seal, impeller, pump housing, wear ring, and bearings. The warranty shall be in published form and apply to all similar units.

1.6 QUALITY ASSURANCE

A. Qualifications: Provide pumping equipment produced by a manufacturer who regularly engages in the design, manufacture, assembly and production of submersible sewage pumping equipment of the size and type as specified for not less than five years.

B. Regulatory Requirements: Rate the motor unit, and wet well wiring for service in hazardous Class 1, Division 1 locations.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1.

1.8 PARTS

A. Special Tools: Furnish a complete set of special wrenches, spanners, eyebolts and other special tools sufficient to completely dismantle and reassemble each kind and size of pumping unit. Provide tools of forged steel, case hardened, and full finished. Furnish the sets with a metal tool case with a handle and provision for padlocking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers are listed in the LCU Approved Materials List.

2.2 GENERAL CONSTRUCTION

A. Materials: Provide stainless steel fasteners, bolts, nuts and washers where exposed to the pumped liquid.

B. Component Joints: Provide machined metal-to-metal joints on component parts that are assembled together. Fit with an "O"ring seal where watertight joints are required. Arrange the "O"ring seal for automatic compression and sealing without adjustment or bolt torquing procedures. Do not use flat gaskets or sealing compounds to obtain watertight joints. Furnish machined rabbet fits on component joints as required to provide automatic alignment of rotating parts.

2.3 CASING

A. General: Provide pump casing of the centrifugal single volute, centerline discharge type. Do not use diffusion vanes.

B. Materials: Construct pump casing of ASTM A48, Class 30B or 35B cast iron.

C. Wear Ring: Construct renewable wear rings of stainless steel.

2.4 IMPELLER

A. General: Design impeller of the enclosed nonclog type. Provide pump-out vanes or a back ring, arranged with minimum clearances so as to preclude solids and stringy material from damaging the mechanical seal, on the back of the impeller.

B. Materials: Construct the impeller of cast iron ASTM A48, Class 30B or 35B.

C. Balance: Dynamically balance the impellers.

D. Wear Ring: Construct renewable impeller wear ring of brass.

E. Assembly: Secure the impeller to the shaft with a stainless steel key and lock nut in such a way that it cannot unscrew or become loosened due to rotation in either direction.

2.5 OIL CHAMBER

A. General: Provide an oil chamber to function as a buffer between the pumped liquid in the casing and the motor. Arrange the oil chamber to accommodate thermal expansion of the oil. Furnish an oil chamber drain plug that is accessible from outside the pump unit and permits changing oil without dismantling pump components.

B. Materials: Construct the oil chamber of ASTM A48 cast iron, Class 30B or 35B.

2.6 MECHANICAL SEAL

A. Design: Provide each pump with double tandem mechanical seals. Design the upper seal unit, between the oil chamber and motor housing, with one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Design the lower seal unit, between the pump casing and oil chamber, with one stationary ring and one positively driven rotating ring. Furnish these rings made of tungsten-carbide. Use type 316 stainless steel for metal parts. Protect the spring element of the lower seal from solids contained in the pumped liquid. Do not rely upon the pumped liquid for lubrication. No seal damage is to result from operating the pumping unit out of its liquid environment. Conventional double mechanical seals with a single or double constant differential pressure to effect sealing and subject to opening and penetration by pumping forces will not be acceptable.

2.7 MOTOR

A. General: Provide submersible pump motor of 460-volt, 3-phase, 60-hertz as specified in Section 16155.

B. Ratings: Design the motor to have suitable output torque and speed characteristic to start and operate the pump over the range of specified conditions. For constant speed pumping units do not exceed the nameplate horsepower rating under

maximum load conditions. For pumping units operated from variable frequency drives, provide a motor nameplate horsepower rating at least 15 percent greater than the maximum load conditions. Base the nameplate horsepower rating on an 80 degrees C temperature rise above an ambient temperature of 40 degrees C. Design the motor for continuous load operation and continuous on-off cycling of ten starts per hour minimum without exceeding the 80 degree C temperature rise.

C. Insulation: Provide the motor with a minimum of NEMA Class F (155 degrees C) moisture resistant insulation. Construct stator coils with NEMA Class F insulated winding wire. Apply impregnation resin to stator assembly in three dip and bake steps.

D. Stator Housing: Provide the motor with an ASTM A48, Class 30B or 35B cast iron stator housing. For motors that employ cooling water jackets, design the water jacket passages to preclude clogging by solids contained in the pumped liquid.

E. Cables: Provide the motor cable entry with a mechanical locking ring or compression type cord grip to protect the cable jacket from being pulled out of the motor. Do not use epoxy for this purpose. Arrange the cable entry so as to provide a watertight seal with a terminal board and terminations next to the motor. Isolate the cable entry leads from the internal motor leads to prevent entry of water into the motor chamber by leakage or wicking. Provide cables suitable for submersible pump application and conforming to NEC specifications for cable sizing. Provide permanent label on cables.

F. Shaft

1. Design: Provide a one piece, fully machined pump and motor shaft. Design the shaft to limit shaft deflection under maximum pumping load to .002 inches at the lower mechanical seal face and to obtain a rotating assembly first critical speed of not less than 150 percent of the rated speed.

2. Material: Provide shafts of either carbon steel or stainless steel. Protect carbon steel shafts from exposure to the pumped liquid by employing a stainless steel sleeve or chrome plating.

G. Bearings

1. Design: Provide two anti-friction bearing assemblies. Design one assembly to carry only radial loads and to be free to float axially within the frame. Design the other assembly to carry both radial and axial loads and to be restrained from axial movement.

2. Bearing Life: Select bearings in accordance with AFBMA 9 and AFBMA 10, Load Ratings and Fatigue Life for Ball and Roller Bearings, to have a 20,000 hours minimum L_{10} bearing life at maximum pumping load that occurs under the specified operating conditions.

2.8 PROTECTION MONITORING SYSTEM

A. General: Provide each pumping unit with a monitoring system to protect critical machine functions during operation.

B. Motor Winding Temperature: Provide three thermoswitches, one per phase, to protect against overheating. Initiate an alarm and motor shutdown on high temperature.

C. Automatic Megger: All pumps 294 watt (30 HP) and larger shall be furnsihed and installed with one (1) completely enclosed solid state electronics module (automatic megger) to automatically monitor the motor winding resistance on each pump. Each automatic megger must have an individual disconnect terminal plug and manual shut off switch. Each automatic megger must have three (3) lights to indicate 10 M ohm, 5 M ohm, and 1 M ohm resistance values. Power source to be 110 VAC fused at ¼ amp. The D.C. test volt to be 500 to 700 volts. The output current to be limited to less than 1 micro amp. Must also have two (2) output circuits for external alarms. When the motor resistance drops to 1 M ohm, an alarm system must be activated by the internal circuit of the automatic megger. The automatic megger must monitor the motor resistance only when the motor is off. Each automatic megger must also include two (2) switches for manual testing. The automatic megger shall be of an approved manufacture (see LCU Approved Materials List).

D. Sensor Monitoring Device: Provide a monitoring device or devices designed to be compatible with the sensors and motor controls. Locate monitoring devices in control panel.

2.9 GUIDE RAIL SYSTEM AND BASE ELBOW

A. Design: Provide each pump with a base elbow and guide rail system. Design the guide rail system to permit installation and removal of the pump from its base elbow discharge connection without requiring personnel to enter the wet well.

B. Guide Rail System: Provide a guide bracket which is an integral part of the pump casing and permits sliding the pumping unit, along two unthreaded 316 stainless steel guide rails. Provide the guide rails of 316 stainless steel pipe connected to the base elbow at the bottom. Support the guide rails at intermediate locations and at the top with stainless steel brackets bolted to the wall of the wet well or concrete slab. Fit each pump with a 316 stainless steel cable of adequate length and strength to permit the raising and lowering of the pump for inspection and removal.

C. Base Elbow: Provide a cast iron base elbow arranged for automatic pump connection. Provide the pump casing with a machined discharge flange which, when the pump is lowered into the pumping position, will automatically align and mate with the plain-end of the base elbow. Design the discharge connection such that no motion other than vertical is required to seat the mating flange of the casing to the

base elbow. Accomplish sealing of the pump connection by metal to metal contact or by a positive resilient seal of Buna-N attached to the pump casing discharge flange. Design the base elbow to support the weight of the pumping unit and prevent it from bearing directly on the wet well floor.

D. Mounting Accessories: Provide anchor bolts, nuts, washers, and accessories and other adapter equipment necessary for mounting the pumping equipment and appurtenances. Construct anchor bolts, nuts, washers, accessories and adaptor equipment of 316 stainless steel. Provide 3/8-inch minimum 316 stainless steel chain a minimum of 20 inches long attached to a minimum ¼-inch minimum 316 stainless steel wire rope which is to be hung on a 316 stainless steel rack at the top of the wet well.

2.10 OPERATION AND CONTROL

A. See Section 16160 for control panel requirements.

B. Each pumping station control system shall include a liquid level controller which shall sense the sewage level in the wet well and provide appropriate signals to the logic circuits to produce the required mode of operation for the pumping facilities. The standard level controls shall be five (5) non-mercury float switched (see LCU Approved Materials List). At pump stations where there is a possibility of massive accumulation of floatables, oil and grease that may interfere with the proper operation of the floats, Lee County Utilities may require the installation of a bubbler type liquid level control system (see LCU Approved Materials List). All pump stations serving commercial and industrial facilities will be required to have a bubbler type liquid level control system unless specifically approved by Lee County Utilities.

C. Any alternative levels sensing and control system must be approved by Lee County Utilities. The bubbler type liquid level control system and any alternative levels sensing and control system shall include a high and a low level floats as a back-up system. Capability shall be provided for manual start-stop control for all pumping units as well as the normal automatic control from the liquid level sensing and logic circuits. An automatic alternator shall change the starting sequence on each pump cycle. A high water level, non-loathing alarm system shall be provided. Each sewage pump shall be provided with an elapsed time meter to indicate pump running time. The submersible station controls shall be housed within an exterior panel, pole-mounted or free-standing enclosure. The panel will be of NEMA 4X, stainless steel, weather-tight construction with double dead front outer doors fitted with hoop and padlock master keyed to County standard. Each panel shall be equipped with a service lock out switch to lock out alarm signals to the Telemetry System.

D. The requirement for variable speed controlling of sewage pumps shall be considered for all large capacity pumps for major installations; and when the hydraulic conditions indicate the requirement. The requirement for variable speed pump controls shall receive prior review with Lee County Utilities. Should such system be directed, the

facility shall be equal to existing Lee County Utilities variable speed control units, or as approved by Lee County Utilities.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Complete all wiring and piping and make all necessary adjustments to equipment to provide a complete operational pumping installation.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Furnish the services of a qualified representative of the manufacturer to provide instruction on proper installation of the equipment, inspect the completed installation, make any necessary adjustments, participate in the startup of the equipment, participate in the field testing of the equipment and place the equipment in trouble-free operation, as specified in Division 1.

B. Tests: After installation of the pumping units, control equipment and all appurtenances, subject each unit to a field running test as specified in Division 1, under actual operating conditions. Perform the field tests in the presence of and as directed by the ENGINEER. Demonstrate that under all conditions of operation each unit:

1. Has not been damaged by transportation or installation.
2. Has been properly installed.
3. Has no mechanical defects.
4. Has been properly connected.
5. Is free of overheating of any parts.
6. Is free of overloading of any parts.

Test the pumps to demonstrate that the pumps and control system operate as specified. Promptly correct any defects in the equipment or failure to meet the requirements of the Specifications.

Conduct 24 hours of continuous operation test prior to acceptance.

3.3 CLEANING AND PAINTING

A. Paint as specified in Section 09 90 00.

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.
2. Stand-by power generator set in skin tight enclosure with sub-base fuel tank and FDEP approved fuel level monitoring system.
3. Ductbank systems for power, fiber optic, instrumentation and control signal distribution.
4. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.
5. 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.
6. Install vendor furnished cables specified under other Divisions of these specifications.
7. Pre-wired pre-fabricated electrical equipment enclosure at Master Pump Station sites.
8. 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.
9. Complete grounding system and special grounds as required or noted.
10. Power and signal surge suppression systems.
11. Concrete work for pad mounted equipment.
12. Instrumentation and control conduit and wiring systems and installation of field instrumentation.
13. Arc Flash evaluation, short circuit and coordination study and electrical testing of equipment including SKM file of approved studies.
14. Lightning protection, bonding and grounding systems.

15. Electronic and hard copy project record drawings, vendor operation and maintenance manuals.
16. Furnish and install field instrumentation termination cabinets, mounting stands and sunshields.
17. Custom Control panels.
18. Shipping of the complete a/c units to Corrosion Solutions Inc. for factory installation of "heresite" corrosion protective coating.
19. Fiber optic cable termination and interconnecting wiring between fiber patch panel and network switches in the electrical equipment enclosure.
20. 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 MASTER PUMP STATION QUALIFICATIONS

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of fifteen (15) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Provide a field superintendent who has had a minimum of fifteen (15) years previous successful experience on projects of comparable size and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. A resume of the Superintendent's experience shall be submitted to Engineer before starting work.

C. Provide the services of a Lee County Utilities pre-qualified electrical contractor that has demonstrated competence in providing electrical systems installation on this type of facility. The pre-approved electrical contractors for this project qualified through the RFQ process. This list can be found on the Procurement website. Any contractor that is not on the list will have to go through the same process as the RFQ qualified contractors.

1.03 LIFT STATION QUALIFICATIONS

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of fifteen (15) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Provide a field superintendent who has had a minimum of six (6) years previous successful experience on projects of comparable size and complexity.

C. Provide the services of a pre-qualified electrical contractor that has demonstrated competence in providing electrical systems installation on this type of facility to Lee County Utilities.

1.04 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).

1.05 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.

1.06 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.

1.07 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.

1.08 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.

1.09 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.

1.10 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.

1.11 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.

1.12 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.

1.13 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 [and aluminum 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, except that sizes 2 AWG and smaller may be solid copper unless noted otherwise noted on the drawings. 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, except that sizes 2 AWG and smaller may be ASTM B1 solid bare copper wire.

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. All documentation and record drawings shall be verified by the signing engineer. 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. The study firm shall provide in house electrical studies and reports as specified. The study firm shall submit proof of 5 similar studies with the above qualifications when requested. At least two of the similar project examples shall include arc flash studies with variable frequency drives.

B. Pre-qualified study firms are:
   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

   Other firms will be considered by the engineer on submittal of qualifications on or before 20 days prior to bid.

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:

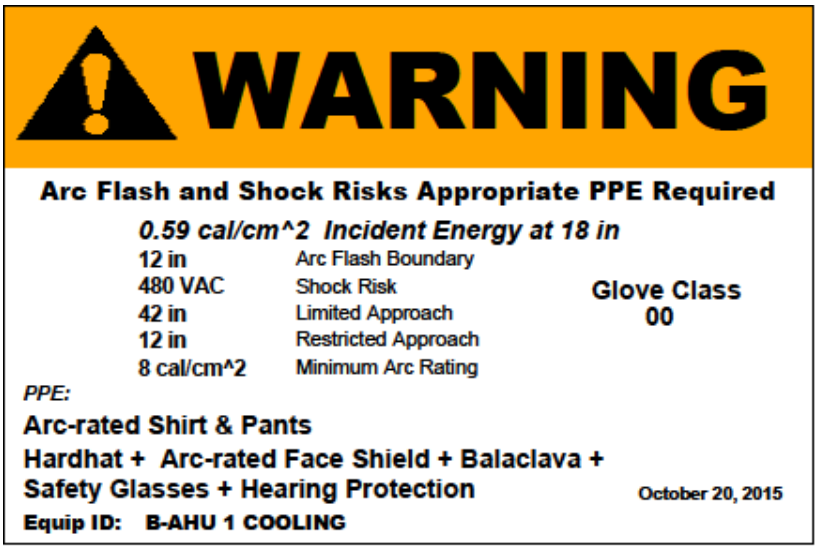
- Voltage (phase to phase).

- 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

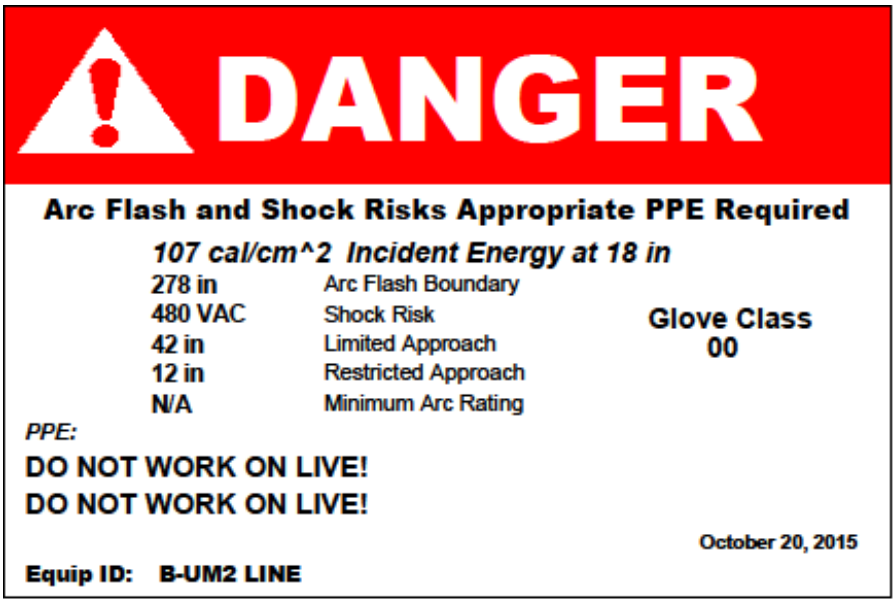
H. Provide a comprehensive report that includes the basis for and results of numerical assessments. The report shall include any significant conclusions and recommendations for corrective or mitigative action as appropriate. In addition, the report shall include the following:

- 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:


WARNING
Arc Flash and Shock Risks Appropriate PPE Required
0.59 cal/cm^2 Incident Energy at 18 in
12 in Arc Flash Boundary
480 VAC Shock Risk
42 in Limited Approach
12 in Restricted Approach
8 cal/cm^2 Minimum Arc Rating
Glove Class 00
PPE:
Arc-rated Shirt & Pants
Hardhat + Arc-rated Face Shield + Balaclava +
Safety Glasses + Hearing Protection
October 20, 2015
Equip ID: B-AHU 1 COOLING


WARNING
Arc Flash and Shock Risks Appropriate PPE Required
14 cal/cm^2 Flash Risk at 24 in
128 in Flash Risk Boundary
480 VAC Shock Risk
42 in Limited Approach
12 in Restricted Approach
40 cal/cm^2 Minimum Arc Rating
Glove Class 00
PPE:
Arc-rated Shirt & Pants + Multi Layer Flash Suit
Hardhat + Arc-rated Flash Suit Hood + Safety
Glasses + Hearing Protection
July 15, 2015
Equip ID: BUS-GEN



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. Testing shall be supervised by qualified professional engineering staff.

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:
11. Project design Specifications.
12. Project design Drawings.
13. 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 testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the International Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the International Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing or be a electrical professional engineer in the state of Florida.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services. The testing firm shall provide in house electrical studies and reports as specified. The testing firm shall have a Florida registered professional electrical engineer on staff.

F. The testing firm shall submit proof of the above qualifications when requested. Pre-qualified testing firms for this Project are:
1. Emerson Electrical Reliability Services, Inc.
2. Industrial Electrical Testing, Inc.
3. Electric Power Systems.
4. Circuit Breaker Sales & Service.

G. Other firms will be considered by the engineer on submittal of qualifications on or

before 20 days prior to Bid.

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 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.01 DESCRIPTION-this section specifies the furnishing, installation and connection of the dry type general-purpose transformers.

1.02 RELATED WORK

A. Section 26 05 11, Special Requirements for Electrical Installations:
B. Section 26 05 33, Conduit Systems:
C. Section 26 05 19, Low-Voltage Wire and Cables
D. Section 26 05 26, Grounding And Bonding For Electrical Systems:

1.03 SUBMITTALS

A. 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 electrical ratings, impedance, dimensions, weight, mounting details, decibel rating, terminations, temperature rise, no load and full load losses, and connection diagrams.
3. Complete nameplate data including manufacturer's name and catalog number.

C. Manuals:
1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets and wiring diagrams.

1.04 REFERENCES

A. National Fire Protection Association (NFPA) 70-08 National Electrical Code (NEC)

B. National Electrical Manufacturers Association (NEMA): ST 20-97 Dry-Type Transformers for General Applications

PART 2 – PRODUCTS

2.01 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Unless otherwise specified, dry type transformers shall be in accordance with NEMA, NEC and as shown on the drawings. Transformers shall be UL listed or labeled.

B. Dry type transformers shall have the following features:

1. Self-cooled by natural convection, isolating windings, indoor, dry type. Autotransformers will not be accepted.
2. Rating shall be as shown on the drawings. Ratings shown on the drawings are for continuous-duty without the use of cooling fans.
3. Transformers shall have copper windings.
4. Insulation systems:
   a. Transformers 30 KVA and larger: UL rated 220 degrees C system having an average maximum rise by resistance of 150 degrees C in a maximum ambient of 40 degrees C.
   b. Transformers below 30 KVA: Same as for 30 KVA and larger or UL rated 185 degrees C system having an average maximum rise by resistance of 115 degrees C in a maximum ambient of 40 degrees C.
5. Core and coil assemblies:
   a. Rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
   b. Cores shall be grain oriented, non-aging, and silicon steel.
   c. Coils shall be continuous windings without splices except for taps.
   d. Coil loss and core loss shall be minimum for efficient operation.
   e. Primary and secondary tap connections shall be brazed or pressure type.
   f. Coil windings shall have end fillers or tie downs for maximum strength.
6. Certified sound levels determined in accordance with NEMA, shall not exceed the following:

Transformer Rating	Sound Level Rating
0 - 9 KVA	40 dB
10 - 50 KVA	45 dB
51 - 150 KVA	50 dB
151 - 300 KVA	55 dB
301 - 500 KVA	60 dB

7. Nominal impedance shall be as per NEMA.
8. Single phase transformers rated 15 KVA through 25 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All transformers rated 30 KVA and larger shall have two, 2-1/2 percent full capacity taps above, and four, 2-1/2 percent full capacity taps below normal rated primary voltage.
9. Core assemblies shall be grounded to their enclosures by adequate flexible ground straps.
10. Enclosures:
    a. Not less than code gage steel.

b. Outdoor enclosures shall be NEMA 4X stainless steel powder coated white or NEMA 3R stainless steel painted grey.
c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformerhas been placed in service.
d. Ventilation openings shall prevent accidental access to live components.
e. Thoroughly clean and paint enclosure at the factory with manufacturer's prime coat and standard finish.

11. Standard NEMA features and accessories including ground pad, lifting provisions and nameplate with the wiring diagram and sound level indicated on it.
12. Dimensions and configurations shall conform to the spaces designatedfor their installations.
13. Transformers shall meet the minimum energy efficiency values per NEMA TP1 as listed below:

kVA Rating	Output efficiency (%)
15	97
30	97.5
45	97.7
75	98
112.5	98.2
150	98.3
225	98.5
312	98.6

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

B. Install the transformers with adequate clearance at a minimum of 4 inches from wall and adjacent equipment for air circulation to remove the heat produced by transformers.

C. Install transformers on vibration pads designed to suppress transformer noise and vibrations.

D. Use flexible metal conduit to enclose the conductors from the transformer to the raceway systems.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 SCOPE

A. The CONTRACTOR shall provide panelboards and general purpose dry-type transformers, complete and operable, in accordance with the Contract Documents.

B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.02 REFERENCES: The latest edition of the following codes or standards shall apply.

A. NEC (NFPA 70) National Electrical Code
B. NEMA 250 Enclosure for Electrical Equipment (1,000 Volts Maximum)
C. UL 50 - Standard for Safety for Enclosures for Electrical Equipment
D. UL 67 - Panelboards

1.03 SUBMITTALS: General: Submittals shall be in accordance section 26 05 02 Basic Materials and Methods.

A. Breaker layout drawings with dimensions and nameplate designations
B. Drawings of conduit entry/exit locations.
C. Assembly ratings including: Short circuit rating, Voltage; Continuous current
D. Cable terminal sizes
E. Descriptive bulletins
F. Product sheets

PART 2 – PRODUCTS

2.01 GENERAL: Provide panelboards by Square-D or Cutler Hammer.

A. Panelboard shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-volt, 3-phase operation or 120/240-volt for single phase operation as indicated. Power panelboards shall be rated for 480 volts, 3-phase, 3 wire operation as indicated.

B. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

C. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

D. Panelboards rated 480 VAC shall have short circuit ratings not less than 42,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.

E. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

2.02 CONSTRUCTION

A. All lighting and power distribution panels shall have copper bus bars density rated for maximum of 1,000 amps/sq-in. Enclosures for panelboards shall be galvanized and painted steel except enclosures for panelboards located in corrosive, damp or wet locations shall be stainless steel and NEMA-4X

B. Breakers shall be one, two, or three pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position. Double and triple pole breakers shall be of the common trip, single handle type.

C. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

D. All circuit breakers shall be interchangeable and bolt on type capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. Plug-in circuit breakers are not acceptable.

E. Panelboards shall be UL listed.

F. Size of wiring gutters and gauge of steel shall be in accordance with NEMA Standards Publication No. PBI 57 and UL Standards No. 67. Cabinets shall be minimum 20" wide for all panels.

PART 3 – EXECUTION

3.01 GENERAL

A. Surface mount panelboards on wall, as indicated on project drawings, at an elevation convenient for operation and as required in the latest NEC.

B. Install typewritten or computer generated circuit directory in panelboards. The directory shall be coordinated with the identification of equipment as shown on the contract drawings and clearly indicating the serving load.

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 dripproof 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^{o}C and at an altitude of 3,300 feet. High ambient Motors shall be rated for continuous duty at an ambient temperature of 65^{o}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 17

WALK-IN ELECTRICAL EQUIPMENT ENCLOSURE

PART 1- GENERAL

1.01 GENERAL

A. Provide a fully integrated equipment enclosure, one which is self-contained, pre-engineered, all new, packaged custom designed with power systems and environmentally conditioned. The enclosure is designed to house the specified electrical equipment, PLC control systems(provided by others) and associated equipment. Provide minimum aisle space and clearance around the equipment that is designed per latest National Electrical Code.

B. The housing superstructure shall be self supporting and totally independent from the interior equipment. Interior equipment does not act as walls or roof. The housing supports and withstands all imposed loading as prescribed by the references herein. No loading is transferred to the interior equipment in any way. Provide structure designed for lifting from lugs located along the base perimeter. Base and floor system to be factory leveled and designed to withstand loading combinations, while maintaining the deflection criteria, when supported at lift points only. Provide removable lifting lugs.

C. Unless otherwise specified all metallic components shall be of corrosion resistant materials or permanently coated for a comparable service life in a corrosive environment.

D. The Equipment Building manufacture shall be an ISO9001 certified facility, with five or more years experience in furnishing complete Packaged Electrical Room Systems. This includes design, manufacturing, wiring, testing and startup of the completed system including but not limited to, Motor Controls, VFD's, HVAC and electrical distribution systems. The Equipment Building shall be a factory fabricated and assembled metal modules designed to house and environmentally protect electrical and electronic controls, instrumentation and equipment as specified. It is a portable structure, totally self-supporting. The Electrical Equipment Room shall be shipped to site completely assembled with equipment installed, wired and factory tested. The enclosure shall be transported to the job site by common carrier and designed to be offloaded with a crane. Provide a minimum of four removable lifting lugs. When properly fixed to the concrete floor base, it will provide wind load protection in compliance with the Florida Building Code requirements. Building manufacturer shall provide a drawing of anchorage to slab signed and sealed by a Florida Structural Professional Engineer verifying wind load.

E. Provide the Electrical Equipment Room integrated building by TAW Custom Equipment 6312 78th Street, Riverview, FLORIDA 33578**;** 866-387-0077 or approved equal.

1.02 REFERENCES

A. All Division 26 Specifications and Drawings.

B. Section 01 33 00, Submittal Procedures.

1.03 STANDARDS: THE ENCLOSURE SHALL BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH INDUSTRY STANDARDS AS OUTLINED BELOW.

A. National Electric Manufacturers Association (NEMA).

B. American Institute of Steel Construction (AISC).

C. NFPA 70 - National Electrical Code (NEC).

D. Florida Building Code latest edition (FBC).

E. American National Standards Institute / American Society of Civil Engineers (ANSI/ASCE).

F. American Iron and Steel Institute (AISI).

G. American Welding Society (AWS).

H. Steel Structures Painting Council (SSPC).

I. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

J. Additional Codes and Standards as Identified.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The equipment enclosure shall be shipped to the job site complete as one unit and with all equipment and electrical devices within assembled with interconnecting wiring complete. The manufacturer shall supervise off loading at the site in the presence of the Contractor.

1.05 CERTIFICATIONS

A. The enclosure shall be designed accordance with ASCE 7-10 “minimum design for building and other structure” and shall conform to the latest edition of the Florida Building Code FBC 2010 with all applicable amendments by Lee County Building Department. The enclosure shall be designed for the following parameters:

1. Ultimate wind speed = 170 mph (3-second gust).
2. Risk category =III.
3. Exposure category = C.

B. The enclosure anchorages to concrete foundation shall be designed and provided by the enclosure manufacturer for the wind conditions specified above.

All anchors shall be designed by a professional engineer registered in the State of Florida. All anchors shall be epoxy adhesive Type 316 stainless steel. The enclosure fabricated aluminum base frame shall be bolted to concrete slab with epoxy adhesive anchors. All imbedded concrete adhesive anchor bolts shall be type 316 stainless steel minimum ¾ in diameter.

C. Enclosure manufacturer shall provide shop drawings and design calculations signed and sealed by a professional engineer registered in the State of Florida for the enclosure, components and anchorages. The enclosure/building complements and cladding shall be designed for the conditions specified in ASCE 7-10, Florida Building Code (FBC), and Lee County building Department Requirements. Components and Cladding shall be designed for the following parameters for internal wind pressures coefficients in accordance of ASCE 7-10 provision for "components and cladding",

1. Condition I, (GCpi= +0.18, -01.18).

D. The enclosure shall bear a Department of Community Affairs (DCA) insignia and be assigned a metal building number (MB#) in accordance with Florida State Statute 553.

PART 2- PRODUCTS

2.01 DESIGN DATA

A. Provide Electrical Equipment Building as a Self-Framing Structure utilizing a Custom Equipment designed and factory formed wall, and roof panel system. Provide wall and roof panels formed from marine grade, 5052-H32, aluminum of minimum 1/8'' thick except thickness of: roof to be 3/16'' thick and suitable for periodic maintenance foot traffic; interior walls .090''. Each panel is individually prepared and painted white using oven baked, electro-statically applied acrylic powder coat system. Construction details ensure a weather-tight assembly that does not depend on gaskets. Panels create a rigid, self-supporting, self-framing structure offering a uniform wall exterior appearance.

B. The building shall be sized as required and as shown on the Drawings to house the equipment and provide adequate clearance and work space as required by the National Electric Code.

C. The base shall be constructed from structural stainless steel or aluminum to form a rigid frame for both lifting and anchoring to concrete slab to meet wind load rating. Supporting cross members will support a steel plate deck that will support required equipment. Structural stainless steel or aluminum will be prepared for painting using an Abrasive Blasting method to remove rust and scale to the Society for Protective Coatings Standard NACE-4/SSPC-SP 7. Prepared metal will have 2 coats 5-8 mils thick of black Rust-Oleum 9100 System High Performance Epoxy. Steel decking shall be coated with skid resistant gray. The floor frame shall be elevated off the concrete pad with 3/8'' thick continuous neoprene pads between the I-beam structure and the concrete pad. The structure shall include the earthquake/hurricane tie down restraint points and drillings for grounding attachments. The enclosure anchorages to concrete

foundation shall be Type 316 stainless steel epoxy grout hardware and provided by the enclosure manufacturer.

D. The enclosure shall be air-conditioned incorporating packaged ductless split systems. Each unit shall be a backup of the other. Only one unit operates at a time. The units alternate operation every 24hours. On the failure of one unit the other unit shall automatically function to maintain climate control and the control system shall notify the operator of the failure through the PLC controls. Unit shall be sized taking into account the heat generated from internal equipment contribution as well as external ambient conditions to provide internal temperatures between 75 and 85 degrees Fahrenheit year round. Unit shall be capable of starting in low ambient conditions. Provide low noise HVAC units equal to Mitsubishi Mr. Slim model MSZ.

E. Walls and ceiling to be insulated with glass fiber thermal batt insulation or equivalent of sufficient quantity to yield a minimum thermal resistance rating of R-11. Interior wall panels shall be manufactured in accordance with Paragraph 2.01-A of marine grade 5052-H32 aluminum minimum thickness 0.090". Interior panels shall be riveted or screwed to the interior ribs with stainless steel or aluminum fasteners. Interior walls and supporting panels are designed to handle interior loads of 400 lbs/linear foot of wall length without impeding wind loading capability.

F. The enclosure will have two man doors with minimum dimension 3'-0" x 7'-0", one at each end of the structure. Doors will be insulated, double walled aluminum, and fastened using a full length SS hinge. All man-doors will be equipped with lockable, panic-type door hardware and automatic door closers. Provide a drip shield above all doors. Provide door jams with adjustable gasketing material around the interior of the door frame to ensure proper sealing of the doors. Door thresholds are provided with flexible gaskets for weather protection at the bottom of the door. Provide "Danger High Voltage / Keep Out" Signs on each door.

2.02 INTERNAL EQUIPMENT:

A. The Equipment Building shall be supplied with twin tube LED fixtures with protective lenses. Illumination will be a minimum of 65 foot candles measured 3 foot above the floor. Lights will be placed as close as practical to the center of each building. Two fixtures will contain battery backup to furnish emergency lighting during a power failure. Interior lighting will be operated by 3-way switches located inside and next to each man-door. Provide exterior GFI duplex receptacles as shown.

B. Provide automatic transfer switch(Cummins Sole Source), main utility service circuit breaker, panelboards, transformers, variable frequency drives, cabinets space for programmable logic controllers and other internal equipment as shown on the drawings and specified under Division 26 of these Specifications. All wiring will be run in surface mounted EMT conduit or in enclosed raceways. Provide 120 volt enclosure lighting and receptacle circuits with green ground wire and wired with 12 AWG, stranded, copper wire as specified in Division 26 Specifications. Provide metal troughs below electrical equipment with powder

coated white finish and removable covers to route field conductors. Adequately size troughs to completely conceal wiring extending from electrical equipment enclosures to building conduit/cable floor entryways.

C. Building manufacturer shall furnish, test, and install the motor control equipment VFDs, Electrical Distribution system in the factory prior to shipping equipment to job site. The building manufacturer shall provide onsite controls coordination assistance to the controls system integrator for PLC setup and testing that is specified elsewhere in these specifications. All provided equipment shall be mounted, wired and tested in the factory prior to shipment to site. Demonstrate final testing to the engineer prior to shipment. Provide 2 week notice of test date. Provide one source responsibility for a completely integrated and tested system to ensure minimal field install time. Provide Electrical Grade rubber matting complete length of equipment on each side.

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 projects 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. 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 32 13

DIESEL ENGINE DRIVEN GENERATOR SETS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install, put into operation, and field test the diesel engine driven generator unit, and controls as shown on the Drawings and specified herein. The equipment installation shall be coordinated in detail by the Genset distributor. The distributor shall supervise the installation of the equipment from off loading to startup.

B. The installation, supervision, and the coordination of testing and startup of the system shall be provided by the installing contractor. The installing contractor shall be responsible for the complete coordination of the installation. The installing contractor shall be responsible to include all necessary equipment and services into the base bid for installation. Where shown on the drawings, accessory materials include but are not limited to sub-base tank, sound attenuated enclosure, exhaust muffler system, battery charger, ETC.

C. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, the shop testing, and delivery and complete installation and field testing, of all materials, equipment and appurtenances for the complete units as herein specified, whether specifically mentioned in these Specifications or not.

D. For all units there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. The genset supplier is responsible for field testing of the entire installation and instruction of the regular operating personnel in the care, operation and maintenance of all equipment.

E. Provide per the project scope all equipment as shown on the drawings including but is not limited to supplying engine generator sets complete, Automatic transfer switch complete, sub-base fuel tank, sound attenuated enclosure, muffler, line circuit breakers, etc.

F. The generator Unit shall be as manufactured by Cummins-Onan, no equal, with a standby rating of ___kW, ____kVA, 1800RPM, 0.8 power factor, 277/480Volt, 3 phase, 60 Hertz, 4 wire including radiator fan and all parasitic loads.

G. The generator unit shall bear a UL2200 label.

1.02 RELATED SECTIONS

A. Section 26 36 00-Automatic Transfer Switches

B. Section 26 05 02-Basic Materials and Methods

C. Section 26 05 19-Low Voltage Wire and Cables

D. Section 26 05 26-Grounding and Bonding for Electrical Systems

1.03 DESCRIPTION OF SYSTEMS

A. A complete package shall be provided by the generator set distributor, maintaining single source responsibility. The complete package shall include the automatic transfer switch specified in other sections. The Contractor shall utilize the authorized distributor, who shall be responsible to furnish, document, instruct and supervise installation, adjust, and test the complete system as shown on the plans and specified herein.

B. The Contractor shall furnish and install all interconnecting wiring as show on the authorized distributor's shop drawings, accessories, and the like whether or not specifically detailed on the plans or in the specifications. It shall be the responsibility of the contractor to ascertain such items from the authorized distributor and include these costs in his bid. No additional payment will be made for items not specifically shown or detailed in the contract documents but needed for a complete installation.

C. The equipment must be purchased from the manufacturers authorized representative authorized to represent the manufacturer in the project's territory. The unit shall be shipped to the jobsite by an authorized engine distributor having a parts and service facility within a 150 mile radius of the jobsite. In addition, and in order not to penalize the Owner for unnecessary or prolonged periods of time for service or repairs to the emergency system, the bidding generator set supplier must have no less than eighty percent (80%) of all engine replacement parts locally available at all times. Certified proof of this requirement shall be furnished to the Engineer upon request

D. Emergency warranty service response shall be guaranteed to be a maximum of four-hours between the time of emergency notification and arrival of service personnel on site. An emergency service condition shall be considered to exist when any failed standby power system hardware or software prevents or threatens to prevent the facility from fulfilling its intended purpose as determined by the owner or engineer. Non-emergency service requests shall be responded to within 2 business days. Telephone support for operating procedures and non-hardware problems shall be provided on an unlimited basis during the warranty period.

E. All materials and parts comprising the units shall be new and unused, of current manufacture, and of the highest grade, free from all defects or imperfections. Workmanship shall conform to the best modern practices. Only new and current models will be considered. The units offered under these Specifications shall be the product of a firm regularly engaged in the production of engine-generator equipment and shall meet the requirements of the Specifications set forth herein.

1.04 SUBMITTALS

A. Submit to the Engineer for review in accordance with division 26 Sections of the specifications, complete sets of installation drawings, schematics, and wiring diagrams which shall show details of installation and connections to the work of other Sections, including foundation drawing showing location and size of foundation bolts for the spring type vibration isolators and brochures covering each item of equipment. Drawings must be created specific the project, manufacturers standard drawings are not acceptable.

B. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all nonconforming aspects. Approval by the Engineer is required.

C. The submittal data for each unit shall include, but not necessarily be limited to, the following:
   1. Installation drawings showing plan and elevations of the complete generator unit; foundation plan; exhaust silencer; starting battery; battery charger; fuel tank; and all other items requiring space for installation. Layout and stub-up locations of electrical and fuel systems.
   2. Interconnect wiring diagram of complete emergency system, including generator, switchgear, fuel tank level monitor/transmitter, battery charger, remote alarm indications.
   3. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
   4. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
   5. Engine Data:
      a. Manufacturer
      b. Model
      c. Number of cylinders
      d. RPM
      e. Bore x stroke
      f. Piston speed, RPM
      g. Make and model and descriptive literature of electric governor
      h. Fuel consumption rate curves at 25,50,75,100% loads
      i. Engine continuous pump drive duty rating
      j. Gross engine horsepower to produce generator standby rating (including fan and all parasitic loads).
      k. Manufacturer's and dealer's written warranty.
      l. Emissions data
   6. Generator Data:
      a. Manufacturer
      b. Model
      c. Rated KVA
      d. Rated kw
      e. Voltage
      f. Temperature rise above 40 degree C ambient

g. Generator efficiency including excitation losses and at 80 percent power factor
h. Generator resistances, reactances and time constants.
i. Generator current decrement curve.
j. Generator motor starting capability.
k. Generator thermal damage curve.
l. Line circuit breaker.

7. Generator Unit Control Data:
   a. Actual electrical diagrams including schematic diagrams, and interconnection wiring diagrams for all equipment to be provided. Control panel schematics
   b. Legends for all devices on all diagrams
   c. Sequence of operation explanations for all portions of all schematic wiring diagrams
8. Generator Unit and Accessories:
   a. Weight of skid mounted unit
   b. Overall length
   c. Overall width
   d. Overall height
   e. Exhaust pipe size
   f. CFM of air required for combustion and ventilation
   g. Heat rejected to jacket water and lubricating oil...BTU/hr
   h. Heat rejected to room by engine and generator...BTU/hr
   i. Jacket water heater connection diagram.
   j. Automatic load transfer switch(es).

D. Submit to the Engineer operating and maintenance data as specified in 26 05 02 Basic Electrical Materials and Methods of this specification. Submit to the Engineer the equipment Manufacturer's Certificate of Installation, Testing and Startup Report.

1.05 SPARE PARTS

A. The Manufacturer shall furnish one (1) complete spare replacement sets of all filter elements required for the generator unit.

PART 2 - PRODUCTS

2.01 RATINGS

A. The rating of the generator set shall not exceed the Manufacturer's published standby rating. The gross engine horsepower required to produce the standby rating shall not exceed the Manufacturer's published continuous duty rating by more than 150 percent. Continuous duty rating shall be as defined in BS5514 or DIN6271 but in no case shall it exceed the Manufacturer's published continuous duty rating for the engine as used in continuous rated pump drive applications. The gross engine horsepower required for the generator set standby rating described above shall include all parasitic demands such as generator inefficiencies, fuel pumps, water pumps, radiator fan (for fan cooled models) and all accessories necessary to the unit's proper operation while operating at rated load and at a rotative speed not to exceed 1800 rpm.

B. The diesel engine driven generator set shall be capable of producing the specified standby kw rating for continuous electrical service during interruption of the normal utility source and shall be certified to this effect by the Manufacturer for the actual unit supplied.

C. The generator set shall operate at 1800 rpm and at a voltage of: 277/480, 3-Phase, 4-wire, 60 hertz. The complete generator set shall be rated per ISO8528 standby rating, based on site conditions of: Altitude 100 meters, ambient temperatures of 50 degrees C, based on temperature measured at the alternator inlet. The generator set rating shall be based on stationary emergency/standby service and marked as applicable per NFPA110.

D. Performance:
   1. Voltage regulation shall not exceed one percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
   2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
   3. Generator sets shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition.
   4. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
   5. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
   6. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
   7. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.
   8. The generator set shall share real and reactive load proportionally within plus or minus 3% with all other generator sets in the system.
   9. The time required to automatically start, accelerate to rated speed and voltage, synchronize and parallel all generator sets to the system bus on a normal power failure shall not exceed 15 seconds, assuming that the water jacket heaters are operating properly.
   10. The generator set and complete sound attenuated enclosure sound levels shall be tested by the manufacturer per ANSI S1.13. Data documenting performance shall be provided with submittal documentation.

2.02 CONSTRUCTION

A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

B. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

C. All outdoor equipment shall be enclosed with corrosion-protected materials. Steel components used in enclosures shall be powder coated and baked, and shall provide fade and corrosion resistance in compliance to Dry film thickness shall be SHD3363 of 2H+ all a minimum of 1.8 Mils, gloss at 60degrees per ASTMD523 of 80+/- 10, pencil hardness per ASTM D3363

2.03 CONNECTIONS

A. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept two hole compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

B. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.04 ENGINES

A. The engine shall be full compression ignition, four cycle, single acting, solid injection engines, either vertical or "V" type. Speed shall not exceed 1800 revolutions per minute at normal full load operation. The engine governor shall be +/- 0.25 percent accuracy electronic type governor.

B. The engine shall be capable of satisfactory performance on No. 2 fuel oil (ASTM Designation D396). Diesel engines requiring a premium fuel will not be considered.

C. The engine shall be capable of operating at light loads for extended periods of time and shall provide a means to reduce carbonization. Periodic cleaning of exhaust ports shall not be required.

D. The engine shall be equipped with spin on fuel filters, lube oil filters, intake air filters, lube oil cooler, fuel transfer pump, engine driven water pump, and unit mounted instruments. The engine shall be provided with low oil pressure, high water temperature and overspeed safety shutdowns.

E. Injection pumps shall be pressure time common rail type. The system shall be self bleeding and self priming in design. The fuel system shall provide redundant overspeed protection with one governor having a dual flywheel fuel limiting mechanical control and the other fail safe electric control. The governors shall be located within the fuel pump body without external linkages or adjustments. Fuel injection pumps shall be positive action, constant-stroke pumps, activated by a cam driven by gears from the engine crankshaft. Fuel lines between injection

pumps and valves shall be of heavy seamless tubing. Digital Electronic fuel injection systems shall be considered equal to common rail type pressure injection systems.

F. The fuel system shall be equipped with spin on fuel filters having replaceable elements. Filter elements shall be spin on canister elements, easily accessible and removable from their housing for replacing without breaking any fuel line connections, or disturbing the fuel pump, or any other part of the engine. All fuel filters shall be conveniently located in one accessible housing, ahead of the injection pumps so that the fuel will have been thoroughly filtered before it reaches the pump. No screens or filters requiring cleaning or replacement shall be used in the injection pump or injection valve assemblies. The engines shall be equipped with a built-in gear-type, engine-driven fuel transfer pump, capable of supplying fuel through the filters to the injection pump at constant pressure. The engine shall be provided with a Racor type fuel water separator, sized as determined by engine manufacturer, to filter fuel continuously while unit is in operation.

G. The engine shall be provided with removable wet-type cylinder liners of close grained alloy iron, heat treated for proper hardness as required for maximum liner life. The cylinder block shall be a one piece stress relieved grey iron casting.

H. The engine shall have a gear-type lubricating oil pump for supplying oil under pressure to main bearings, crank pin bearings, pistons, piston pins, timing gears, camshaft bearings, valve rocker mechanism and governor. Effective lubricating oil filters shall be provided and so located and connected that all oil being circulated is continuously filtered and cleaned. Filters shall be spin on canister elements, easily accessible, easily removed and cleaned and shall be equipped with a spring-loaded by-pass valve as an insurance against stopping of lubricating oil circulation in the event the filters become clogged. The engine shall have a suitable water cooled lubricating oil cooler and dipstick oil level indicator.

I. The engine shall be provided with one or more engine mounted dry type air cleaners of sufficient capacity to protect effectively the working parts of the engine from dust and grit. The air cleaner shall be replaceable, easily accessible with restriction indicators.

J. Provide fuel ramping control to limit black smoke and frequency overshoot.

K. The engine shall be radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.

L. Provide fuel cooler, suitable for operation of the generator set at full rated load in ambient temperature.

M. Provide Racor Crankcase Ventilation System.

N. A digital electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states. The governor control logic shall be based in the engine ECM and must communicate with the alternator and set control. Third party and private labeled governors are not acceptable.

2.05 COOLING SYSTEMS

A. The engine shall be furnished with a unit mounted radiator type cooling system having sufficient capacity for cooling the engine when the diesel generator set is delivering full rated load in an ambient temperature of 122 degrees F. The engine shall be provided with a thermostatic valve placed in the jacket water outlet between the engine and the cooling source. This valve shall maintain the proper jacket water temperature under all load conditions.

B. Radiator shall be sized based on a core temperature which is 10 degrees C higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

C. Closed circuit jacket water systems shall be treated with a rust inhibiter as recommended by the engine Manufacturer.

D. A unit mounted thermal circulation type water heater incorporating a thermostatic switch shall be furnished to maintain engine jacket water to 70 degrees F. The heater shall be rated as shown on the drawings.
   1. Heater shall be UL499 listed and labeled.
   2. Install on the engine with SAEJ20 compliant materials. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches.
   3. Installation shall be specifically designed to provide proper venting of the system.
   4. Install using isolation valves to isolate the heater for replacement of the heater element. The design shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
   5. Provide a thermostat, installed at the engine thermostat housing. Provide for a single AC power connection to the coolant heater system.

2.06 EXHAUST SYSTEMS

A. The engine exhaust silencer shall be a critical grade and provided by the genset manufacturer. Silencer shall be sized and approved by the engine manufacture and supported by acoustical and pressure loss calculation not to exceed 55db max at the property line.

B. All exhaust equipment must be rated to withstand temperatures of approximately 1,000 degrees F. A flexible stainless steel pipe connection shall be provided between the engine exhaust stack and exhaust piping. One silencer raincap with counter weight shall be provided for each silencer. The exhaust system shall be mounted inside genset enclosure.

2.07 AUTOMATIC STARTING SYSTEM

A. A DC electric starting system with positive engagement shall be furnished. The starting motor voltage shall be as recommended by the engine Manufacturer.

B. An engine control shall be furnished as an integral part of the electric set to start and stop the engine as signaled by the automatic transfer controls on the generator control unit. The control shall start the engine by adjustable timed cranking cycles for a total period of not less than one minute. The crank and rest cycles shall be individually adjustable. The starting circuit shall open, and the control shall activate an alarm circuit if the engine does not start. The control shall be equipped with automatic safety shutdowns so that upon signal of a low oil pressure, high water temperature, or overspeed condition of the engine, the control shall immediately stop the engine. The control shall be equipped with digital display to indicate any of the engine failures and also with a 3-position control switch identified for "automatic-off-manual" externally mounted.

C. Engine Cranking Batteries: The batteries shall be of the lead acid type, and shall be of domestic manufacture. The battery shall be rated S.A.E. type "D", diesel engine starting type and of sufficient size and capacity in a fully charged condition to crank start the engine generator for the maximum allowed crank cycle, (minimum 20-second cranking periods) six consecutive times at 20 degrees F with out recharging between cranks. The batteries shall be mounted in suitable covered racks. Battery rack location will be as shown on the Shop Drawings. The electrical Contractor shall provide the required lengths of all interconnecting battery cables. Minimum wire size and type shall be 2/0 welding cable.

D. Battery Chargers:

1. Provide a 10amp battery charger. Chargers shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications. The charger shall be compliant with UL991 requirements for vibration resistance.
2. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours.
3. The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an

equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.

4. The DC output voltage regulation shall be within plus or minus 1%. The DC output ripple current shall not exceed 1 amp at rated output current level.
5. The charger shall include the following features:
   a. Two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming;
   b. LED indicating lamp(s) indicating normal charging condition (green), equalize charge state (amber), and fault condition (red);
   c. AC input overcurrent, over voltage, and undervoltage protection;
   d. DC output overcurrent protection;
   e. Alarm output relay;
6. Locate Charger in the automatic transfer switch.

2.08 ALTERNATOR, EXCITER AND ACCESSORIES

A. Rating: The alternator shall be rated ___KW, ___KVA at 0.8 p.f., 1800 RPM 3 phase, 60 Hertz, 277/480 volts, at a maximum temperature rise of 80 degrees C (both armature and field) by resistance at full rated load in ambient air of 40 degrees C. The alternator shall be wound for 2/3rds pitch for harmonic mitigation. The alternator shall conform to NEMA Standard MG-1. As an alternate to the 80 degree C rise alternator (if not a standard option), the manufacturer shall upsize the diesel generator such that at the derated capacity of ___kw, the heat rise on the alternator will be 80 degree C rise or better.

B. Performance: The instantaneous voltage dip shall not exceed 25 percent of rated voltage when full load, at rated power factor, is suddenly applied. Recovery of stable operation shall occur within 1 second. Steady state modulation shall not exceed +/- l/2 percent. Provide documentation of submitted unit meeting performance criteria with shop drawing submittals.

C. The alternator shall be capable of starting across the line, ___ HP motors that are 85% efficient with a power factor of 0.8 in ___ equal steps with no more than 10% instantaneous voltage dip and 2% frequency dip. Provide documentation of submitted unit meeting performance criteria with shop drawing submittals.

D. Construction:
   1. The alternator and exciter shall be dripproof, with split sleeve, or ball race bearings. A shaft-mounted brushless exciter shall be a part of the assembly. The stator core shall be built up of high grade silicon steel laminations precision punched, and individually insulated. Armature lamination followers and frame ribs shall be welded integral with the frames for support of the stator core. A directional blower shall be mounted on the unit to draw cooling air from the exciter and over the rotor poles and through louvered openings on the opposite end.

   2. The exciter shall be a fast response type, with a rotating 3-phase full-wave bridge. The exciter shall have a low time constant and large capacity to minimize voltage transients under severe load changes.

3. Alternator stator and exciter stator windings shall be a full Class H insulated system (generator rated for class B temperature rise of 80 degrees) vacuum impregnated with epoxy resin which after curing shall have additional treatment of epoxy for resistance to an environment of moisture and salt air.

4. Alternator rotor poles shall be built up of individually insulated silicon steel punchings. Poles shall be wound and bonded with high strength epoxy resin. Cage connections to the amortisseur rings shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to the rotor shaft with bolts sized for the centrifugal forces on the rotor. Alternator windings shall be braced for full line to ground fault currents, on a solid grounded neutral system.

5. Provide an anti-condensation heater for the alternator for generator sets installed outdoors or in unheated environments.

2.09 ACCESSORIES AND ATTACHMENTS

A. Terminal boxes: The unit shall contain a controls terminal box properly sized and provided with terminal strips and interposing relays and devices to properly interface genset controls with remote controls and instrumentation. The generator shall have separate AC and DC low voltage terminal boxes with suitably marked terminal strip for required connections.

B. All required P.T.'s, C.T.'s and protective relays shall be supplied by the engine-generator Manufacturer.

C. Vibration isolation: Provide spring type vibration isolation.

D. Provide a molded case line circuit breaker. Provide breaker with solid state adjustable functions for long time, and instantaneous trip. Instantaneous adjustment trip setting range 2-10 or greater. Provide line circuit breaker with a 100% continuous current rating.

2.10 GENERATOR ASSOCIATED CONTROLS

A. Voltage Regulator: The generator Manufacturer shall furnish a hermetically sealed, silicon controlled rectifier type voltage regulator employing a zener reference with a plus or minus one percent regulation for the generator. The regulator shall include 3 phase voltage sensing, automatic short circuit protection and shall include automatic underfrequency protection to allow the generator to operate at no load at less than synchronous speed for engine start-up and shutdown procedures. Switches and/or fuses shall not be used to provide this protection. An over-voltage sensing module with manual reset shall be furnished with the regulator. A volts per Hz., sensing module shall be provided as part of the regulation system. A voltage adjustment rheostat for 5 percent voltage adjustment on the unit shall be provided.

B. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at 300% of rated current for not more than 10 seconds.

2.11 GENERATOR SET INSTRUMENTATION

A. The generator set shall be provided with a microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions, both local and remote, for the generator set. The control shall be mounted on the generator set. Controls shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The control shall be UL508 listed, and meet IEC8528 part 4. All switches, lamps, and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. The entire control shall be tested and meet the requirements of IEEE-587 for voltage surge resistance.

B. The front display of the genset control panel unit shall include the following:

1. 1% accuracy generator set AC output instruments; Ammeter, Voltmeter, Frequency Meter, Wattmeter, KW-hour meter, Power Factor Meter. Selector switches to allow viewing of voltage and amperes for each phase shall be provided. For 3-phase/4-wire systems the voltmeter shall indicate line to line and line to neutral conditions. Running Time Meter and Start Counter.
2. Generator Set Mode Selector Switch: Switch shall provide hand, off, and automatic functions for control of the generator set.
3. Control Reset push-button switch with indicating lamp. Lamp shall flash to indicate that generator set is locked out due to a fault condition.
4. Lamp test push-button switch. Operation of this switch shall cause all lamps on the panel to be simultaneously tested.
5. Emergency Stop switch. The emergency stop switch shall be a red, mushroom head switch which maintains it's position until manually reset.
6. Precision voltage and frequency adjust raise/lower switches. Switches shall allow the generator set frequency and voltage to be adjusted plus or minus 5% when the generator set is operating independently of the system bus. Voltage and frequency adjustment switches shall be located adjacent to the generator set and bus metering, for ease of use by the operator.
7. Provide an alarm and status indicating panel to indicate the genset conditions to the operator via LED display; provide the following ***alarm*** condition indicators:
   Low DC Voltage
   High DC Voltage
   Weak Battery
   Low Oil Pressure Alarm
   Low Fuel - main tank
   Fuel tank leak
   High Engine Temp Alarm Amber
   Ground Fault
   Overcurrent Alarm

8. The alarm and status indicating panel shall indicate the following genset *shutdown* conditions to the operator:
   Breaker Failure
   Not in Auto
   High Engine Temp
   Low Oil Pressure
   Overcurrent
   Short Circuit
   Loss of Excitation
   Reverse Power
   Overcrank
   Overspeed
   Under Frequency
   Under Voltage
   Over Voltage
   Low Coolant Level
   Emergency Stop
9. The alarm and status indicating panel shall indicate the following genset *status* conditions to the operator:
   Genset Ready (in auto and ready)
   Generator Running (ready to load)
10. In addition, provisions shall be made for indication of three (3) customer-specified alarm or shutdown conditions.
11. Provide controller with optional run relay package to enable direct hardwired connection to SCADA system. Provide the following status and alarms conditions to the PLC:
    Generator Common Warning(parameter 1540)
    Generator Common Fault(parameter 1541)
    Generator Not in Auto
    Low Fuel - main tank
    Fuel tank leak

2.12 GENERATOR ENCLOSURE

A. Provide an Outdoor Weather-Protective Sound Attenuating Generator Housing. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 72 dBA at any location 7 meters from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass.

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure, and allows the generator set package to meet specified

sound level requirements. Silencer and exhaust shall include a raincap and rainshield.

D. The entire enclosure shall be sheathed in aluminum. Provide aluminum enclosure finish painted with the manufacturer's standard color.

E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be stainless steel or non-metallic corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

F. The Generator enclosure shall be designed accordance with ASCE 7-10 "minimum design for building and other structure" and shall conform to the latest edition of the Florida Building Code. The enclosure shall be designed for the following parameters: Basic wind speed = 170 mph; Risk Category =III; Exposure category = C.

G. Generator enclosure/tank anchorages to concrete foundation shall be designed for the wind conditions specified above and designed by a professional engineer registered in the State of Florida. All anchors shall be Type 316 stainless steel. Enclosure manufacturer shall provide shop drawings for the enclosure, components and anchorages. Generator enclosure/building complements and cladding shall be designed for the conditions specified in ASCE 7-10, Florida Building Code (FBC) and Lee County Building Department Requirements. Components and cladding shall be designed for the following parameters for internal wind pressure coefficients in accordance with ASCE 7-98 provision for "components and cladding", Condition I, (GCpi=+0.18,-0.118)

2.13 SUB-BASE FUEL TANK

A. Provide where shown on the drawings, a UL listed Double Wall diesel fuel storage tank. The fuel tank shall be an integral part of the enclosure/generator mounting frame. Fuel tank shall have a capacity of no less than 1100 gallons usable to provide 48 hours of run time under 100% generator full load conditions. Fuel tank provided shall comply with and be constructed in accordance with the requirements of Underwriters Laboratories UL-142 "Special Purpose Protected Secondary Containment Generator Base Tank"; N.F.P.A. 30, 37 & 110; Florida Department of Environmental Protection (FDEP) and the Steel Tank Institute. Fuel tank venting in compliance with NFPA and UL

B. Complete assembly shall be manufactured using minimum 3/16" sheet steel for the inner tank and 3/16" 304 Stainless Steel for outer tanks. Fuel tank and containment basin are to be leak tested at 3-PSI air as outlined in UL-142 standards. The interstitial space shall be monitored using a float type level switch and shall indicate the presences of fuel in the annular space by use of normally open contacts that are to be wired back to the generator set control panel for visual/audible indication.

C. Fuel tank provided shall have the following devices but by no means be limited to those as specified. A 2" Manual fuel fill cap, with means to padlock fill cap, mechanical fuel level gauge, low level alarm set at 40% of tank capacity, rupture basin alarm with normally open contacts, fuel supply and return ports with full length pick-up tubes. A foot or check valve shall be installed on the generator

supply to prevent loss of prime during idle conditions. A rectangular double-walled electrical stub-up area is to be provided and located directly under the generator circuit breaker to provide a pass-through for field installation of electrical load conductors. Tank color shall match the generator enclosure.

D. The tank shall be elevated off the concrete pad with integral tank supports that provide a 2 inch air space to control moisture accumulation. The tank supports shall be arranged so that moisture is not trapped in the channel of the supports. Provide 3/8”TH x 6”W continuous neoprene pads between the tank supports and the concrete pad. The tank shall include the hurricane tie down restraint points and drillings for grounding attachments.

E. Provide a level gauge near the fill location. Provide a drop tube and leak alarm switch located in the interstitial space area of the tank indicating inner tank failure and wire to genset control panel.

F. Provide DEP approved Fuel management system, Pneumercator TMS 2000. The system shall include an audible and visual high level alarm station at the fill location set to alarm at 90% of tank capacity. System shall include Pneumerator TMS200 manufacturer level transmitter. The alarm station shall be housed in a NEMA 4X SS powder coated white enclosure. Provide a high level alarm float switch in the tank and wire to the generator controller and remote annunciation alarm console. Fuel level transmitter (4-20ma) output wired to the Pump Station PLC. Provide 6-channel optional analog output card.

G. The contractor shall coordinate with the owner and provide all tank permit applications and reviews as required by the FDEP and proper fire district regulating authority and properly permitted.

H. All tanks shall be labeled by product, capacity and manufacturer per NFPA requirements.

PART 3 - EXECUTION

3.01 SERVICES

A. Furnish the services of a competent and experienced Manufacturer's field service technician who has complete knowledge of proper operation and maintenance of the equipment to inspect the installed equipment, supervise the initial test run, coordinate checkout of the interlocks between ATS and the Genset and to provide instructions to the plant personnel. The first visit will be for checking and inspecting the equipment after it is installed.

B. Provide instruction of plant personnel in operation and maintenance of the equipment. This instruction period shall be scheduled at least ten days in advance with the Owner and shall take place prior to final acceptance and after substantial completion by the Owner.

C. The final copies of operation and maintenance manuals specified in division 1 Sections must be delivered to the Engineer prior to scheduling the instruction period with the Owner.

D. The distributor of the Genset shall provide installation coordination services to insure a properly installed and coordinated system including all coordination with the electrical and instrumentation contractor for proper interfacing. As a minimum the Genset Distributor shall coordinate the installation with factory trained technicians with weekly site visits from the time the genset arrives on site to the time it is fully operational. Also the technician shall provide on site coordination of all conduit stub ups, fuel line stub-ups, pad dimensions, embedment etc prior to slab pour. It is the intent of these specifications that the Distributor of the Genset provide complete system coordination including but not limited to; fuel system with venting and filling requirements; exhaust system requirements; cooling and ducting system; power; control, battery and grounding systems, switchgear system; testing and acceptance certification. The site technician shall submit written reports of the coordination efforts weekly to the engineer and meet with the engineer as requested. The technician shall certify the units installed per manufacturers recommendation prior to test runs or functional testing.

3.02 INSTALLATION

A. The genset installer shall install suitable jacket water additives as furnished by the engine Manufacturer and approved by the Engineer, for prevention of both scale formation and corrosion in the water jackets and cooling system components which are in contact with the engine jacket water. These additives shall be added to the cooling system prior to running the field acceptance test.

B. The Contractor shall install the complete exhaust system, together with the silencer, the piping and insulation, and the complete supporting system. Where the exhaust passes through the roof or side wall, furnish and install suitable thimble and "rain skirt".

C. The engine generator set and associated equipment shall be shop primed and finish coated in accordance with the Manufacturer's standard practice prior to shipment. An adequate supply of touch-up paint shall be supplied by the Manufacturer.

D. Neoprene pads shall be installed to isolate the fuel tank bottom from making direct contact with the concrete equipment pad. Provide a neoprene pad or strip- for all points that come in contact with the concrete equipment pad.

3.03 TESTING

A. The engine-generator set shall be given the Manufacturer's standard load bank test at full rated load and power factor at the factory.

B. Prior to final acceptance of the generator set, all equipment furnished under this Section shall be field tested to show it is free of any defects and that the generator set can operate satisfactorily under full load test using resistance type load banks. The genset testing shall be for four (4) continuous hours. Any defects which become evident at this time shall be corrected before acceptance.

C. During the field tests, readings will be taken at thirty (30) minute intervals of the following: oil temperature, exhaust temperature, water temperature, volts, amps, frequency, fuel pressure, manifold pressure, and oil pressure, KW, KWH.

D. The owner shall provide fuel for start-up and testing of the generator system.

3.04 WARRANTY

A. The complete electrical standby power system; generator set, controls, and associated switches, and accessories, as provided by the factory distributor including the ancillary equipment shall be warranted by the manufacturer against defects in materials and workmanship for a period of five years or 1500 genset run hours, whichever occurs first from the date of system startup. Coverage shall include parts, labor, travel expenses and labor to remove reinstall defective equipment under terms of the Manufacturer's comprehensive standard warranty. No deductibles shall be applied to the warranty except for starting batteries and water jacket heater being warranted for one year.

END OF SECTION

SECTION 26 36 00

AUTOMATIC TRANSFER SWITCHES

PART 1-GENERAL

1.01 GENERAL

A. Automatic transfer switches shall be furnished as shown on plans, with full load current and voltage rating as shown, normal and emergency. The transfer switch shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure NEMA ICS 6 or 4X that is constructed in accordance with Underwriters' Laboratories, Inc., Standard UL-1008. Provide transfer switches by Cummins no equal. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing).

B. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

C. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents. Contractor to verify available fault currents. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

D. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position. Transfer switches shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions. The transfer switch shall be configurable to control the operation time from source to source (program transition; delayed transition operation). Sync checked two position transfer switches without delayed transition are not acceptable

E. The transfer switch shall be capable of transferring successfully in either direction with 90% of rated voltage applied to the switch terminals. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating. Transfer switch shall be provided with copper long barrel Hi-Press lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

F. Operator Panel. Each transfer switch shall be provided with a control panel to

allow the operator to view the status and control operation of the transfer switch. The operator panel shall be provided with the following features and capabilities.

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control. High intensity LED lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.
2. "OVERRIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load. "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
3. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via the operator display panel.
4. Analog AC meter display panel, to display 3-phase AC Amps, 3-phase AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

G. Engine starting contacts shall be provided in transfer switch to start the generating plant if **any** phase of the normal source drops below 85% of rated voltage, after an adjustable time delay period of 1-120 seconds. Provide loss of normal source circuit with phase sequence sensing capability that verifies phase angle relationship of source voltage.

H. The transfer switch shall transfer to emergency as soon as the generator source voltage and frequency have reached 90% of rated. After restoration of normal power on all phases to 95% of rated voltage, adjustable time delay period of 2-25 minutes shall delay transfer to normal power until it has had time to stabilize. If the emergency power source should fail during the time delay period, the time delay shall be by-passed, and the switch shall return immediately to the normal source. Whenever the switch has retransferred to normal, the engine-generator shall be allowed to operate at no load for an adjustable period of time (10 minutes initially) to allow it to cool before shut-down. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

1. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
2. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup

voltage level).

3. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance, loss of single phase, phase rotation, over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level), over or under frequency conditions.
4. Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150% of rated phase current for more than an adjustable time period of 10 to 60 seconds.

I. The transfer switch shall include a test switch to simulate normal power failure with actual load transfer. A remote contact from the plant control system shall be accepted by the ATS to provide generator start and load control testing. Pilot lights shall be included on the cabinet door to indicate the main switch closed on normal (green) or emergency (Red); a yellow pilot light shall indicate the emergency power source running.

J. The transfer switch shall include two auxiliary contacts on the main operating shaft indicating closed on normal and two auxiliary contacts indicating closed on emergency. In addition, two sets of relay contacts shall be provided to operate upon loss of the normal power supply. All relays, timers, control wiring and accessories to be front accessible. Auxiliary contacts shall be provided for remote plant control system monitoring.

K. Include an exerciser with transfer switch for exercising generator in loaded condition every 168 hours for a period adjustable to 15 minute increments from 20 minutes minimum. Include automatic return to normal should the genset fail to provide load during the exercise run, if normal power is available. Provide programmed transition controls with adjustable time delay option to limit inductive load inrush currents. Switches without adjustable programmed transition are not acceptable.

L. Provide for utility to genset ATS dry maintained contact input from the Pump Control Panel to start generator and transfer ATS on load. Provide a 20 light remote annunciator to be mounted adjacent to or within the front panel of ATS. I/O List from the ATS/Standby power system and standby system annunciator to the plant controls:

<u>Contact outputs from ATS:</u>
ATS/Genset not in Auto
Utility Supplying Load
Generator Supplying Load
Utility Available
Generator Available
ATS Common Alarm

<u>Contact inputs to ATS:</u>
Remote Test

M. The transfer switch shall be provided in a NEMA 12 (interior installation locations) or NEMA 4X stainless steel (exterior installation locations) wall mounted enclosure with a continuous hinge, gasketed and a 3 point latch. HMI deadfront

mounted through enclosure door shall be fitted with a hinged window kit, Schaefer's SPHWKSS-(###)-BC or approved equal.

1.02 SUBMITTALS

A. Submit shop drawings and product data clearly indicating:
1. Cabinet dimensions.
2. All applicable options and accessories.
3. Wiring diagrams.
4. Interrupting or withstanding current rating.
5. All electrical characteristics and data as required showing compliance with these specifications.
6. Digital Metering device and wiring.

PART 2-PRODUCTS(NOT USED)

PART 3-EXECUTION

3.01 QUALITY ASSURANCE/TESTS

A. As a precondition for approval, transfer switch, complete with timers relays and accessories shall be listed by Underwriters' Laboratories, Inc. in their Electrical Construction Materials Catalog under Standard UL-1008 (automatic transfer switches) and approved for use on emergency systems.

B. When conducting temperature rise tests to paragraph 99 of UL-1008 the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

C. Electrical Field Tests: Field testing shall be performed prior to substantial completion.
1. Perform insulation resistance tests phase-to-phase and phase-to-ground with switch in both source positions.
2. Perform a contact resistance test across all main contacts.
3. Verify settings and operation of control devices in accordance with the specifications provided by the manufacturer.
4. Calibrate and test all relays and timers including voltage and frequency sensing relays, in phase monitor (synchronism check), engine start and cool-down timers, transfer and retransfer timers, etc.
5. Perform automatic transfer tests: Simulate loss of normal power. Test Return to normal power. Simulate loss of emergency power. Simulate all forms of single phase conditions. Monitor and verify correct operation and timing of the following simulations: Normal voltage-sensing relays: Engine start sequence: Time delay upon transfer: Alternate voltage-sensing relays: Automatic transfer operation: Interlocks and limit switch function: Time delay and retransfer upon normal power restoration: Engine cool-down and shutdown feature.
6. SYSTEM FUNCTION TESTS: Perform system function tests upon completion of equipment tests. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
a. Develop test parameters for the purpose of evaluating performance

of all integral components and their functioning as a complete unit within design requirements.

b. Test all interlock devices.

c. Record the operation of alarms and indicating devices.

3.02 SHOP DRAWINGS

A. Submit Shop Drawings and product data clearly indicating:

1. Cabinet dimensions.
2. All applicable options and accessories.
3. Wiring diagrams.
4. Interrupting or withstanding current rating.
5. All electrical characteristics and data as required showing compliance with these specifications.
6. Digital Metering device and wiring.

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 240 volt 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 41 00

LIGHTNING PROTECTION SYSTEM

PART 1 -GENERAL

1.01 DESCRIPTION

A. Description of Systems:

1. A Lightning Protection System shall be placed on the structures by experienced installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. Intent of the lightning protection systems shall be to protect the structures against damage by lightning. All equipment to that result shall be included whether or not specifically called for herein. Installers shall be Underwriters Laboratories certified as Master Label installers or of equal qualifications as approved by Engineer.
2. Provide complete and upgraded lightning protection systems as noted on the drawings. Provide bonding and grounding systems and interconnection to the site lightning protection and grounding systems as shown on the drawings and as specified. All systems shall be in conformance to NFPA-780, UL-96, UL96-A and as shown on the contract drawings.
3. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be U.L. labeled.
4. All installations shall be performed to meet Underwriters Laboratories Master Label standards. Provide a UL Master Label or Lightning Protection Institute (LPI) certification for all protected structures to the extent the structures are eligible under the standards of UL 96A. If the structure is not eligible under the standards of UL 96A, provide a Letter of Findings for the installation at completion of work.

1.02 SUBMITTALS

A. Shop Drawings and Product Data:

1. Shop Drawings: Shop drawings shall be submitted before work is started. Drawings shall include full layout of cabling and points, and connections. The drawing shall show the type, size and location of all equipment, grounds and cable routing. The drawing shall show all grounds and air terminals that are shown on the contract drawings. See additional requirements for shop drawings in section 26 05 02.
2. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation. Provide a sample of the air terminal to be used with the shop drawing submittal.
3. Provide the owner with 2 spare tubes of the adhesive used to affix bases, fasteners and down conductors to facilities.

1.03 SYSTEM DESIGN

A. The system shall be an effective, aesthetically acceptable streamer-delaying lightning protection system to the standards of Underwriters Laboratories UL 96 & UL96A. The purpose of the system shall be to reduce the likelihood of a direct strike to the protected structure by delaying the formation of streamers from that structure. Secondarily the system shall be designed in such a manner that it affords protection to the structure upon which it is installed in the event a direct lightning strike to the structure does occur.

B. The system components shall not require mounting in a specific configuration or impose any other mounting limitations which may interfere with utility use of structure space or otherwise preclude or limit the intended use of the structure.

C. All components shall be attached to the structure in such a manner as to reduce the possibility of corrosion between dissimilar metals. If installed on a metallic or otherwise electrically conductive structure, the system shall be electrically bonded to the structure upon which it is installed through mounting clamps and brackets, with additional bonding to grounded objects and to the structure, as required or as indicated on the drawings.

D. The system shall be composed of components that meet the requirements of Underwriters Laboratories UL 96. Aluminum and Stainless Steel components shall be employed on structures and portions of structures subject to corrosive elements, where the use of copper components could be rendered ineffective, due to the surrounding environment. No dissimilar metals shall be allowed to be in contact. In areas where chemical conditions may deteriorate the specified materials faster than the life expectancy of the material, the LP installer shall bring these conditions to the attention of the engineer prior to installation.

E. Air Terminals shall be mounted on all outside corners of each structure, around the perimeter of each structure at intervals not to exceed twenty (20) feet, and on the interior of each structure in such a manner that no two Air Terminals are separated by a distance of more than fifty (50) feet. In the event this is not practical, such as on a large open tank, Air Terminal spacing around the perimeter shall be decreased to not more than fifteen (15) feet, with a total number around the perimeter not less than the total of the normally required perimeter Air Terminals, plus the additional number of Air Terminals if Air Terminals had been installed on the interior at intervals not greater than fifty (50) feet.

F. Each Air Terminal shall be provided with two (2) contiguous paths to ground. On structures with handrails, exposed structural members, or other conductors, provide a bond to structural conductors from the lightning protection system. Handrails shall not be used as a main lightning protection conductor. Provide a continuous lightning protection conductor parallel with handrails and bond from it to each handrail section and a minimum of 10’ on center. In the case of a structure or a portion of the structure where the structure itself is electrically conductive, such as a light pole, tower, etc, that structure or portion of the structure itself may be employed as part of the lightning protection system, provided it meets the minimum requirements of UL 96 or UL 96A, and down conductors are specifically not required on such structures.

PART 2 - PRODUCTS AND INSTALLATION

2.01 AIR TERMINALS

A. Air Terminals shall be of the streamer delaying type. Each air terminal shall have a minimum of five hundred dissipater electrode wires, none of which exceed ten thousands of an inch diameter. Electrode material shall be high quality 316 series stainless steel and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface. Terminals shall project a minimum of 18" above top of object to which attached. Air terminal point must be 3/16 or greater to meet current UL standards.

B. Streamer-delaying Air Terminals shall be manufactured by Altec Global or Thompson.

2.02 CONDUCTORS

A. Roof conductors shall consist of rope lay aluminum conductor complying with the weight and construction requirements for Class II lightning protection systems (192,000 CM). Conductors shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be Aluminum and transition to copper 18” minimum above grade. Down conductors shall be installed in PVC conduit and hidden within the structure. Approved bi-metal transitions from aluminum conductors for bonding of aluminum roof structures (exhaust fans, etc.) to copper down conductors shall be provided. Radius of bends shall not be less than 8 inches.

B. Counterpoise loop ground conductors shall be tinned copper and be a minimum size equal to the main roof conductor size (192,000cm) or 4/0.

2.03 FASTENER

A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

B. All fasteners shall be of a heavy-duty double bolted type typically used for Class II lightning protection systems. Conductor to conductor connections shall be through heavy-duty pressure type bolted fasteners. Splice and bimetal connections shall be through four bolt pressure type heavy-duty connectors. Crimp fasteners shall not be used.

C. Dissimilar metals shall not be allowed to be in contact. Aluminum fittings shall be mounted on aluminum where necessary, and bonded to the main system using bi-metal connectors. Lead coating shall not be acceptable as a bi-metal transition.

D. All mechanical termination points and lugs shall have an anti-corrosive coating applied. In areas subject to chemical corrosion (odor control, degasifiers, chem. Rooms, etc.) apply Glyptal 1201 red enamel coating after termination is made. In

other less corrosive areas apply Permatex battery protector sealer (SA-9) or Glyptal 1201 or equal.

E. Lugs for copper cable shall be high copper alloy terminals or stainless steel equal to Burndy type QDA Qiklug. Lugs of aluminum alloy are not acceptable.

2.04 GROUND CONNECTIONS

A. Ground rods shall be installed in the quantities as indicated on the drawings and as required by NFPA-780. Ground rods shall be placed a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each two-path system shall be connected to water piping system with approved water pipe type strap connector. All ground rods shall be 5/8" X 20' copperweld type. All connections made below grade shall be exothermically welded (cadweld) connection and placed in a ground rod inspection well as detailed.

B. Soil type in the area is primarily sand with rock layer below. The rock layers on site will require drilling of ground rod holes. All ground rods shall be installed vertically. After drilling and installation of rod, back fill with sand and hydro compact around rod to provide low resistance to ground.

2.05 GROUND ROD & GROUND SYSTEM TESTING

A. The contractor shall utilize a clamp on ground loop tester during construction to check the system for high resistance connections. The resistance at any point below the air terminal shall be less than 5 ohms. The resistance at grade level on the down conductors should be less than 2 ohms. The contractor shall investigate and correct high resistance readings within the system. Demonstrate to the engineer's satisfaction with witness testing, provision of a low resistance installation meeting this specification.

B. Provide three point fall of potential ground testing on a minimum of one ground rod on each facility prior to connection to the counterpoise system. As an alternate provide ground rod selective method testing with appropriate ground testers. The complete ground system shall be three point fall of potential tested after completion of work. The system shall be tested at a minimum of three points spaced around the site using the "Tagg Slope" technique. Total grid system grounds should be less than one ohm.

2.06 INSTALLATION

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. Surface mount down conductors to existing structures in a neat and workmanlike manner. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground and other ground systems in the area.

2.07 COORDINATION

A. The installer shall coordinate the lightning protection work to insure a correct, neat,

and unobtrusive installation. In normally accessible areas, catwalks, equipment platforms, etc., provide installation without trip hazard. Provide embedded conduit sleeves across access ways for ground conductors. In retrofit projects provide flat copper strap to ground or bond across access ways.

B. Any electrical service grounding system and metallic water service piping to the structure shall be electrically bonded to the lightning protection system.

C. The contractor shall coordinate his work in such a manner as to not interfere with the normal operation of the structure upon which the installation is performed.

2.08 MATERIAL MANUFACTURERS

A. Equipment shall be as manufactured by Altec Global Lighting Protection, Thompson Lightning Protection, Inc. Independent Protection Company, Inc., Heary Brothers Lightning Protection, Harger Lightning Protection or Robbins Lightning Protection.

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

NOTE: Edit as required.

A. Tree Removal Within Property Limits: Remove trees and shrubs within the (limits of the right-of-way) (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) (right-of-way) 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 (right-of-way) (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 land owner 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

NOTE: Select locations which require protection and edit as required.

A. Protection: Protect trees and shrubs within the (construction site) (right-of-way) (construction strip) 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 31 10 00 - Site Clearing
2. Section 31 40 00 - Shoring, Sheeting and Bracing
3. Section 31 23 23 - Backfilling
4. Section 03 30 53 – Concrete for Non-Plant Work

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.

NOTE: Add Geotechnical Firm in 1.4 (A)

1.4 SITE CONDITIONS

A. Geotechnical Investigation: A geotechnical investigation and report was prepared by _____ and was intended only for use by the OWNER and ENGINEER in preparing the Contract Documents.

1. The geotechnical investigation report may be examined for what ever 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 opencut 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 opencut 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 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 a Florida Registered, Professional ENGINEER at the expense of the Developer or 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 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.

NOTE: Edit as required, this subsection is job specific and it may be necessary to delete the entire subsection and renumber.

It is recommended that a 8 inches minimum thickness of compacted drainage blanket material be provided under tank base slabs in conjunction with pressure relief valves in the base slab to protect the tank from hydrostatic uplift.

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.

NOTE: Job specific, edit as required. Earth embankment is for small dams or dikes, such as for retention ponds. If such use is not a part of the project, delete this subsection and renumber.

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.

NOTE: Pay item for sheeting left in place if required when using paragraph G2 as is.

2. Cut off sheeting not designated as "Sheeting Left in Place". The cut ends of sheeting left adjacent to the pipe will be paid for as "Sheeting Left in Place".

3. 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 endanager 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 pipe lines, 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

The following comments are provided to aid the designer in the comparison of Types of Fence:

The all aluminum fence is most expensive. Aluminum fence is not as strong as other types. Maintenance is less for plastic coated and aluminum.

The vinyl coated steel fence may be the best choice with framework strength equal to galvanized, but there would be little need for future painting.

The attached diagrams show manufacturer's standard nomenclature for the various components, Diagram "A" for fence, and Diagram "B" for gates.

ESTIMATED RANKING OF TYPES OF FENCE

	First Cost	Service Life	Fabric Breaking Strength(1)	Frequency of Maintenance
Vinyl coated steel(2)	1 (lowest)	1 (best)	1,800 lbs.	1 (least freq.)
Aluminum coated steel	2	5	2,170 lbs.	4
Galvanized steel (1.2 oz)(3)	1 (lowest)	4	1,800 lbs.	5
Galvanized steel (2.0 oz)	3	3	2,170 lbs.	3
Aluminum	4	2	1,500 lbs.	2

(1) Per Federal Specification RR-F-191.
(2) Thermal fusion applied.
(3) 1.2 oz fabric not recommended.

NOTE: ACTUAL SPEC STARTS HERE.

NOTE: This spec has been written for (1) galvanized steel (2) aluminum (3) vinyl coated fences. Designer should select the type of fencing and delete any inappropriate items not required for the project.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing and installing (aluminum) (galvanized steel) (vinyl coated galvanized steel) chain link fencing and gates.

B. Related Work Specified in Other Sections Includes:

1. Section 03 30 53 – Concrete for Non-Plant Work
2. Section 09 90 00 – Painting and Coating

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A53 -
2. ASME B36.10M - Welded and seamless wrought steel pipe

3. FS RR-F-191 - Fencing, Wire and Post, Metal

1.3 DESIGN

NOTE: Determine height of fence.

A. General: Provide fencing of the chain-link type and (_____) (seven) feet high with (_____) (six) feet of diamond mesh woven wire fabric topped by extension arms with a vertical height of approximately one foot above the top of the fabric. Design the extension arms slanted out at an angle of 45 degrees and provide the arms to carry three double strands of barbed wire. Locate the fence as shown.

NOTE: Delete item B or C depending on type of fences used and renumber as required.

B. Fabric, Supports and Fittings: Provide (aluminum) (steel) fabric, supports and fittings except as specified.

NOTE: Color coated chain link fence consists of polyvinyl chloride (PVC) fused and bonded to a zinc coated steel wire fabric. Structural parts are galvanized steel, coated with thermoplastic or thermoset polyester resins and oven baked for complete fusion. An alternate method of color coating by extrusion is not acceptable, as it is subject to possible separation from the supporting element and to blistering.

C. Fabric, Supports and Fittings: Provide (green) (black) color coated steel fabric, supports and fittings. Coat the framework, posts and hardware except hinges and latches to match the fabric with thermoplastic or thermoset resins and provide oven baked materials to a minimum dry coating of seven mils. Color coat all accessories except hinges and latches to match the fence. Provide aluminum hinges and latches.

D. 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. Acceptable manufacturers are listed in the LCU Approved Materials List.

2.2 FABRIC

NOTE: Minimum breaking loads:	
Vinyl Coated	1,800 lbs/ft
Aluminum	1,500 lbs/ft
Galvanized Steel	2,170 lbs/ft
Edit as required.	

A. Provide fabric that is a one piece woven 2-inch mesh chain link of 6-gauge (steel wire) (Type 6061 aluminum alloy) with a minimum breakload of (1800) (1500) (2170) lbs/ft. and which is interwoven to form a continuous fabric with no splices (and is hot-dip galvanized) (and is coated) 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 (coating and) (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.

NOTE: Delete as required when vinyl coating is not specified.

1. Provide galvanized fabric that is fusion coated with a minimum seven mil coating of polyvinyl chloride (PVC) applied over a thermoset plastic bonding agent. Conform the PVC to Federal Specification RR-F-191.

2. Vinyl coat all cut ends.

3. Conform aluminum fabric to Fed. Spec. RR-F-191.

2.3 BARBED WIRE

NOTE: Five-inch spacing is standard construction for barbs on fencing. If greater security is required, the following changes can be made:

a. Change barb spacing to three inches.

b. Delete the top tension rail and add top tension wire which will be more flexible and make climbing the fence more difficult.
Change Subsection 2.05 to read as follows:

2.5 TOP TENSION WIRE AND BRACE RAILS

A. General: Run a top tension wire of minimum 7-gauge (aluminum) (galvanized coil spring steel), (fusion color coated as specified for fabric,) continuously for each run of fence, and within the top six inches of the fence fabric. Provide brace rails at all terminal posts, located midway between the top and bottom of the fabric extend from the terminal post to the first adjacent line post. Securely fasten rails at both ends. Provide brace rails that are galvanized steel, (fusion color coated as specified for framework in Subsection 1.03 C).

B. Pipe Type: Provide brace rails that are 1-1/4-inch Schedule 40 pipe or a 1.625- by 1.25-inch roll-formed section with a minimum bending strength of 192 pounds in a 10-foot span.

A. Provide barbed wire consisting of two strands of (0.110-inch diameter wire with 0.080-inch diameter) (12-1/2 gauge galvanized steel wire with 14 gauge) 4-point round barbs spaced not more than five inches apart.

NOTE: Delete as required.

1. Provide barbed wire for vinyl coated fence, finished with color coating as specified for the fabric. Provide uncoated barbs.

2. Use Alloy 5052-H38 for aluminum wire.

2.4 TENSION WIRE

A. For the tension wire for the fence bottom use (minimum 6-gauge galvanized coil spring steel) (fusion color coated as specified for the fabric) (6-gauge alloy 6061) (minimum 7-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 fusion color coated as specified for framework in Subsection 1.03 C) (galvanized steel) (aluminum alloy Type 6063-T6).

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.) (For aluminum top and brace rails, use 1-1/4-inch, Schedule 40 pipe.)

2.6 POSTS

NOTE: Several manufacturers size gate posts according to the following schedule:

Width of Gate Leaf	Nominal Minimum Post Size	Minimum Depth into Concrete
up to 6'-0"	2-1/2-inch Schedule 40	36"
over 6'-0" to 12'-0"	3-1/2-inch Schedule 40	36"
over 12'-0" to 18'-0"	6-inch Schedule 40	48"
over 18'-0" to 23'-0"	8-inch Schedule 30	48"
over 23'-0" to 30'-0"	10-inch Schedule 30	48"

A. General: Provide all posts that are (aluminum alloy 6063-T6 conforming to Fed. Spec. RR-F-191) (galvanized steel pipe or roll-formed section) (coated as specified for vinyl coated framework, posts and hardware in Subsection 1.03 C).

NOTE: Item B for galvanized steel fences, both coated and uncoated.

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

NOTE: Delete as necessary either the columns and line items for the steel or aluminum.

C. Bending Strength (and Weight): Provide materials with the minimum bending strength (and weights for aluminum posts) based on a 6-foot cantilever for rolled formed or tube posts as follows:

	Minimum Bending Strength, lbs		Minimum Weight, lbs/ft
	Galvanized Steel	Aluminum	Aluminum
1. End, Corner and Pull Posts:			
2.875" O.D. roll formed or	444		
2-1/2-inch square tube	547		
2-1/2-inch square, heavy wall extrusion		646	2.90
2. Line Posts:			
For fences 8 feet maximum height 1.875- by 1.625-inch C-Section	245		
For fabric height to 6 feet 1.875-inch by 1.625-inch H-Section		202	0.913
For fences over 8 feet high 2.25- by 1.703-inch C-Section	347		
For fabric height to 7 feet and more 2.25-inch by 1.875-inch H-Section		325	1.22
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		
For leaves to 6 feet wide 2-1/2-inch square, heavy wall extrusion		646	2.90
For leaves over 6 feet wide to 12 feet wide 3-1/2-inch Schedule 40 pipe			3.15
For leaves over 12 feet to 18 feet wide 6-inch			6.56

Schedule 40 pipe

2.7 GATES

A. General: For the perimeter construction of gates with leaves up to 6 feet wide, use 1-1/2-inch (Schedule 40) (Schedule 40 aluminum) pipe or 1-1/2-inch square (steel tube) (aluminum tube or extrusion), and for gates with leaves greater than 6 feet wide, use 2-inch (Schedule 40) (Schedule 40 aluminum) pipe or 2-inch square (steel tube) (aluminum tube or extrusion).

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.

NOTE: Delete if not required.

C. Cantilever Sliding Gates: Furnish cantilever overhang as follows:

Gate Leaf Size	Overhang
6'-0" to 10'-0"	6'-6"
11'-0" to 14'-0"	7'-6"
15'-0" to 22'-0"	10'-0"
12'-0" to 30'-0"	12'-0"

1. For gates leaf sizes 23'-0" to 30'-0", add one additional 2-inch square lateral support rail welded adjacent to the top horizontal rail. Make the bottom rail of 2" x 4" tubing weighing 1.71 pounds per foot.

2. Provide all cantilever overhang frames having 3/8-inch (galvanized steel) (aluminum) brace rods.

3. Provide the enclosed track made of a combined track and rail aluminum extrusion having a total weight of 3.72 pounds per foot and designed to withstand a reaction load of 2,000 pounds.

4. Provide each gate leaf with two swivel type zinc die cast trucks having four sealed lubricant ball-bearing wheels, 2-inch in diameter by 9/16-inch in width, with two side rolling wheels to insure alignment of the truck in the track. Hold trucks to post brackets by 7/8-inch diameter ball bolts with 1/2-inch shank. Design truck assemblies to take the same reaction load as the track.

5. Install gates on 4-inch OD Schedule 40 (galvanized) (aluminum) posts weighing 9.1 pounds per foot. Use three posts for single slide gate and four posts for double slide gate.

6. Provide guide wheel assemblies for each supporting post. Provide each assembly consisting of two rubber wheels 4 inches in diameter attached to a post so that the bottom horizontal member will roll between the wheels which can be adjusted to maintain gate frames plumb and in proper alignment.

NOTE: Use aluminum accessories for both aluminum and vinyl coated gates.

D. Gate Accessories: Equip gates with hinges, latches, center stops, hasps, holdbacks, and padlocks. Provide hinges, latches, center stops, hasps, and holdbacks that are (aluminum) (cast iron, malleable iron, or pressed steel hot-dip galvanized after fabrication). Provide double gates with a center drop bar and gate holdbacks.

E. Latches: Provide gate latches that are positive locking, pivoting type with the padlocking arrangement accessible from either side of the gate.

F. Hinges: Hang all gates on offset hinges to permit swinging the gate through a 180-degree arc to lie, when not obstructed, along and parallel to the line of the fence.

G. Barbed Wire: Top gates with barbed wire on extension arms the same as specified for the fence.

2.8 ATTACHMENTS

A. General: Provide all attachments fabricated of (aluminum) (galvanized carbon steel) (coated to match the fabric as specified for framework, posts and hardware in Subsection 1.03, except provide aluminum hinges and latches).

B. Tension Bars: Provide 3/16-inch by 3/4-inch (galvanized carbon steel) (aluminum) tension bars attached to the terminal posts by means of beveled edge bands.

C. Truss Rods: Provide 3/8-inch diameter (aluminum) (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 (aluminum alloy 6063-T6) (galvanized pressed steel or malleable iron) to form weathertight caps for (pipe) (post or tube posts). Make provisions for installation or passage of the top rail.

E. Brace and Tension Bands: Provide (aluminum alloy 6063-T6) (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 (aluminum) (galvanized steel) rail couplings.

G. Fabric Ties: Provide (9-gauge alloy 1100-H18) (11-gauge galvanized steel) (or equal aluminum wire) fabric ties.

H. Hog Rings: Provide 11-gauge wire, aluminum alloy, Type 6061-T6 hog rings.

NOTE: Use a force of 200 pounds for aluminum wires and 250 pounds for galvanized steel arms.

I. Extension Arms: Provide (galvanized pressed steel) (aluminum alloy 6063-T6) extension arms for supporting the barbed wire. Design the arms with an adequate cross section to withstand without failure or permanent deflection a perpendicular force of (200) (250) pounds applied at the end of the arm when the arm is securely attached to the post. Construct extension arms to be slanted out.

NOTE: Delete if not appropriate.

1. Provide aluminum arms conforming to Fed. Specs. RR-F-191.

2. Provide Vee-type arm at 45 degrees to vertical with a vertical height approximately one foot above the top of the fabric, one for each post.

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 (using post hole digger) 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. Barbed Wire: Firmly install the barbed wire in slots in the extension arms, anchored to the terminal extension arms after removal of all sag from the wire.

D. 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.

E. 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.

2. Where aluminum is in contact with concrete, coat the aluminum as specified in Section 09 90 00.

F. Fabric Ties: Space fabric ties approximately 14 inches apart on the line posts and 24 inches apart on the rails. (For clips used with C-section posts, use galvanized 11-gauge steel wire.)

G. 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.

H. 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.

NOTE: Use barbed tape only for high security enclosures.

I. Barbed Tape: Install barbed tape in configurations indicated in accordance with manufacturer's recommendations and securely fasten to fencing to prevent movement or displacement.

NOTE: Delete Subsection 3.2 if not needed.

3.2 GALVANIZING

A. Provide galvanizing meeting the requirements of Section 05 50 01.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 32 90 01

LANDSCAPING WORK

PART 1 GENERAL

NOTE: Edit as required for items in project. Check related sections.

1.1 SUMMARY

A. Section Includes: Soil, soil preparation, soil tests, excavation, planting, seeding, sodding, pruning, edging, fertilizing and maintenance.

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 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM C 33 - Specification for Concrete Aggregates

1.3 SUBMITTALS

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

B. Soil Tests: Submit soil test results.

C. Maintenance Instruction Manual: Upon completion of the landscaping work and prior to final payment, furnish a landscaping maintenance manual. Include complete and detailed instructions on the recommended maintenance procedure to be followed for maintaining lawns and each species of plant material. Include a schedule of all planted and seeded materials and all pertinent growing and maintenance information and requirements for watering, fertilizing, lime applications, spraying, cultivating, pruning and weed control.

NOTE: Add specific information on delivery, storage and handling as required.

1.4 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

B. Top Soil: Deliver top soil in a dry state without enough moisture to allow it to be packed or squeezed into a ball.

NOTE: Include the following to the next sentence for balled plants in the southwest region. "In hot weather, maintain stock in a shade house for a minimum of one week to allow plants to recover from digging shock."

C. Balled and Bare Root Plants: Immediately after delivery, set all balled plants on the ground with the balls well protected with soil. Water and properly maintain all plants until planting. Plant or heel in bare rooted plants which cannot be planted immediately upon delivery. No materials heeled in for more than a week may be used. Before the roots are covered, open bundler and separate the plants.

D. Grass Seed: Deliver grass seed in standard size bags of the vendor, showing weight, analysis and name of vendor. Store the seed so as not to impair its effectiveness.

E. Sod: Deliver sod to the site in fresh condition and within two days of the time it has been dug.

F. Fertilizer: Deliver fertilizer mixed as specified, in standard size bags, showing weight, analysis and the name of the manufacturer. Store the fertilizer in a weatherproof storage place in a manner that will keep it dry without affecting its effectiveness.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Seeding and Sodding: Sow grass seed between August 15th and October 15th unless sowing between March 15th and June 1st is permitted. Sow seed when the wind velocity is below 5 mph. Place sod between August 15th and October 15th or between March 15th and June 1st, or during the season or seasons which are normal for such work as determined by weather conditions and accepted practice in the locality and as approved.

NOTE: Planting times may vary with project location. Edit as required.

B. Planting: Unless otherwise directed, plant deciduous material from March 1st to June 1st and from September 1st to December 1st. Plant

evergreen material from April 1st to June 1st and from September 1st to November 1st.

1.6 WARRANTY

A. General: Apply the warranty to all seeded, sodded and planted areas. Have the warranty period commence after the final acceptance of all landscaping work exclusive of all replacement plant materials.

B. Plant Material: Warranty plant materials for a period of one year.

C. Seeded Areas: Warranty seeded lawn areas to the time of establishment of an acceptable uniform stand of grass.

D. Sod: Warranty sod to 30 days following the first cutting.

1.7 MAINTENANCE

A. General: Maintain all seeded, sodded and planted areas during the warranty period.

B. Grass Areas: Maintain all seeded and sodded areas to well establish a uniform stand of weed-free grass. Reseed or resod areas failing to develop a uniform stand.

C. Trees, Shrubs and Ground Covers: Cultivate trees, shrubs and ground covers and weed and water when necessary, but not less than twice a month, to prevent plant material from dying. Replace any plant material which is found to be dead or dying during the warranty period to original specifications upon request. Include the full cost of replacing dead or dying plant material in the Contract Amount. No separate payment will be made for replacements. Maintain plant material to be alive, in good growing condition and free of weeds.

D. Replacement: Replace plant material and resod or reseed only during the specified planting seasons and warranty the replacement material for the same period of time as the original material.

PART 2 PRODUCTS

2.1 SOIL

A. Topsoil: Provide a natural friable top soil of the region, rich in organic matter, without any material toxic to plant growth and of uniform quality, free of large roots, sticks, hard clay, weeds, brush, stones over 1-inch in maximum dimension or other litter or waste products. Provide topsoil containing no decomposed stone, salts or alkali, and not less than 15 parts per million of available nitrates, 3 parts per million of available phosphorus, 15 parts per million of potash, and having a pH of not less than 6.0 nor more than 7.2 at a depth of 8 inches below the surface of the field from which it is removed. Provide topsoil with a mechanical analysis as follows:

Sieve	Percentage Passing
1 inch	100
1/4 inch	97-100
No. 100	40- 60

B. Planting Soil: Prepare planting soil by mixing 10 parts of topsoil with fertilizer and 1 part of peat moss.

2.2 GRASS SEED AND SOD

NOTE: Mixture shown is for midwest and northeast areas. Consult USDA "Regions of Grass Adaptions" map and local county or state agricultural agency for recommended components and percentages for all other areas and edit as required.

A. Grass Seed: Provide a fresh, clean, new crop of grass seed composed of 35 percent Pennlawn Fescue and 15 percent Red Top and 50 percent Improved Kentucky Blue Grass. Provide seed components free of noxious weed seeds and having not less than the following purity and germination:

Component	Percent Purity	Percent Germination
Pennlawn Fescue	95	85
Improved Blue Grass	85	75
Red Top	75	70

Tag each sack in accordance with the agricultural seed laws of the United States and the State of (_____). Show on each tag the producer's guarantee as to the year grown, the percentage of purity, the percentage of germination and the tests by which the percentages were determined. Provide seed for this project having a test date within 6 months of the date of sowing.

B. Sod: Provide nursery-grown Improved Kentucky Blue Grass sod, free of weeds, a minimum of 1-inch thick of dense growth and cut with sharp edges in 18-inch widths and not less than 3 feet long. Sod which has been grown on peat or which has been dug more than two days previous to delivery or which has been allowed to have the roots dry out or on which the grass has turned brown will not be accepted.

2.3 PLANT MATERIALS

A. General: Provide plant materials that are true to species or variety, sound, healthy, vigorous acclimated plants free from defects, disfiguring knots, sun-scaled injuries, abrasions of the bark, plant diseases and insect eggs, borers and all other forms of infestations. Provide material that has normal, well-developed branch systems and vigorous root systems and that is freshly dug, nursery-grown stock grown under the same climatic conditions as the Project location. Provide material grown under climatic conditions similar to those in the locality of the project for at least 2 years and transplanted or root pruned at least in the last 3 years.

B. Plant Size: Dimension a plant as it stands in its natural position. Measure trees under 4 inches in caliper at a point 6 inches above the ground and trees more than 4 inches in caliper at a point 12 inches above ground. Provide the stock of a fair average of the minimum and maximum sizes specified. Do not cut back large shrubs to sizes specified.

C. Balled, Burlapped and Platformed Plants: Dig balled and burlapped, as well as balled and platformed, plants with sufficient roots and a solid ball of earth securely held in place by burlap and stout natural fiber rope. Manufactured balls are not acceptable. Provide balled and platformed plants with sturdy platforms of a size equal to the diameter of the horizontal midsection of the ball of earth.

D. Bare-Rooted Plants: Dig bare-rooted plants with sufficient root spread and depth to ensure full recovery and development of the plants. Cover

roots for these plants with a uniformly thick coating of mud by being puddled immediately after they are dug.

NOTE: Request inspection of plant material at the place of growth for large planting projects.

E. Inspection: Submit plants to inspection for approval at the place of growth, for conformity to specification requirements as to quality, size and variety. In addition to the place of growth inspection, submit plants to inspection for approval upon delivery at the project site or during the progress of the work, for size and condition of balls or roots, diseases, insects, and latent defects or injuries. Remove rejected plants immediately from the site. Do not substitute plants for those specified unless approved.

2.4 COMMERCIAL FERTILIZER

NOTE: Percentages of nitrogen, phosphorus pentoxide and potash are determined by the soil test information as recommended by local county or state agricultural agency for local conditions and desired early rate of growth.

A. Provide all commercial mixture fertilizer uniform in composition, free flowing, conforming to state and federal laws and suitable for application with equipment designed for that purpose. Provide fertilizer with organic, inorganic or combined elements with the following composition by weight:

1. Nitrogen (_____) percent
2. Phosphorus pentoxide(_____) percent
3. Potash (_____) percent

2.5 ACCESSORIES

A. Tree Wrap: Provide new, clean, plain, 8-ounce weight burlap material 6 inches wide for wrapping tree trunks.

B. Weed Barrier Fabric: Provide Pro-5 fabric as manufactured by the DeWitt Co., or equal.

C. Gravel: Provide smooth river bed gravel of solid or mixed color range to be as selected and meeting the requirements of ASTM C 33 and graded according to Size No. 467, Table II.

D. Mulch: Provide ground corn cobs, wood chips, tree barks, buckwheat hulls or other approved materials for mulch.

E. Edging: Provide commercial hot-rolled steel edging plate, 4 inches wide and 1/8-inch thick. Fabricate edging in sections with loops pressed from or welded to the face of sections at 30-inch centers to receive 16-inch long tapered steel stakes. Provide edging finished with the manufacturer's standard paint.

2.6 TESTS

A. Sample: Submit a 10-ounce sample of the proposed topsoil to a testing laboratory in sealed containers to prevent contamination.

B. Analysis: Analyze the topsoil sample to determine the amount of lime necessary and the appropriate fertilizer mix and quantity required for planting, seeding and sodding.

PART 3 EXECUTION

3.1 GRADES

A. General: Existing and final contours shown depict finished grades after completion of landscaping work.

B. Lawn Grades: Grade lawns to meet walks, curbs and adjoining surfaces after uniform settlement of surfaces. Correct water pockets or ridges which appear after surface settlement takes place on or before the end of the guarantee period.

3.2 EXCAVATION FOR PLANTING

A. General: Obtain approval for all plant locations before excavation. Remove from the site all material that is surplus and unsuitable for backfill.

B. Ground Cover and Grass Areas: Excavate for ground cover and grass areas to the required depths for grass to receive 6 inches of topsoil and for groundcover to receive 6 inches of planting soil.

C. Plant Pits: Excavate plant pits with vertical sides and a circular outline.

1. Dig tree and evergreen pits at least twice the diameter of the ball, and deep enough to permit an 8-inch layer of compacted planting soil beneath the ball.

2. Dig shrub pits a minimum of twice the diameter of the ball and deep enough to allow 6 inches of compacted planting soil beneath the ball.

D. Drain: Install french drains for all trees, ornamental trees, and evergreens planted on berms and other locations where the grade permits, from bottom of planting pit to the finished grade with a trench 9 inches wide, filled with a 6-inch thick layer of 3/4-inch washed gravel. Cover the gravel layer with a filter mat before backfilling the trench with soil.

3.3 SOIL CONDITIONING

A. Disking: Before the application of topsoil, sodding or seeding, disk the area to be seeded, sodded or planted with groundcover to a depth of 6 inches. Continue the disking until the subsoil surface is sufficiently broken to provide a good bond between subsoil and topsoil. Spread 6 inches of planting soil over the disked area to a uniform depth and density.

B. Ground Limestone: Incorporate ground limestone, if required by the results of the soil test report, into the upper 3 inches of planting soil. Uniformly spread fertilizer and mix into the soil to a depth of 1-1/2 inches or as recommended by the manufacturer.

3.4 SEEDING AND SODDING

A. Seeding: Sow seed at the rate recommended by the seed producer. Evenly rake the surface after seeding with a fine-tooth rake. Mulch all newly seeded areas and cover with a minimum of 1/4-inch of straw or hay, approximately at the rate of 1 bale per 1,000 square feet, then thoroughly wet.

B. Sodding: Lay sod in such a manner that the surface is smooth and even and all edges abut one another tightly. Water and roll sod so that a bond is produced between the prepared topsoil and the sod. On slopes greater than 3 to 1, stake installed sod with approved wooden sod stakes at a minimum rate of three stakes per square yard of sod.

3.5 PLANTING

A. Layout: Outline locations for trees, shrubs, evergreens and bed and stake for approval. Obtain location approval prior to commencing planting operations.

B. Setting Plants: Set plants plumb and straight with the crown at finished grade. Compact soil around the base of the ball, and fill the void 3/4 of the way up from the bottom. Water each plant immediately. After the water has completely drained, fill the plant pits to finished grade. Properly spread out roots of bare root plants and carefully work topsoil among them. Cut off any broken or frayed roots with a clean cut. Form a shallow basin, the size of the ball with a ridge of soil to facilitate watering. After that operation is completed, apply a second watering immediately. Finish all planting pits and beds within a period of 3 days following installation. Construct tree saucers, cultivate and outline planting pits with a neat edge, when necessary.

C. Mulching: Immediately after planting operations are completed, cover all tree and shrub pits with mulch to a minimum depth of 2 inches. Limit mulch for trees to saucer diameter and, for shrubs, the entire shrub bed.

D. Pruning: Prune each tree and evergreen with clean, sharp tools in accordance with standard horticultural practice to preserve the natural character of the plant. Remove suckers and all dead, broken or badly bruised branches.

E. Wrapping: Wrap the tree trunks of all trees with burlap tree wrapping securely tied with suitable cord at top and bottom and at 2-foot intervals along the trunk. Overlap the wrapping 2 inches top and bottom and entirely cover the trunk from the ground to the height of the second branch, neat and snug.

F. Guying: Guy trees as necessary to be plumb and straight through final inspection. Remove guy wires at completion of project.

G. Watering: During planting, thoroughly saturate the soil around each plant with water and as many times later as seasonal conditions require until the end of the guarantee period.

3.6 EDGING

A. General: Establish a neat edge where planting areas meet grass areas, with spade or edging tools, immediately after all planting and seeding is completed. Establish good flowing curves as shown. Maintain edging until the end of the guarantee period.

3.7 GRAVELED AREAS

A. General: Lay a weed barrier in accordance with the manufacturer's recommendations and top with a 4-inch layer of gravel. Edge graveled areas with metal edging.

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 no 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 01 33

SMOKE TESTING OF WASTEWATER COLLECTION SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Work specified herein:

Furnishing all labor, tools, test equipment and materials, including permits, required to smoke test and video tape the designated systems. CONTRACTOR shall provide all labor and materials for notices and notifications to affected customers, and appropriate public and/or private agencies.

B. Related work specified elsewhere:

1. Section 33 01 36 - Televising and Inspection of Gravity Sewer Systems

1.2 QUALITY ASSURANCE

A. CONTRACTOR shall provide a minimum of three references proving competence in the field of smoke testing.

B. CONTRACTOR shall do all testing with ENGINEER present, unless prior written approval is obtained from the OWNER. CONTRACTOR shall confirm with ENGINEER all notifications of appropriate agencies in writing.

C. Equipment used shall be in good working order and provide continuous operation during testing.

D. All smoke bombs used shall not be more than 6 months old and have been stored according to the manufacturer's specifications.

1.3 SUBMITTALS

A. CONTRACTOR shall submit to the OWNER a list of equipment and materials to be used on the project including all permits obtained prior to commencing with the testing.

B. CONTRACTOR shall submit to the OWNER a sample of the notifications for review, testing log reports, and videotaping methods.

PART 2 PRODUCTS

2.1 SMOKE BOMBS

A. Smoke Bombs shall be manufactured by Superior Signal Company, Inc., W. Greystone Road, Spotswood, New Jersey (Phone: (908) 251-0800), or approved equal.

PART 3 EXECUTION

3.1 NOTIFICATIONS

A. CONTRACTOR is responsible for and shall notify all agencies involved (fire department, police, etc.) and notify all affected homeowners. In the test area, homeowners shall be notified in the following manner:

1. 48 Hour Notification - Door Hangers
2. Verbal notification to homeowner and the leaving of notices explaining smoke testing, time, and dates.

Fire Department, Police Department, and any other public agencies shall be notified in the following manner:

3. 48 hours prior to any work they shall be given a written itinerary indicating dates and locations in which work will be done in for the complete project.
4. 24 hour verbal notice of where the CONTRACTOR will be working.
5. Verbal notification at the start of each day the specific areas in which the CONTRACTOR will be working in.

B. All notification shall be done and reviewed with ENGINEER prior to commencing work. CONTRACTOR is liable for any and all expenses incurred by improper notification of local, county, state or federal agencies.

3.2 SMOKE TESTING OF SYSTEMS

A. The CONTRACTOR shall smoke test all sections of the specified collection systems. Smoke testing shall test no more than two (2) consecutive sections at one time.

B. CONTRACTOR shall only work on dry weather days. Under no circumstances shall smoke testing be done under rainy conditions. Delays/postponements due to rain are the CONTRACTOR's responsibility and no additional payment will be made for these delays.

C. Smoke blowing machine shall be capable of a minimum of 1700 cubic feet per minute. Smoke blower shall create a complete seal around the manhole into which it is discharging. Blower shall operate continuously prior to, during, and until the test is

complete. If blower ceases operating during the test, the CONTRACTOR shall retest that section at no additional cost to the OWNER.

D. CONTRACTOR shall use a minimum of two (2) 3-minute bombs for every two (2) manhole segments of pipe. If only one segment is tested then only one (1) 3-minute bomb is required. Smoke bombs shall be suspended above the bottom of the manhole by quick clips or a perforated bucket. All smoke bomb debris shall be removed from the manhole and site after the test is complete. If a smoke bomb fails to ignite, the CONTRACTOR shall retest the sections at no additional cost to the OWNER.

E. CONTRACTOR shall seal upstream and downstream manholes of test area. Sealing procedures shall be approved prior to smoke testing. NASSCO standards for smoke testing shall be followed.

3.3 VIDEO RECORDING OF SMOKE TESTING

A. CONTRACTOR shall video, all areas during smoke testing. CONTRACTOR shall indicate in video the address and location of damage and all recorded smoke discharges.

B. Each sewer pipe system will have its own video recording. Videos shall be labeled with the following information:

1. Sewer System Tested (street name and manhole to manhole numbers)
2. Date Tested
3. CONTRACTOR Name and representative
4. OWNER's name and ENGINEER

C. All videos shall be backed up electronically after they are completed. ENGINEER shall be present during smoke testing and approve all video recording techniques. Recording shall be complete and to the satisfaction of the ENGINEER.

D. Video format shall be specified by the ENGINEER.

3.4 FINAL REPORT

A. CONTRACTOR shall supply a final report, containing the following information as a minimum:

1. Dates of tests and locations by street names, manhole numbers, and division name in which smoke testing was performed.
2. Locations of all suspected problems identified by the testing. These locations shall be referenced to the videotape using manhole number and customer address.
3. Any incidents with customers, local and state agencies.

4. List of equipment used.

B. CONTRACTOR shall supply three (3) originals of the final report. The final report shall be typewritten and bound in a professional manner.

3.5 MAINTENANCE OF TRAFFIC

A. CONTRACTOR is responsible for all maintenance of traffic around work site. CONTRACTOR shall maintain traffic in accordance to all federal, state and local regulations. At no additional cost to OWNER, CONTRACTOR shall submit a Maintenance of Traffic Plan, for review and approval by LCDOT as necessary, prior to commencing work. CONTRACTOR shall also obtain all necessary permits prior to commencing work, at no additional cost to the OWNER.

B. MOT shall also include construction and maintenance of any necessary detour facilities, furnishings, installing and maintaining of traffic control and safety devices during construction, control of dust, and any other special requirements for safe and expeditious movement of traffic around or through the work site.

C. The CONTRACTOR shall be responsible for coordination with Lee County sheriff's department, fire department, public service, LCDOT, Lee County school board, and other affected agencies when roadways will be closed or traffic will be detoured. No detours or roadway closings shall be permitted unless specifically approved in writing by the OWNER or ENGINEER.

3.6 LIABILITY FOR SMOKE DAMAGES

A. CONTRACTOR is responsible for any and all smoke damage and/or injury done during testing. CONTRACTOR shall provide damage and liability insurance per the Supplementary Conditions of the Contract. CONTRACTOR shall also indemnify and hold harmless the OWNER in the event of any smoke damage and/or any damage or injury related to or caused by the smoke testing.

END SECTION

SECTION 33 01 36

TELEVISING AND INSPECTION OF GRAVITY SEWER SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Work specified herein:

Furnish all labor, tools, test equipment and materials, including any and all permits required to televise, inspect, video tape, still photograph and document the gravity wastewater collection systems.

1.2 QUALITY ASSURANCE

A. The CONTRACTOR shall provide a minimum of three (3) references proving competence in the field of TV/video inspection of wastewater collection systems.

B. CONTRACTOR shall do all work with the ENGINEER present. CONTRACTOR shall schedule all work with ENGINEER.

C. Equipment used shall be in good working order and provide continuous operation during video inspection.

D. Video shall be of good visual quality capable of slow motion and pausing without significant reduction of visual quality.

1.3 SUBMITTALS

A. CONTRACTOR shall submit to the OWNER a list of equipment and materials to be used on the project, including all permits obtained prior to commencing with the Work.

B. CONTRACTOR shall submit to the OWNER a copy of all television inspection log sheets and video recordings completed.

PART 2 MATERIALS

2.1 GENERAL

A. Equipment used shall be designed for use in gravity wastewater collection systems. CONTRACTOR has the option of an approved equal device or other material than that which is specified. Submittals are required prior to commencement of work.

2.2 TELEVISION CAMERA

A. Camera used shall be 360 degree camera. Camera shall be operative in 100% relative humidity and be specifically designed for the environment. Camera shall have an integral lighting system capable of producing clearly focused, well defined images of the entire periphery of the pipe. The quality of video picture and definition provided shall be to the satisfaction of the ENGINEER and, if unsatisfactory, equipment shall be removed and replaced with satisfactory equipment.

2.3 MONITOR

A. A high resolution TV monitor screen shall be used. Quality of monitor shall be to the satisfaction of the OWNER.

2.4 RECORDING EQUIPMENT

A. Recording equipment shall be furnished by the CONTRACTOR to provide a visual and audio recording of all areas in the pipe. Recording system at the site shall be capable of rewind, play back, slow motion and stop motion. The recording shall contain an audio channel for clearly recording the camera locations and operator observations (cracks, leaks, service connections, etc.). The system shall continuously indicate distance, in feet, from manhole to manhole and the manhole to manhole run numbers on the recording.

2.5 WINCHES

A. Variable speed powered remote controlled winches shall be furnished for upstream and downstream manhole locations to control two-way movement of the camera. If a self-propelled camera is used, winches are not necessary.

2.6 POWER SUPPLY

A. Power supply shall be continuous. If night operations occur, CONTRACTOR shall supply all labor, power and lighting equipment for operations, traffic safety, permits, etc.

PART 3 EXECUTION

3.1 GENERAL

A. All sanitary sewer gravity lines shall be televiewed at the CONTRACTOR's expense; and a videotape of the subject mains provided prior to acceptance by Lee County Utilities. Televiewing may only occur after the stabilized subgrade has been installed and satisfactory density tests has been submitted to Lee County Utilities. A Lee County Utilities representative must be present during the televiewing. The sewer video inspection shall include rotating the camera lens to inspect the interior of each

sewer lateral. Additionally, the CONTRACTOR shall provide by tabular form utilizing "Remote Televiewing Form" (see Lee County Utilities Design Manual).

B. The CONTRACTOR shall demonstrate the ability of the video equipment (camera/light/video tape/audio/ photograph system) to the satisfaction of the OWNER. Distance meter shall be furnished on the recording. Meter shall be checked using distances between manholes. Meter distances and actual distances shall be consistent.

3.2 TELEVISING/INSPECTION

A. Inspection shall be done one manhole section at a time. Flow into the section being inspected shall be stopped prior to video inspection, unless otherwise approved in writing by the OWNER. CONTRACTOR shall not begin inspection without the ENGINEER present unless prior written approval is obtained from the OWNER.

B. CONTRACTOR shall locate recording vehicle on upstream side of manhole. CONTRACTOR shall always record in the downstream direction such that camera movement is with the flow.

C. CONTRACTOR shall insert the camera in the upstream manhole after flow restrictions required have been accomplished. Flow into the system being inspected shall be stopped, with the exception of service laterals into the system being inspected. Camera shall be moved through the pipe lines at a moderate speed not exceeding 30 feet per minute. Camera shall be stopped at locations where one or more of the following conditions is observed:

1. Infiltration/inflow sources.
2. Service Laterals.
3. Structural defects including broken pipe; collapsed or collapsing pipe, cracks, deterioration, punctures, etc.
4. Abnormal joint conditions such as misalignments, open joints and joints not sealed.
5. Unusual conditions such as root intrusion, protruding pipes, in-line pipe size changes, mineral deposits, grease and obstructions.

D. Camera shall be stopped long enough for a thorough visual inspection of the conditions. All such conditions as specified above shall be audio recorded on video tape and the inspection log sheet. The camera shall be moved and rotated to obtain optimum view of the conditions. If requested by the OWNER's representative, problem areas shall be viewed in the opposite direction by pulling the TV camera from the opposite direction at no additional cost to the OWNER.

E. While the camera is stopped at each service connection, the camera shall be rotated so as to be able to view the service connection for a length of time that enables a good visual inspection of the service connection for damage and infiltration. The

CONTRACTOR will be responsible for measurements such as service lateral locations, if used for subsequent rehabilitation work.

F. When, during the inspection operation, the television camera will not pass through the entire manhole to manhole section, CONTRACTOR shall set up his equipment so that the inspection can be performed from the opposite manhole at no additional cost to the OWNER.

3.3 DOCUMENTATION

A. CONTRACTOR shall furnish a detailed report and video recording of the system inspected. The minimum information supplied shall be the following:

1. Name and address of CONTRACTOR and the ENGINEER.

2. Name of OWNER, system(s) inspected, and OWNER's representative involved.

3. Log reports:

a. Log sheet for each section of pipe
b. Separate line for each deficiency and location
c. Corresponding video recording and location of each section of pipe and deficiencies on the video.

4. Video recordings shall be labeled with the following information:

a. System that is video recorded(street name and manhole to manhole numbers) and log report number corresponding to video recording
b. Date video was recorded
c. CONTRACTOR's name and representative
d. OWNER's name

B. All video recordings shall be backed up electronically after they are completed.

3.4 MAINTENANCE OF TRAFFIC

A. CONTRACTOR is responsible for all maintenance of traffic around work site. CONTRACTOR shall maintain traffic in accordance to all federal, state and local regulations. At no additional cost to OWNER, CONTRACTOR shall submit a Maintenance of Traffic Plan, for review and approval by LCDOT as necessary, prior to commencing work. CONTRACTOR shall also obtain all necessary permits prior to commencing work, at no additional cost to the OWNER.

B. MOT shall also include construction and maintenance of any necessary detour facilities, furnishings, installing and maintaining of traffic control and safety devices

during construction, control of dust, and any other special requirements for safe and expeditious movement of traffic around or through the work site.

C. The CONTRACTOR shall be responsible for coordination with Lee County sheriff's department, fire department, public service, LCDOT, Lee County school board, and other affected agencies when roadways will be closed or traffic will be detoured. No detours or roadway closings shall be permitted unless specifically approved in writing by the OWNER or ENGINEER.

END OF SECTION

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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.

1. Test gravity sewers and drain lines by low pressure air testing.

2. Test all other pipelines with water under the specified pressures.

B. 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. Make an inspection 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 02

ROADWAY CROSSINGS BY OPEN CUT

PART 1 GENERAL

1.1 SCOPE OF WORK

The CONTRACTOR shall provide all labor, materials, equipment, supervision and incidentals required to install the pipeline as shown on the Drawings in Lee County Streets by method of open cut.

1.2 SUBMITTAL

A. Submit shop drawings to the ENGINEER for review.

B. CONTRACTOR shall adhere to the requirements of Section 01 55 26.

C. The CONTRACTOR shall engage the services of a Professional Engineer who is registered in the State of Florida to design all cofferdam and sheeting and bracing systems which the CONTRACTOR feels necessary for the execution of his work. The CONTRACTOR's Engineer shall submit to the ENGINEER a signed statement that he has been employed by the CONTRACTOR to design all sheeting and bracing systems. After the systems have been installed, the CONTRACTOR's Engineer shall furnish to the ENGINEER an additional signed statement that the cofferdams and sheeting and bracing systems have been installed in accordance with his design.

D. If a detour is required, a traffic control plan shall be submitted for approval to Lee County, municipalities and/or the Florida Department of Transportation.

E. A plan for maintenance of traffic in accordance with Index 600 through 650 of the Florida Department of Transportation Specifications shall be submitted by the CONTRACTOR.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall meet those specified in other applicable portions of this Specification.

PART 3 EXECUTION

3.1 GENERAL

A. Trench dimensions for open cutting of road crossings are shown on the Drawings.

B. The CONTRACTOR will be limited to a 24-hour period to complete the open-cut crossing. The road surface shall be repaved, with temporary pavement, if necessary, at the end of the 24-hour period.

C. The CONTRACTOR shall notify Lee County DOT forty-eight (48) hours in advance of starting construction.

3.2 INSTALLATION

A. Temporary Roadways

1. Temporary roadways required for traffic relocation shall be constructed of materials meeting the requirements of the FDOT. Temporary roadways shall be used when crossing a state highway right-of-way or at the direction of the ENGINEER.

2. Temporary roadways shall be maintained in good condition throughout their use.

3. Drainage shall be maintained through all existing ditches by the use of culvert pipe as necessary.

4. Drawings indicating the type and location of temporary roadways shall be submitted as discussed in Paragraph 1.04.C. for approval prior to beginning work.

5. Where detours are permitted, the CONTRACTOR shall provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the CONTRACTOR shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the ENGINEER.

6. Lee County DOT will inspect all work being done.

7. All work at the roadway crossing shall be performed and completed in a manner fully satisfactory to Lee County DOT.

B. Maintenance of Traffic

1. The requirements specified herein are in addition to the plan for Maintenance of Traffic as specified in Sections 01 31 13 and 01 55 26.

2. The CONTRACTOR shall furnish during construction and any subsequent maintenance within State secondary road right-of-ways and Lee County streets, proper signs, signal lights, flagmen, and other warning devices for the protection of traffic all in conformance with the latest Manual on Uniform Traffic Control and Safe Streets and Highways, and the Florida Manual of Traffic Control and

Safe Practices for Street and Highway Construction, Maintenance and Utility Operations. Information as to the above may be obtained from FDOT Division engineers. The ENGINEER, County Engineer, or FDOT Manager of the right-of-way of their representatives reserves the right to stop any work for non-compliance.

3. The CONTRACTOR shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The CONTRACTOR shall be fully responsible for damage or injuries whether or not police protection has been provided.

4. Unless permission to close a County street is received in writing from the proper authority, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the CONTRACTOR's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the ENGINEER.

5. The CONTRACTOR shall be fully responsible for the installation of adequate safety precautions, for maintenance of the channelization devices, and for the protection of the traveling public.

6. At all open cut crossings, a minimum of one-way traffic shall be maintained during the daylight hours, and two-way traffic at night.

C. Installation of Pipeline

1. Pavement removal, sheeting, shoring and bracing, excavation and backfill, and dewatering shall meet the requirements of the applicable portions of this Specification.

2. The pipe shall be installed in accordance with these Specifications.

3. The trench shall be backfilled in accordance with the requirements of Section 31 23 23.

4. Pavement replacement shall be in accordance with Section 32 10 01 of this Specification.

END OF SECTION

(NO TEXT FOR THIS PAGE)

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 01 - Polyvinyl Chloride (PVC) Water Main Pipe
5. Section 33 11 02 - High Density Polyethylene (HDPE) Pipe and Fittings
6. Section 33 11 03 - Ductile Iron Pipe and Fittings
7. Section 33 11 12 - Disinfection
8. Section 33 31 01 - Polyvinyl Chloride (PVC) Gravity Sewer Pipe
9. Section 33 31 02 - Buried Fiberglass Reinforced Plastic (FRP) Gravity Sewer Pipe
10. Section 33 34 01 - Polyvinyl Chloride (PVC) Force Main 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: Rebed, 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 fingertight.

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 05 13

SEWER MANHOLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing sewer manholes and all other appurtenances for a complete installation. Provide manholes built without steps and in accordance with the standard details shown in Section 6 of the Lee County Utilities Operations Manual. Except as otherwise specified, construct sewer manholes of precast reinforced concrete sections conforming to ASTM C 478.

B. Related Work Specified in Other Sections Include:

1. Section 33 05 14 – HDPE Concrete Protective Liner
2. Section 33 05 15 – Fiberglass Reinforced Plastic (FRP) Concrete Protective Liner
3. Section 09 96 35 – IET Coating System
4. Section 05 56 00 – Metal Casings
5. Section 02604 – Raven Coating System

1.2 REFERENCE

A. Codes and standards referred to in this Section are:

1. ASTM C 478 - Specification for Precast Reinforced Concrete Manhole Sections

2. ASTM A 48 - Standard specification for gray iron castings

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings of sewer manholes as specified in Division 1.

B. Quality Control: Submit shop and field test reports of concrete samples tested in an approved laboratory.

1.4 DELIVERY, STORAGE AND HANDLING

A. General: Take every precaution to prevent injury to the manhole sections during transportation and unloading. Unload manhole sections using skids, pipe hooks, rope slings, or suitable power equipment, if necessary, and keep the sections under control

at all times. Do not allow the manhole sections to be dropped, dumped or dragged under any conditions. Follow applicable requirements specified in Division 1.

B. Damaged Section: If any manhole section is damaged in the process of transportation or handling, reject and immediately remove such sections from the site, and replace the damaged manhole sections at no increase in Contract Amount.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. For acceptable manufacturers, see the LCU Approved Materials List.

2.2 MATERIALS

A. Concrete, Steel Reinforcement and Aggregates: Provide reinforced concrete, cementitious materials, aggregates and steel reinforcement conforming to the requirements of ASTM C 478, with Grade 40 reinforcement bars, Type II cement, and a minimum wall thickness of 8 inches.

B. Manhole Frames and Covers: Provide manhole frames and covers as shown on the Lee County Standard details. Castings for manhole frames, covers and other items shall conform to the ASTM Designation A48, Class 35B. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects in positions which would impair their strength, or otherwise make them unfit for the service intended. The scating surfaces between frames and covers shall be machined to fit true so the frames and covers do not shift under traffic conditions or permit entry of storm water from flooding. Lifting or “pick” holes shall be provided, but shall not penetrate the cover. The words SANITARY SEWER, as well as LEE COUNTY shall be cast in all manhole covers. All manhole frames and covers shall be traffic bearing unless otherwise specified. Frames and covers shall be fully bedded in mortar in the correct finish grade elevation with adjustment brick courses or concrete grade rings installed in conformance with the Lee County Utilities Operation Manual.

C. Preformed Joint Sealing Compound: Provide preformed joint sealing compound for joining manhole sections.

D. Concrete Protective Liner: Provide concrete protective liner conforming to Sections 33 05 14, 33 05 15, or 09 96 35.

E. Pipeline Connections: Provide neoprene boots with type 316 stainless steel clamps of a design approved by Lee County Utilities for joining sewers to manhole riser sections. The unfilled portion of the connection shall be filled with a plastic joint sealing compound (see LCU Approved Materials List).

F. Inflow Protectors: All manholes under non-traffic bearing areas shall have a plastic inflow protector installed. All manholes under traffic bearing areas shall

have an inflow protector installed manufactured from a high-quality 304 stainless steel with a consistent thickness of not less than 18 gage. The inflow shall have a deep-dish bowl design with no less than 8 inches in depth to allow easy and unobstructed removal of the manhole cover. The manhole inflow protector is to be manufactured with a one-piece rubber gasket installed at the factory for a tight, consistent fit. The rubber gasket is to be designed to securely wrap around the entire leading edge of the inflow protector at the point where it comes in contact with the manhole frame and cover. The wrap around rubber gasket is to be manufactured to a width of no less than 3/8 inches, consistent on top and bottom of the leading edge of the inflow protector. The gasket shall be no more than 3/32 inches thick. The insert removal handle shall be manufactured of a high-quality stainless steel for strength and durability. The handle is installed in such a way that it does not interfere with the installation or removal of the manhole lid. The insert handle will be manufactured to withstand a minimum pull force of 500 pounds before it fails or separates from the insert. The inscription “PROPERTY OF LEE COUNTY UTILITIES” shall be etched, at the base of the handle frame, to provide a long-lasting identification marker for the owner. The inflow protector shall be from the LCU Approved Materials List.

G. Master Manholes: Master manholes shall have a double cover with an outer 35-inch opening and a smaller inner 22-1/4-inch access cover and shall be constructed in accordance with the Lee County Standard Details. The double manhole rings and covers shall be from the LCU Approved Materials List. The connecting gravity sewer between the master manhole and the wet well shall be PVC C900 SDR 18 pipe material. For manholes receiving flows from 16-inch or larger pipe, a six-feet diameter master manhole will be required.

2.3 SOURCE QUALITY CONTROL

A. At least three cylinders will be taken each day that manhole sections are cast, with batch samples to be designated by the laboratory representative. At least one set of cylinders will be taken from each 9 cubic yards of concrete used in manhole section construction. These samples will be tested for strength. If the samples fail to meet specified minimum concrete strength requirements, all manhole sections manufactured from the concrete from which the cylinders were made will be rejected.

B. The OWNER reserves the right to core manholes either at the job site or point of delivery to validate strength of concrete and placement of steel. If cores fail to demonstrate the required strength or indicate incorrect placement of reinforcing steel, all sections not previously tested will be considered rejected until sufficient additional cores are tested, at no increase in Contract Amount, to substantiate conformance to these requirements.

PART 3 EXECUTION

A. Lifting Holes: Lifting holes through the structure shall be grouted with non-shrink grout.

B. Precast Base: The design of the structure shall include a precast base of not less than 8 inches in thickness poured monolithically with the bottom section of the manhole walls.

C. Joining Manhole Sections: Precast sections shall be joined using a plastic joint sealing compound (see LCU Approved Materials List) and trimmed prior to grouting. Non-shrink grout shall be used inside and outside for sealing between manhole precast sections and shall be of a type acceptable to Lee County Utilities and designed for use in water. All openings and joints shall be sealed watertight.

D. Top Termination: Manhole tops shall terminate at such elevations as will permit laying up grade rings under the manhole frame to make allowances for future street grade adjustments.

E. Drop Connections: Drop connections, where required on precast manholes, shall be manufactured with the manhole elements at the casting yard. Drop manholes shall be constructed per the Lee County Standard Details.

F. Internal Protection: Unless otherwise approved by Lee County Utilities, all manholes shall be protected internally from deterioration by either of the following:

1. GU manhole liner, as manufactured by GU Industries, Inc. or

2. AGRU, Suregrip high-density polyethylene (HDPE) polypropylene (PP-R) protective liner system, or

3. IET Coating system – surface preparation shall include pressure washing at 5,000 psi, abrasive blasting with black beauty steel slag and application of the IET coat at three (3) different intervals to a total thickness of 125 mils.

   The liner or coating system must be installed per manufacturer's recommendation and completely protect the structure from corrosion. The liner or coating system must extend and seal onto manhole ring, seal onto and around pipe openings, and any other protrusions, completely cover the bench and flow invert. Provide a five (5)-year unlimited warranty on all workmanship and products. The work which includes the surface preparation and application of the coating or liner 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.

G. Coal Tar Epoxy: All manhole, wet well, and valve vault exteriors shall be coated with two (2) coats of coal tar epoxy to a minimum thickness of 18 mils. Where no corrosive conditions are expected in a wet well or manhole, with Lee County Utilities specific written approval, the interior of the manhole may be coated with two (2) coats coal tar epoxy to a minimum thickness of 18 mils.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 05 14

HDPE CONCRETE PROTECTIVE LINER

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish and install all labor, materials, equipment, and incidentals required to supply and install High Density Polyethylene (HDPE) and Polypropylene Copolymer (PP-R) concrete protective liner (CPL) in the lift station/wet wells, receiving manholes, drop manholes, and manholes as required or as shown on the plans.

B. HDPE concrete protective liner (CPL) shall be designed and installed to protect concrete surfaces from corrosion.

PART 2 PRODUCT

2.1 MATERIALS

A. Liner shall be AGRU Sure Grip® HDPE (high density polyethylene) with a minimum thickness of 2 mm. All HDPE liner sheets shall be extruded with a large number of anchoring studs, a minimum of 39/ft^2, manufactured during the extrusion process in one piece with the sheet so there is no welding and no mechanical finishing work to attach the studs to the sheet. The liner shall have a pull out of 112.5 lbs./anchoring stud.

B. Flat liner sheet, non-anchored, used for overlapping joints, shall have a minimum thickness of 3mm. All joints shall be sealed by means of thermal welding performed by Agru certified welders.

C. The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge up to a 1/4-inch settling crack, without damage to the lining. The liner shall be able to bridge any expansion cracks that may occur.

D. The lining shall be repairable at any time during the life of the structure.

E. An AGRU certified fabricator shall custom fit the liner to the form work in order to protect the concrete surfaces from sewer gases. The interior surfaces to be protected shall include the walls, ceiling, and pipe entries.

F. For all lined manholes the use of HDPE Grade rings shall be used in lieu of brick or precast grade rings. Grade rings shall meet HS-25 load rating. Butyl sealant shall be used between each ring to make a watertight joint. The first grade ring shall be welded to the liner to provide a gas tight seal.

2.2 PHYSICAL PROPERTIES

A. The AGRU Sure Grip CPL systems and welding rod shall be manufactured from the same resins and meet the following properties:

Property	Testing Method	Unit	HDPE	PP-R
Density	ASTM D792-13.	g/cm^3	.0945	1.78
MFI (Melt Flow Index)	ASTM D1238-13	g/10min	(190/5)	(190/5)
Yield Stress	ASTM D638-14	PSI	> 2,320	> 2,900
Elongation of Yield	ASTM D638-14	%	> 12	> 10
Elongation at break	ASTM D638-14	%	> 200	> 50

Property	Testing Method	Unit	HDPE	PP-R
Fire Classification	UL-94		V2	V2
Maximum Working Temperature		C°	60	90
		F°	140	194

B. Upon request, the manufacturer shall provide written certification that the liner used meets or exceeds the requirement of this specification.

PART 3 EXECUTION

3.1 WELDING

A. All welding shall be performed in accordance with the published directives and procedures of the manufacturer and by welders certified by the manufacturer. Completion of welding will provide a one-piece monolithic concrete protective liner system that will provide excellent resistance to hydrogen sulfide attack and will not pull off the wall in the event that infiltration occurs.

The following welding techniques are acceptable:

1. Extrusion Welding

2. Wedge Welding

3. Butt Welding

4. Hot Air Welding

B. Testing and supervision of the installation and welding shall be performed by qualified staff only and must be checked when completed by visually checking and by Spark Testing all welded joints.

C. Sample welds shall be taken from each jobsite during the field welding process and submitted to the quality assurance department for testing. The following test are performed: Shear and Peel Test. Shear weld test results shall meet or exceed at least 80% strength of parent material in a destructive test which pulls the sample apart to test the strength and integrity of the extrusion weld. The peel test pulls the weld apart from the backside of the weld using a peeling type motion. The results of this test shall meet or exceed 70% of the value of the parent material.

D. Provide a five (5) year unlimited warranty on all workmanship and products. The work includes the surface preparation and application of the liner 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

(NO TEXT FOR THIS PAGE)

SECTION 33 05 15

FIBERGLASS REINFORCED PLASTIC (FRP) CONCRETE PROTECTIVE LINER

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. This work shall include the furnishing of a fiberglass reinforced plastic (FRP) of polyurethane hybrid polymer resin to be installed in sanitary sewer manholes and lift station/wet wells as a protective surface barrier. The FRP polyurethane hybrid polymer liner shall be a non-load bearing component which is resistant to the chemical environment normally found in wastewater collection systems. The liner shall be prefabricated rigid FRP sections of unlayered homogeneous composite with an aggregate-coated outer surface to insure adequate mechanical anchoring of FRP liner to concrete/grout in sanitary sewer structures.

PART 2 MATERIALS

2.1 FRP POLYURETHANE HYBRID POLYMER COMPOSITE

A. The FRP liner shall be as manufactured by GU Florida Inc., Sarasota, FL.

B. Minimum Thickness:

1. Integrally cast in new precast concrete structures: Minimum thickness 3/16-inch

2. Field installed rehab/retrofit into existing sanitary manholes: Minimum thickness 1/4-inch

C. Material Properties:

Fiberglass, minimum length of fibers = 0.0625.
Content by weight = 12% - 15%

Inert Filler, content by weight = 10% - 13%

Bonding aggregate: Pre-washed, kiln-dried, fractured 3/8-inch gravel. Graded particle size minimum 3/16 inches and maximum 3/8 inches. Rate of application 3.5 lbs/sq ft.

D. Physical Properties:

Abrasion resistance – Falling Sand (ASTM D968):

Thickness of material removed passes:

Passes	0-5	5-10	10-15	15-20	20-25	Total
Thickness removed	0.04 mil	0.04 mil	0.6 mil	0.04 mil	0.12 mil	1.2 mil

Density of FRP Polyurethane Hybrid Composite (ASTM D1622): 1.17 g/cm3
Shore "A" Hardness Durometer (ASTM D2240): Exceeds 90 on scale
Percolation Test: Water absorption of top surface: 0.032%
Thermal shock: (CSA-B45-M93): 100 thermal cycles, no signs of surface defects.

E. Chemical Resistance (Selected Reagents) (ASTM D1308):

Nitric Acid 69%	No surface degradation, surface staining
Hydrochloric Acid 60%	No surface degradation
Ammonia 28%	No surface degradation
Sodium Hydroxide 5.25%	No surface degradation
Sulfuric Acid 50%	No surface degradation
Sulfuric Acid 70%	No surface degradation
Acetone	No surface degradation
Unleaded gasoline	No surface degradation
Turpentine	No surface degradation

F. Acetone immersion (ASTM D2152): No attack

PART 3 EXECUTION

A. The prefabricated FRP liner shall be a one piece construction of unlayered, homogenous composite and shall be in lengths and nominal inside diameters corresponding to the precast concrete manhole section.

B. The prefabricated FRP manhole base liner shall include full flow channels with side walls to the crown of the pipe; inner surface of the bench to have an anti-skid pattern; watertight gasketed pipe bell connections and FRP hole sleeves to suit specific pipe types, grade and alignment, shall be monolithically attached to prefabricated FRP base manhole liners to extend to the outside profile of the precast concrete structure per drawing details.

C. The outer surface of the liner to be aggregate coated and have steel spirals/ lattice bonded to the FRP to insure anchoring to concrete sections to pass vacuum test with 10 psi negative pressure.

D. The FRP base liner shall be cast integral with the precast concrete manhole riser and flat top/ cone sections in accordance with the liner manufacturer's specifications. The liner must be fully supported during the casting process, lifting devices shall not penetrate inside walls FRP base liner.

E. Inside FRP liner surfaces shall be free of bulges, dents and other defects that result in a variation of inside diameter of more than 1/4 inches for base liner flow channel and pipe connections. The precast concrete pipe penetration joint surfaces shall be free of excess concrete at external and internal surface to insure proper seal of pipe connection and FRP liner.

F. Prefabricated FRP brick adjustment collar or GU FRP convertible collar liner for masonry grade adjustment shall extend vertically to cast iron cover ring.

G. During the field installation of FRP lined precast manhole sections, all internal seams are to be sealed per the liner manufacturer's standard method and details, to include the use of approved butyl sealant strips at internal liner joint flange. Outer joints of precast concrete sections shall be sealed as prescribed by precast manufacture and utility specifications.

H. The interior surfaces of the liner shall be completely free from pinholes, cracks, pits or defects which are detrimental to the intended use of the liner. No FRP liner shall have holes, or openings, which will permit the passage of liquid or gases through the liner wall to precast concrete. There shall be no exposed concrete mortar through inside liner surface to include (but not limited to) pipe penetrations precast section joints or cast iron cover ring joint. All mechanical anchor attachments through liner surfaces must be sealed with an elastomeric sealant approved by the liner manufacturer.

I. Provide a five (5) year unlimited warranty on all workmanship and products. The work includes the surface preparation and application of the liner 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

(NO TEXT FOR THIS PAGE)

SECTION 33 05 23

JACKING, AUGERING AND MINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Pipeline installation in casing pipe beneath highways, railroads and other structures may be installed by jacking and augering or by jacking and mining.

B. Related Work Specified in Other Sections Includes:

1. Section 31 40 00 - Shoring, Sheeting and Bracing
2. Section 31 23 16 - Excavation - Earth and Rock
3. Section 03 30 53 - Concrete for Non-Plant Work

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM A 139 - Specification for Electric-Fusion (Arc) -Welded Steel Pipe (NPS in 4 in. and Over)
2. OSHA PL-91-596- Occupational Safety Health Act of 1970 Public Law 91-596

1.3 SUBMITTALS

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

1. Working drawings of the jacking pipe, jacking frame, jacking head, reaction blocks, sheeting, including design calculations and the complete jacking installation.

2. It shall be the responsibility of the CONTRACTOR to submit the necessary permit documents and data to the appropriate authority and receive approval thereof.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Use one of the following for casing piping.

1. New prime steel pipe, meeting the requirements of ASTM A 139, Grade B. The minimum casing pipe size and wall thickness shall be as shown in the latest revision of the Lee County Design Manual, for the carrier pipe size indicated. For sizes not included therein, or for special design considerations, approval shall be obtained from Lee County Utilities.

2. HDPE may be used as the carrier pipe and casing pipe with approval from Lee County Utilities. The HDPE casing shall be SDR 11 and there shall be a minimum of 4 inches clearance between the interior of the casing pipe and the outside of the carrier pipe, unless otherwise approved by the OWNER.

B. Fill Material: Use fill material consisting of 1-1/4 pounds of Bentonite per gallon of water during jacking to fill any voids between pipe and the earth.

PART 3 EXECUTION

3.1 INSTALLATION

A. Casing Pipe:

1. Install all casing pipe in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

2. The provisions of this section shall represent the minimum standards for the installation of casing pipe for sewer force main or water main pipeline.

3. Sewer force mains and water mains to be placed under all Lee County Department of Transportation & Engineering roadways shall be installed in a casing. The steel casing procedures shall conform to the requirements of Lee County DOT as outlined in “Administrative Code AC-11-12” and any supplements thereto. All work and materials shall be subject to inspection by DOT. The Department’s property and surface conditions shall be restored to the original condition in keeping with the Department’s specifications and standards.

4. In general, all underground sewer force mains and water mains crossing all existing Lee County roadways, Florida State Highways and railroads shall be installed under these traffic ways within steel casing pipe. Specific crossing requirements shall be obtained in advance from the authority having jurisdiction.

5. It shall be the sole responsibility of the CONTRACTOR to submit the necessary permit documents and data to the appropriate authority and receive approval thereof. The CONTRACTOR shall maintain traffic on the roadway and shall keep all workmen and equipment clear of the travelway during the work. All safety regulations of the Department and any permit(s) shall be complied with.

6. Casing pipes crossing under County roadways shall be located at suitable approved alignments in order to eliminate possible conflict with existing or future utilities and structures with a minimum 36 inches depth of cover between the top of the casing pipe and the surface of the roadway.

7. For casing pipe crossing under roadways, railroads, or other installations not within the jurisdiction of Lee County, the CONTRACTOR shall comply with the regulations of said authority in regard to design, specifications and construction. State Highway casing installations shall be as specified in the FDOT, "Utility Accommodation Guide", and for railroads, the American Railway Engineering Association, Part 5, Section 5.2, "Specifications for Pipelines Conveying Nonflammable Substances", shall be applicable. However, in no case shall the minimum casing pipe diameter and wall thickness, for a specific carrier pipe size, be less than that specified above.

8. Any boring and jacking operations shall be done simultaneously, with continuous installation until the casing pipe is in final position. Correct line and grade shall be carefully maintained. Add-on sections of casing pipe shall be full-ring welded to the preceding length, developing water-tight total pipe strength joints. The casing installation shall produce no upheaval, settlement, cracking, movement or distortion of the existing roadbed or other facilities. Following placement of the carrier pipe within the steel casing, masonry plugs are to be installed at each open end. Said plugs shall be suitable for restraining the external earth load, while allowing internal drainage.

9. Casing pipe holes shall be mechanically bored through the soil by a cutting head on a continuous auger mounted inside the pipe. The auger shall extend a minimum distance beyond the end of the casing pipe to preclude formation of voids outside the pipe shell.

10. The casing pipe shall be adequately protected to prevent crushing or other damage under jacking pressures. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage. Should the casing pipe be damaged, such damaged portion, if not in the hole, shall be replaced; however, if inserted, the encasement pipe shall be abandoned in place, suitably plugged, and an alternate installation made, as directed by the OWNER.

11. Required boring or jacking pits or shafts shall be excavated and maintained to the minimum dimension. Said excavation shall be adequately barricaded, sheeted, braced and dewatered as required.

12. Directional boring may be used for the installation of HDPE pipe.

B. Casing Spacers:

1. Stainless steel carriers with PE Skids being on center and restrained shall be the preferred method for installing the carrier pipe. Skids shall be installed 7 feet or less, on center. After the carrier pipe has been tested for leakage, the casing shall have the ends blocked with a 8" wall of brick masonry with a weep hole installed near the bottom of each wall..

2. High density polyethylene casing spacers (see list of approved materials), can be used for all size PVC pipes and on DIP pipe with diameters 12 inches or less. The spacers shall be of a projection type with a minimum number of projections around the circumference totaling the number of carrier pipe diameter inches. Casing spacers shall be spaced per manufacturer's recommendation with double spacers on each end of the casing. The casing spacers shall provide a minimum safety factor of 2 to 1 to support the service load.

C. Augering: Conduct augering with the proper equipment and procedure such that the carrier pipe and the casing pipe can be installed to the grades specified without disturbing the adjacent earth. Submit all equipment and procedures for prior approval.

D. Hand Mining: Conduct hand mining only in casings that are sufficiently large enough to permit such operation. Provide adequate fresh air supply within the casing pipe and conduct all operations in accordance with the requirements of the U.S. Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act 7 1970 (PL-91-596).

E. Jacking Pit: Make the jacking pit of adequate length to provide room for the jacking frame, the jacking head, the reaction blocks, the jacks, auger rig, and the jacking pipe. Make the pit sufficiently wide to allow ample working space on each side of the jacking frame. Make the depth of the pit such that the invert of the pipe, when placed on the guide frame, is at the elevation desired for the completed line. Provide excavation in conformance with Section 31 23 16.

F. Sheeting: Sheet the jacking pit tightly and keep it dry at all times. Conform sheeting to Section 31 40 00. Have complete design calculation for sheeting the jacking pit sealed and submitted by a Professional Engineer registered in the State of Florida.

G. Jacking Frame: Use a jacking frame that applies a uniform pressure over the entire pipe wall area of the pipe to be jacked.

H. Reaction Blocks: Use reaction blocks designed to carry the thrust of the jacks to the soil without excessive soil deflection and in such a manner as to avoid any disturbance of adjacent structures or utilities.

I. Operation: Use hydraulic jacks in the jacking operation. Use extreme care to hold the pipe to exact line and grade. Advance the excavation at the heading manually or with an auger. Do not allow the advance to exceed one foot ahead of the casing pipe. Make every effort to avoid loss of earth outside the casing.

J. Safety Railing: Provide a safety railing all around the top of the pit at all times.

K. Property and surface conditions shall be restored to the original condition in accordance with Lee County DOT specifications and standards.

L. Carrier Pipe:

1. Water Mains or Sewer Force Mains installed within casing pipes shall utilize joint restraining for the entire pipe length inside the casing. Special supporting of the carrier pipe within the casing shall be required with a design approved by Lee County Utilities.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 05 24

DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Provide all necessary tools, materials and equipment to successfully complete the installation of directionally, drilled piping as specified herein and shown on the drawings. The CONTRACTOR shall be responsible for the final constructed product, and for furnishing the qualified labor and superintendence necessary for this method of construction.

B. Furnish all items necessary to perform the horizontal directional drilling operation and construct the pipe to the lines and grade shown on the drawings.

C. Boring must use techniques of creating or directing a borehole along a predetermined path to a specified target location. This must involve use of mechanical and hydraulic deviation equipment to change the boring course and must use instrumentation to monitor the location and orientation of the boring head assembly along a predetermined course.

D. Drilling must be accomplished with fluid-assist mechanical cutting. Boring fluids shall be a mixture of bentonite and water or polymers and additives. Bentonite sealants and water will be used to lubricate and seal the mini-tunnel. It is mandatory that minimum pressures and flow rates be used during drilling operation as not to fracture the sub-grade material around and or above the bore.

E. The mobile drilling system shall utilize small diameter fluid jets to fracture and mechanical cutters to cut and excavate the soil as the head advances forward.

F. Steering shall be accomplished by the installation of an offset section of drill stem that causes the cutterhead to turn eccentrically about its centerline when it is rotating. When steering adjustments are required, the cutterhead offset section is rotated toward the desired direction of travel and the drill stem is advanced forward without rotation.

G. The mobile drilling system must be capable of being launched from the surface at an inclined angle and drilling a 2 inch to 3 inch diameter pilot hole. The pilot hole will then be enlarged with reamers as required.

1.2 REFERENCE STANDARDS

A. Lee County Design Manual

B. American Association of State Highway and Transportation Officials (AASHTO).

C. Occupational Safety and Health Administration (OSHA).

1.3 DEFINITIONS

A. CONTRACTOR's Construction Drawings shall be defined as drawings by which the CONTRACTOR proposes to construct, operate, build, etc., the referenced item. The submission of these drawings shall be required for the sole purpose of providing the sufficient details to verify that the CONTRACTOR's work in progress is in accordance with the intent of the design.

1.4 SUBMITTALS

A. The ENGINEER will base the review of submitted details and data on the requirements of the completed work, safety of the work in regards to the public, potential for damage to public or private utilities and other existing structures and facilities, and the potential for unnecessary delay in the execution of the work. Such review shall not be construed to relieve the CONTRACTOR in any way of his responsibilities under the contract. CONTRACTOR shall not commence work on any items requiring CONTRACTOR's construction drawings or other submittals until the drawings and submittals are reviewed and accepted by the ENGINEER.

B. The CONTRACTOR shall:

1. Submit for review complete construction drawings and/or complete written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction, as required by the method of tunnel excavation approved. The drawings and descriptions shall be sufficiently detailed to demonstrate to the ENGINEER whether the proposed materials and procedures will meet the requirements of this specification. CONTRACTOR shall submit arrangement drawings and technical specifications of the machine and trailing equipment (including any modifications), three-year experience record with this type of machine and a copy of the manufacturer's operation manual for the machine.

2. CONTRACTOR's construction drawings shall be submitted on the following items.

a. Complete details of the equipment, methods and procedures to be used, including but not limited to primary lining installation, timing of installation in relation to the excavation plan and sequence, bulkheads, etc.

b. Grouting techniques, including equipment, pumping procedures, pressure grout types, mixtures and plug systems.

c. Method of controlling line and grade of excavation.

d. Details of muck removal, including equipment type, number, and disposal location.

e. Proposed contingency plans for critical phases and areas of directional drilling.

C. Quality Control Methods. At least 10 days prior to the start of directional drilling, CONTRACTOR shall submit a description of his quality control methods he proposes to use in his operations to the ENGINEER. The submittal shall describe:

1. Procedures for controlling and checking line and grade.

2. Field forms for establishing and checking line and grade.

D. Safety. Procedures including, but not limited to, monitoring for gases encountered shall be submitted.

E. Hazardous chemical list as well as all MSDS and technical data sheets.

1.5 DESIGN CRITERIA

A. Compatibility of Methods.

1. The methods of excavation, lining, and groundwater control shall be compatible.

1.6 JOB CONDITIONS

A. Safety Requirements

1. Perform work in a manner to maximize safety and reduce exposure of men and equipment to hazardous and potentially hazardous conditions, in accordance with applicable safety standards.

2. Whenever there is an emergency or stoppage of work which is likely to endanger the excavation or adjacent structures, operate a full work force for 24 hours a day, including weekends and holidays, without intermission until the emergency or hazardous conditions no longer jeopardize the stability and safety of the work.

B. Air Quality.

1. Conduct directional drilling operations by methods and with equipment, which will positively control dust, fumes, vapors, gases or other atmospheric impurities in accordance with applicable safety requirements.

1.7 PERMITS

A. Obtain any and all other permits required for prosecution of the work.

PART 2 PRODUCTS

2.1 GENERAL

A. Refer to Section 33 11 02 for HDPE pipe material.

PART 3 EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall be responsible for his means and methods of directional drilling construction and shall ensure the safety of the work, the CONTRACTOR's employees, the public, and adjacent property, whether public or private.

B. Anticipate that portions of the drilled excavation will be below the groundwater table.

C. Comply with all local, state and federal laws, rules and regulations at all times to prevent pollution of the air, ground and water.

3.2 EQUIPMENT

A. Diesel, electrical, or air-powered equipment will be acceptable, subject to applicable federal and state regulations.

B. Any method or equipment that the CONTRACTOR can demonstrate will produce the specified results will be considered.

C. Employ equipment that will be capable of handling the various anticipated ground conditions. In addition, the equipment shall:

1. Be capable of minimizing loss of ground ahead of and around the machine and providing satisfactory support of the excavated face at all times.

2. Provide a system to indicate whether the amount of earth material removed is equivalent to that displaced by the advance of the machine such that the advance rate may be controlled accordingly.

D. Provide adequate secondary containment for any and all portable storage tanks.

3.3 DIRECTIONAL DRILLING DATA

A. Daily logs of construction events and observations shall be submitted on at least the following:

1. Location and elevation of significant soil strata boundaries and brief soil descriptions.

2. Jacking pressures and torsional forces, if applicable.

3.4 CONTROL OF THE TUNNEL LINE AND GRADE

A. Construction Control.

1. Establish and be fully responsible for the accuracy of his own control for the construction of the entire project, including structures, tunnel line and grade.

2. Establish control points sufficiently far from the tunnel operation not to be affected by construction operations.

3. Maintain daily records of alignment and grade and shall submit three copies of these records to the ENGINEER. However, the CONTRACTOR remains fully responsible for the accuracy of his work and the correction of it, as required.

4. Check control for the bore alignment against an above ground undisturbed reference at least once each hour and once for each 50 feet of tunnel constructed, or more often as needed or directed by the ENGINEER.

3.5 DISPOSAL OF EXCESS MATERIAL

A. Where such effort is necessary, cost for groundwater control during the course of the tunnel work shall be included in the unit contract price for the work.

B. Dewatering required during the course of the project to lower water table, to remove standing water, surface drainage seepage, or to protect ongoing work against rising waters or floods shall be considered incidental to the work being performed.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 11 01

POLYVINYL CHLORIDE (PVC) WATER MAIN PIPE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install polyvinyl chloride (PVC) waterline, fittings, service connections and appurtenances as shown on the Drawings and as specified herein.

B. All water mains less than or equal to 12 inches in diameter shall be constructed of PVC, unless otherwise approved by Lee County Utilities.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. This standard references the documents listed below. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

1. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
2. ASTM D1599 - Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
3. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM A252 -
5. ASTM D2464 -
6. ASTM B88 -
7. ASTM 2737 -
8. ASTM D3139 - Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
9. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
10. AWWA C110 -

11. AWWA C153 -

1.3 SUBMITTAL

A. Submit to the Engineer within fourteen 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 Supplement to 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 WATER MAIN

A. Polyvinyl Chloride (PVC) Pipe

1. All 4-inch through 12-inch diameter PVC pipe shall be rated per AWWA, C900, DR18, Class 150. Water mains larger than 12 inches shall be constructed of Ductile Iron Pipe.

2. PVC pipe less than 4-inches in diameter shall be Schedule 80 with a pressure rating of 200 psi solvent welded, including blow-off assemblies. PVC pipe will be acceptable for pipe diameters of 12 inches or less.

3. The potable water mains shall be blue in color.

4. All pipe shall be manufactured in the United States.

B. Steel Encasement Pipe: Conform to ASTM Designation A252, Grade 2. Joints shall be welded completely around the pipe by a certified welder. Pipe shall meet all AASHTO standards and Florida DOT requirements.

C. Fittings:

1. PVC Pipe: Fittings shall be ductile iron mechanical joint, with a working pressure of 250 psi and conforming to AWWA Specifications C110 or C153.

2. Acceptable manufactures of fittings can be found in the LCU Approved Materials List.

3. All fittings shall be manufactured in the United States.

D. Joint 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 Section 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 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.

2. Bolts and nuts shall be Ductile Iron, 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.

E. Joint Design: PVC pipe 4 inches in diameter or larger shall have provisions for expansion and contraction provided in the joints. All joints shall be designed for push-on make-up connections. Push-on joint may be a coupling manufactured as an integral part of the pipe barrel consisting of a thickened section with an expanded bell with a groove to retain a rubber sealing ring of uniform cross section, similar and equal to John's Mannville ring-type and Ethyl Bell Ring or may be made with a separate twin gasketed coupling similar and equal to Certainteed Fluid-Type.

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:

1. Nominal size and OD base.

2. PVC

3. Dimension ration

4. AWWA pressure rating.

5. AWWA designation.

6. Manufacturer's name and trademark.

7. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacturer.

8. All PVC water pipe shall be color-coded blue.

PART 3 EXECUTION

3.1 WATER MAIN INSTALLATION

A. Polyvinyl Chloride (PVC) water pipe shall be installed in accordance with the manufacturer's recommendation, as shown on the drawings, and as specified herein.

B. The Contractor shall 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. 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.

3.2 SERVICE CONNECTIONS

A. All potable service taps shall be located in open/green areas unless specifically approved by Lee County Utilities. Any service taps that are approved within a paved area, a 2-inch cast iron body gate valve shall be used in lieu of a corporation stop.

B. Service connections shall be installed at the locations and in the manner shown on the Drawings.

C. Service clamps for PVC mains shall be full-circle bearing types as shown on the details in Section 6 of the Lee County Utilities Operations Manual.

D. Corporation stops and curb stops shall be fitted with a compression connection outlet with split-lock devices for polyethylene or copper pipe.

E. On curbed streets the exact location for each installed service shall be marked by etching or cutting a "W" in the concrete curb; where no curb exists or is planned, locations shall be adequately marked by a method approved by Lee County Utilities.

F. Service connection shall not be installed on pipelines 16 inches and larger unless extenuating conditions exist and said connection is approved by Lee County Utilities.

G. When practical, in new residential, commercial, or/and industrial subdivisions, the corporation stop shall be located at the intersecting property line or in the center of the lot.

1. Copper Pipe Copper pipe for 3/4-inch to 1-inch service line installations shall be American manufactured, Type K, and conform to the requirements of ASTM designation B88. Brass compression couplings with screw-clamp fittings shall be used with copper pipe.

2. Polytubing Polyethylene Tubing will be acceptable in sizes from 1-1/2 inches to 2 inches in diameter. Tubing for service lines shall be of a type approved by the National Sanitation Foundation for use in transmitting fluids for human consumption. The tubing shall be designed for a minimum burst pressure of 630 psi for water at 23ºC, and shall be manufactured in accordance with the requirements of ASTM D2737 and shall be blue in color.

3.3 CLEANING

A. At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipe lines by flushing with water and pigged to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed at the Contractor's expense.

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 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 and fittings 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 every day 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. Hydrostatic Pressure Testing: HDPE pipes shall be pressure tested in a similar manner as for PVC force main in accordance with Section 33 05 01.

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

10. ASTM G62

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 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.

2.3 MATERIALS

A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of ANSI/AWWA C151.

B. Cement: Cement for mortar lining 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 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 pipe furnished shall be ductile iron pipe, mortar-lined, with rubber gasketed joints.

B. The pipe 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 CEMENT-MORTAR LINING

A. Cement-Mortar Lining For Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. Ductile-Iron pipefittings need not have the cement-mortar lining applied centrifugally. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be repaired in the filed in accordance with ANSI/AWWA C104.

B. The nominal wet lining thickness shall be as follows:

Nominal Factory Nominal Replacement		
Nominal Pipe Diameter (in.)	Applied Lining Thickness (in.)	Lining Thickness (in.)
3-12	1/8	1/8

14-24	3/16	3/16
30-64	1/4	1/4

C. Protection of Pipe Lining/Interior: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

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.

NOTE:

Where severely corrosive soils and other adverse conditions occur, this coating may not provide the desired protection. In such cases, a heavier coating, polyethylene wrap, cathodic protection or a combination of these may be required. To determine the protection needed, an investigation should be made of the following items.

a. Experience with existing installations in the area, if any
b. Soil resistivity
c. Soil Ph
d. Oxidation-reduction potential of the soil
e. Sulfides
f. Moisture content
g. Soil description
h. Existence of stray direct currents
i. Possible cathodic interference

To use the polyethylene wrap, refer to ANSI A21.5 for Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

Edit this Section if additional protection is needed. Also edit Sections 33 05 03 "Laying and Jointing Buried Pipelines". A section on cathodic protection of buried ductile-iron pipe may be also required.

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 11 04

POLYVINYL CHLORIDE (PVC) WATERLINE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install polyvinyl chloride (PVC) waterline, fittings, and appurtenances as shown on the drawings and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES & STANDARDS

A. This standard references the documents listed below. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

1. ASTM D1784 - Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

2. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series).

3. ASTM A252 -

4. AWWA C900 -

5. AWWA C110 -

6. AWWA C111 -

1.03 SUBMITTAL

A. Submit to the Engineer within ten 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 Supplement to 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

2.01 WATER MAIN

A. Polyvinyl Chloride (PVC) Pipe

1. Pipe smaller than 4 inches: Conform to requirements of ASTM D2241 with a standard dimension ratio (SDR) of 18, and a pressure rating of 200 psi. PVC material used in pipe shall be as specified in ASTM D1784, Cell Classification 12454-B.

2. Pipe 4 inches through 12 inches: Conform to requirements of AWWA C-900 with a dimension ratio (DR) of 18, pressure class 150. PVC material used in pipe shall be as specified in ASTM D1784, Cell Classification 1245-B.

3. The potable water mains shall be blue in color.

4. All pipe shall be manufactured in the United States.

B. Steel Encasement Pipe: Conform to ASTM Designation A252, Grade 2. Joints shall be welded completely around the pipe by a certified welder. Pipe shall meet all AASHTO standards and Florida DOT requirements.

C. Fittings:

1. PVC Pipe: Fittings shall be ductile iron mechanical joint, with a working pressure of 250 psi and conforming to AWWA Specifications C110 or C153. All bolts and nuts shall be 304 stainless steel, Cor-blue or Cor-Ten or equal. Cor-Ten shall meet the requirements for ANSI/AWWA C111/A21-11 for buried application. For pipe 8 inches and smaller, fittings shall be C900 PVC rated fittings.

2. Tapping Sleeves: Sleeve shall be stainless steel, mechanical joint type, with working pressure rating of 250 PSI, and conform to AWWA Standard C223.

3. All fittings shall be manufactured in the United States.

D. Joints

1. Restrained Joint for PVC Pipe: Pipe fittings and other requiring restraint shall utilize approved appurtenances (see LCU Approved Materials List) joint restrain devices.

2.02 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:

1. Nominal size and OD base.

2. PVC

3. Dimension ratio

4. AWWA pressure rating.

5. AWWA designation.

6. Manufacturer's name and trademark.

7. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacturer.

8. All PVC water pipe shall be color-coded blue.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Polyvinyl Chloride (PVC) water pipe shall be installed in accordance with the manufacturer's recommendation, as shown on the drawings, and as specified herein.

B. The Contractor shall 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. 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.

3.02 TESTING WATER MAIN

A. All force mains shall be field tested in accordance with AWWA C-900 and as specified herein. The Contractor shall supply all labor, equipment, material, gages, pumps, and incidentals required for testing.

B. The test pressure shall be 150 psi for water mains, unless noted otherwise. The test pressure shall be measured at the highest point along the test section.

C. Testing shall be conducted after backfilling has been completed and before placement of permanent surface.

D. Testing procedures shall be as follows:

1. Fill line slowly with water. Maintain flow velocity less than two feet per second.

2. Expel air completely from the line during filling and again before applying test pressure. Air shall be expelled by means of taps at points of highest elevation.

3. Apply test pressure. Maintain pressure within 5 psi of the test pressure for a period of two hours. Measure the quantity of water that was pumped into the line to maintain pressure and the quantity of water required to bring the line up to test pressure. The sum of these two quantities is defined as leakage.

4. Carefully examine all exposed pipe, fittings, and joints during the test.

E. No pipe installation will be accepted if the leakage is greater than that determine by the following formula:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

in which L is the allowable leakage, in gallons per hour; S is the length of pipe tested; D is the nominal diameter, in inches; and P is the test pressure, in psi.

F. If any test of pipe laid discloses leakage greater than that allowed, the Contractor shall, at his own expense, locate and repair the cause of leakage and retest the line.

G. All visible leaks are to be repaired regardless of the amount of leakage.

3.03 CLEANING

A. At the conclusion of the work, the Contractor shall thoroughly clean all of the new pipe lines by flushing with water and pigged to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed at the Contractor's expense.

3.04 DISINFECTION

Disinfect completed water pipeline in accordance with Section 33 11 12.

END OF SECTION

SECTION 33 11 12

DISINFECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Disinfection of all pipelines, tanks, structures, conduits and equipment which are to store, handle or carry potable water. Furnish all labor, water, chemicals and equipment, including taps, corporation stops, temporary pumps and other items necessary to perform the Work, except as otherwise specified.

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. AWWA C651 - Disinfecting Water Mains
2. AWWA C652 - Disinfection of Water-Storage Facilities

1.3 QUALITY ASSURANCE

A. Disinfection Standards: Disinfect in accordance with AWWA C651 for water mains and AWWA C652 for water storage facilities and equipment.

B. Chlorinated Water Disposal: Dispose of old highly chlorinated water in accordance with applicable regulations.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WATER MAIN DISINFECTION

A. Following acceptable pressure testing, disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies, prior to placing in service. Advance notice of 24 hours shall be provided to the County before disinfecting procedures start. The disinfection shall be accomplished in accordance with the applicable provisions of AWWA Standard C601, "Disinfecting Water Main" and all appropriate approval agencies.

B. The disinfecting agent shall be free chlorine in aqueous solution with sustained concentration for 12 hours or more of not less than 50 parts per million. Chlorine may

be derived from Chlorine gas, or 70% (high test) calcium hypochlorite (HTH or Perchloron, or equal). Administration may be by any of the several methods described in AWWA Standard C601 as proposed by the CONTRACTOR and approved by the ENGINEER. Proposals as to method must be made prior to commencement of the disinfection process.

C. Following contact with chlorine solution, the system shall be thoroughly flushed out. Samples shall then be taken using sterile containers obtained from the County Health Department. Samples shall be taken by the CONTRACTOR and delivered by him to the County Health Department or approved laboratory for analysis.

D. If samples do not demonstrate satisfactory results, the disinfection procedure shall be repeated until two series of satisfactory samples are obtained, the period between such series of samples to be a minimum of 24 hours.

3.2 DISINFECTION PROCEDURES FOR TANKS

A. Disinfect potable water storage tanks and equipment in accordance with AWWA C652, Method 2 or 3, using sodium hypochlorite.

1. In Method 2, spray method, spray the entire interior surface of the tank with chlorinated water containing 200 mg/l of available chlorine. After spraying, allow the tank to stand at least two hours before filling with fresh water.

B. After disinfection, allow the tanks and equipment to overflow until the chlorine residual is approximately 2 mg/l.

END OF SECTION

SECTION 33 12 16

WATER 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.

1.2 REFERENCES

A. Codes, specifications, and standards referred to by number or title form a part of this Section to the extent required by the references to codes, specifications, and standards. Latest revisions, as of the date of bid opening, apply, unless otherwise noted on the Drawings or specified in this Section.

B. Standards

Designation	Title
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C500	Gate Valves
ANSI/AWWA C509	Resilient-Seated Gate Valves 3 through 12 NPS, for Water Systems
ANSI/AWWA C510	Double Check Valve Backflow Prevention Assembly
ANSI/AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
AWWA C550	Protection Interior Coatings for Valves and Hydrants
ANSI/B16.1	Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250
ANSI/B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
ANSI/B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
ASTM A48	Standard Specification for Gray Iron Castings

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Specification for Stainless and Steel Bars and Shapes
ASTM A231	Standard Specification for Chromium-Vanadium Alloy Steel Spring Wire
ASTM D429	Standard Test Methods for Rubber Property – Adhesion to Rigid Substrates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A743	Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Application
ASTM D2794	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
MSS SP-60	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves

1.3 DEFINITIONS

A. References to valve sizes on the Drawings and in the Specifications are intended to be nominal size, and shall be interpreted as nominal size.

1.4 SUBMITTALS

A. General: as specified in:

1. General Conditions;
2. Supplementary General Conditions;

1.5 QUALITY ASSURANCE

A. Testing: Test valves as specified in this Section.

PART 2 PRODUCTS

2.1 GENERAL:

A. 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.

B. 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.

2.2 MANUFACTURERS

A. See LCU Approved Materials List.

2.3 DESIGN

A. Resilient, Wedge or Gate Valves and Boxes

1. Valves for pipe less than 2" in diameter shall conform to the requirements of AWWA C509 (latest revision) and shall be cast iron, single wedge, non-rising stem, screwed bonnet, 125 pounds S.P., 200 pounds W.O.G with stuffing box repackable under pressure and all parts renewable. Ends shall be as shown or indicated on the drawings.

2. Resilient, wedge or gate valves 2" in diameter and larger shall be cast or ductile iron body, non-rising stem, bronze mounted gate valves, mechanical joint conforming to requirements of the AWWA Standard C509 and shall be provided with a 2" square operating nut. Valves shall be resilient, wedge, or gate type and shall turn to the left (counter clockwise) to open. The wedge or gate shall be cast iron or ductile iron per ASTM A536, minimum 65,000 psi strength and, completely encapsulated with urethane rubber, permanently bonded to the wedge or gate to meet ASTM test for rubber metal bond, ASTM D429. The valve stems for non-rising stem assemblies shall be cast bronze with integral collars in full compliance with AWWA. The NRS stem stuffing box shall be the O-ring seal type with two rings located above thrust collar; the two rings shall be replaceable with valve fully open and subjected to full rated working pressure.

3. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior. The valve shall be designed and tested to be opened and closed under a differential pressure of 150 psi or greater.

B. 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 "WATER" cast into the top. The covers shall be so constructed as to prevent tipping or rattling. Valve boxes shall be manufactured by an approved manufacturer (see LCU Approved Materials List).

3. One tee-handled wrench 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.

C. Gate Valves Greater Than 20 Inches

1. Valves larger than 20" in diameter and larger shall be approved by the County and shall be epoxy-coated, cast or ductile iron body mechanical joint type conforming to requirements of the AWWA Standards and shall be provided with a 2" square operating nut.

2. 20" or larger resilient gate valve must have a 4" bypass line and 4" gate valve. If an approved equal resilient gate valve (see LCU Approved Materials List) is used, the 4" bypass line and 4" gate valve is not required. Butterfly valves may be used for valves greater than 24" without the 4" bypass line and 4" gate valve.

D. Check Valves

1. Check valves smaller than 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.

2. 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.

3. The check valve 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.

4. 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° angle requiring the flapper to travel only 35° from closed to full open position, for minimum head loss and non-slam closure.

5. Non-slam closing characteristic shall be provided through a short 35º disc stroke and a memory flex disc return action.

6. When essential to create backflow thru the check valve, i.e.; to prime or backflush a clogged pump, an external backflow device shall be included.

7. Valve exterior to be painted Phenolic Primer Red Oxide for high resistance to corrosion.

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).

E. Backflow Prevention Devices

1. Backflow prevention devices for fire protection systems which do not utilize chemical additives or an auxiliary water supply shall be double detector check valve assemblies, shall be USC approved, painted red, and meet all requirements of ANSI/AWWA C510 For all other applications, backflow prevention devices shall be reduced pressure principle assemblies and shall be USC approved, and shall meet all requirements of ANSI/AWWA C511 and the Southern Standard Plumbing Code. Refer to Section 9 of the Lee County Utilities Operations Manual for details and Section 17196.

F. Air Release Valves

1. Air release valves shall be of the short body, automatic type as shown on the Lee County Standard Detail No. 9.27 in the Operations Manual. The valve body shall be cast iron construction, ASTM A126, Class B, and all internal working parts shall be 300 Series stainless steel, and BUNA-N orifice button. The inlet openings shall be 1" NPT screwed connection. The venting orifice shall be 3/16" in diameter and shall be installed to vent a minimum of 1 foot above the flood elevation. Air release valves shall be of an approved make and model (see LCU Approved Materials List).

G. Tapping Valves and Sleeves

1. Tapping valves shall be of non-rising stem type of O-Ring seals and conform to the applicable requirement as specified above for valves and shall have one flange joint end and mechanical joint end.

2. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue which fits a recess in sleeve. Tongues shall meet the requirements of MSS SP-60. Resilient-seated gate valves having a port diameter equal to or exceeding 1/4 inch over nominal diameter shall not require a tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11. A full nominal diameter cutter shall be used for tapping.

3. Tapping valves 16" and smaller, shall be installed vertically. Tapping valves larger than 16" shall be installed horizontally and shall have bypass valves. Tapping valves installed horizontally shall have rollers and tracks. Valves 16" and larger, shall have gear operators with enclosed gear cases suitable for buried service. Gear cases shall be extended type or totally enclosed type. Extended type gear cases shall have bolted side plates to cover stem and stuffing box.

H. Meter Boxes

1. Meters shall be installed in an approved meter box (see LCU Approved Materials List).
2. Meters larger than 2” shall be installed above ground and approved by Lee County Utilities. Refer to Lee County standard details.

Meter boxes, which need to be replaced, shall be of an approved make and model (see LCU 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. After installation, all valves and appurtenances shall be tested at least one 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.

C. 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, the CONTRACTOR shall 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.

D. Flanged joints shall be made with Series 300, stainless steel bolts. All exposed bolts shall be made with Series 300 stainless steel bolts.

E. 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.

F. 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.

G. 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. Gate valves,

unless shown otherwise, shall be set with their stems vertically above the center line of the pipe. Any valve that does not operate correctly shall be removed and replaced.

H. 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 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.

3.2 SHOP PAINTING

A. Ferrous surfaces of valves and appurtenances shall receive a coating of epoxy in accordance with AWWA Standard C550 and meets or exceeds all test requirements including the Food and Drug Administration Document Title 21 of the Federal Regulations on Food Additives, Section 175.000 entitled "Resinous and Polymeric Coating"; Impact Test Requirement in accordance with the ASTM D2794.

END OF SECTION

SECTION 33 12 19

HYDRANTS

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Furnish and install fire hydrants where shown on the Drawings or directed by the ENGINEER.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 33 12 16 – Water Valves and Appurtenances

B. Section 03 30 53 – Concrete for Non-Plant Work

C. Section 09 90 00 – Painting and Coating

1.3 QUALITY ASSURANCE

A. Install hydrants to meet current requirements of Lee County Utilities.

B. Provide manufacturer's certificate those products meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

A. Submit manufacturer's certificates on conformance.

B. Shop Drawings: Submit manufacturer's drawings and data sheets for material to be supplied under this Section. Indicate sizes and types to be installed.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, exercise care to prevent damage to materials.

B. Handling: Fire hydrants should be unloaded carefully. The hydrant should be carefully lowered from the truck to the ground, not dropped. Only hoists and slings with adequate load capacity to handle the weight of the hydrant shall be used.

C. Storage: Should be stored in the fully closed position to prevent entry of foreign material that could cause damage to the seating surfaces. Whenever practical, hydrants should be stored indoors. If outside storage is required, means should be provided to protect the operating mechanism. In outside storage, parts and flanges should be protected from the weather and foreign materials.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Fire hydrants shall be of the compression type with break away upper sections capable of ready replacement without loss in the event of traffic damage. Each hydrant shall have a 6" bottom inlet connection and valve opening at least 5-1/4 inches in diameter. Hydrants shall turn to the left (counter clockwise) to open. Each hydrant shall be fitted with one 4-1/2-inch pumper connection and two 2-1/2 inch hose connections, both having threads that conform to the Fire Division Standard for the area. Hose caps shall be chained to the hydrant barrel and fitted with nuts similar to the hydrant operating nuts. Each hydrant shall have a barrel of sufficient length to bring the bottom of the 6" pipe connection 3 feet below the surface of the finished ground. Each hydrant shall be made in at least two sections bolted together. All interior working parts of the hydrant shall be removable from the top of the hydrant to allow repairs without removing the hydrant barrel after it has been installed. Hydrants shall have renewable O-ring stem seals. Hydrant barrels shall be painted AWWA Safety Yellow. They shall be designed for a working pressure of 150 psi and will conform to AWWA Standard C502, “Dry-Barrel Fire Hydrants”.

B. Hydrant shall have no drain parts. If parts exist, they shall be plugged with a threaded plug.

C. Operating stem shall be equipped with anti-friction thrust bearing to reduce operating torque and assure easy opening. Stops shall be provided to limit stem travel. Stem threads shall be enclosed in a permanently sealed lubricant reservoir with O-ring seals.

D. Hydrants shall be designated for 150 psi working pressure and shop tested to 300 psi pressure with main valve both opened and closed. Under test the valve shall not leak, the automatic drain shall function and there shall be no leakage into the bonnet.

E. Hydrant guard posts (bollards) shall be 6-inch diameter Class 50 ductile iron pipe.

F. Acceptable models are listed in the LCU Approved Materials List.

PART 3 EXECUTION

3.1 INSTALLATION

A. Hydrants shall be set plumb and in true alignment with mains. They shall utilize concrete thrust blocks or restrained joints and Grade-Lok adapters as shown in details in Section 9 of the Lee County Utilities Operations Manual. Backfilling around hydrants shall be carefully done so as not to disturb the hydrant and shall be thoroughly compacted so as to support the hydrant securely. The hydrants shall have

between 18" and 24" clearance measured from finish grade to the center of pumper connection.

B. Hydrant guard posts (bollards) shall be 6 feet long, buried 3 feet below finished grade, filled with 2500 psi concrete and painted AWWA safety yellow as shown on the Lee County Standard Details.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 31 01

POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required, and install PVC gravity sewer pipe and appurtenances as shown on the Drawings and as specified herein.

1.2 SUBMITTALS DURING CONSTRUCTION

A. Submittals during construction shall be made in accordance with Section 01 33 00, Shop Drawings, Working Drawings, and Samples.

B. Submit to the ENGINEER not less than fourteen (14) calendar days after the date of the Notice to Proceed, a list of materials to be furnished, the names of suppliers and an expected schedule of delivery of materials to the site.

C. Furnish in duplicate to the ENGINEER sworn certificates that all tests and inspections required by the Specifications under which the pipe is manufactured have been satisfied.

1.3 INSPECTION AND TESTS

A. All pipe and accessories to be installed under this Contract shall be inspected and tested at the place of manufacture by the manufacturer as required by the Standard Specifications to which the material is manufactured.

B. In the event that any of the test specimens fail to meet the applicable standards, all pipe presented by such tests shall be subject to rejections. The CONTRACTOR may furnish two additional test specimens from the same shipment or delivery for each specimen that failed and the pipe will be considered acceptable if all of these additional specimens meet the requirements of the applicable standards.

C. Pipe which has been rejected by the ENGINEER shall be removed from the site of the work by the CONTRACTOR and replaced with pipe which meets these specifications.

D. Other testing requirements specific to the type of pipe are included under the appropriate Paragraph in Part 2, below.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE

A. Polyvinyl chloride (PVC) gravity sewer pipe and fittings 4-inch through 12-inch diameter shall conform to ASTM D-3034, "Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings," DR 26. If any portion of a gravity sewer has less than four feet of cover, the entire run shall be constructed of AWWA C-900 DR 18 or thicker wall pipe.

B. The pipe shall be joined with an integral bell and spigot type rubber gasketed joints. Each integral bell joint shall consist of a formed bell with a rubber gasket. Flexible gasketed joints shall be elastomeric compression types conforming to ASTM F1336 and ASTM F477. Joints shall permit contraction, expansion and settlement, and yet maintain a watertight connection. Joints shall be tested in accordance with ASTM D3212.

C. Pipe shall be furnished in standard laying lengths not exceeding 20 feet and shall be colored green in accordance with the Utility Location and Coordination Council Uniform Color Guide.

D. All fittings and accessories shall be furnished by the pipe supplier and shall have bell and/or spigot configurations compatible with the pipe.

PART 3 EXECUTION

3.1 LAYING POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Polyvinyl Chloride (PVC) gravity sewer pipe shall be laid in accordance with the instructions of the manufacturer, Section 31 23 23 and ASTM D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Bell holes shall be excavated so that after installation only the pipe barrel shall bear upon the trench bottom. Proper selection and placement of bedding and backfill materials are necessary to minimize deflection of the pipe diameter. No blocking under the pipe will be permitted. For gravity sewers 12 inches in diameter and larger, Laser leveling shall utilize two (2) laser beams to check gradient and deflection. One laser beam shall be positioned 1-1/2 inches or less from the inside top of pipe. The second laser beam shall be positioned 2 inches or less from the inside bottom of pipe. Both beams must hit the target for the entire run of pipe being installed between manholes.

For pipelines less than 12 inches in diameter, a single laser level beam shall be utilized and centered inside the pipe.

B. Use care in handling and installing pipe and fittings. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation and with approval of the ENGINEER. Under no circumstances shall pipe or fittings be dropped

either into the trench or during unloading. The interior of the pipe shall be kept clean of oil, dirt, and foreign matter, and the machined ends and couplings shall be wiped clean immediately prior to jointing.

C. Use a PVC pipe cutter where necessary to cut and machine all PVC pipe in the field. A "full insertion mark" shall be provided on each field cut pipe end. Field-cut pipe shall be beveled with a beveling tool made especially for plastic pipe. Bevels shall be in accordance with the manufacturer's requirements.

D. Each length of pipe and fitting shall be marked with the nominal size, the SDR designation, the name of the manufacturer or his trademark, and the date of manufacture.

E. Rubber gaskets shall be marked with manufacturers identification sizes and proper insertion direction.

F. Pipe stubs for all manhole connections shall not exceed 2 feet in length unless otherwise shown on the drawings. Install caps where required.

G. Each time the work on the sewer is halted, the ends of the pipe shall be sealed to prevent foreign material from entering the pipe.

3.2 TESTS FOR GRAVITY SEWERS - GENERAL

A. Gravity sewers shall be required to pass a leakage test before acceptance. Leakage tests shall be as described in Section 33 05 01.

B. All polyvinyl chloride and fiberglass sewer pipe shall be subject to deflection testing assuring that the maximum deflection of 5% has not been exceeded. Any pipe failing this test is subject to removal and replacement at the CONTRACTOR’s expense. Do not use pipe rounders.

3.3 TELEVISION INSPECTION

A. All sanitary sewer gravity lines shall be televiewed in accordance with Section 33 01 36.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 31 02

BURIED FIBERGLASS REINFORCED PLASTIC (FRP) GRAVITY SEWER PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM)

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 30 05 02 – Laying and Jointing Buried Pipe

1.3 REFERENCES

A. Commercial Standards: (Latest Revision)

1. ASTM D3262 – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe

2. ASTM D4161 – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe Joints using Flexible Elastomeric Seals

3. ASTM D2412 – Standard Test Method for Determination of external Loading Characteristics of Plastic Pipe by parallel-Plate Loading.

PART 2 PRODUCTS

2.1 MATERIALS

A. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

B. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

C. Silica Sand: Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.

D. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used shall not detrimentally affect the performance of the product.

E. Elastomeric Gaskets: Gaskets shall be supplied by qualified gasket manufacturers and be suitable for the service intended.

2.2 MANUFACTURE AND CONSTRUCTION

A. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, non-porous, corrosion-resistant, consistent composite structure

B. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed, may utilize fiberglass, gasket-sealed closure couplings.

C. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy-coated steel and stainless steel fittings may also be used.

D. Flanges, elbows, reducers, tees, wyes, and other fittings shall, when installed, be capable of withstanding specified operating conditions. Field taps shall be made using “inserta-Tee” as manufactured by Fowler manufacturing Company, or equal. All fittings and accessories shall be furnished by the pipe supplier and shall have bell and/or spigot configuration compatible with the pipe.

E. Acceptable Manufacturer: Price Brothers, Hobas Pipe USA Inc., or approved equal.

2.3 DIMENSIONS

A. Diameters: The actual outside diameter (18 – 48 inches) of the pipes shall be in accordance with ASTM D3262. For other diameters, OD’s shall be per manufacturer’s literature.

B. Lengths: Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal +1, -4 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.

C. Wall Thickness: The minimum wall thickness shall be the stated design thickness.

D. End Squareness: Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8 inch.

2.4 TESTING

A. Pipes: Pipes shall be manufactured and tested in accordance with ASTM D3262.

B. Joints: Coupling joints shall meet the requirements of ASTM D4161.

C. Stiffness: Minimum pipe stiffness when tested in accordance with ASTM D2412 shall be 46 psi (F/Y = 32.34 Kg/cm^2).

2.5 INSPECTION

A. The OWNER or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.

2.6 PACKAGING, HANDLING, SHIPPING

A. Packaging, handling, and shipping shall be done in accordance with the manufacturer's instructions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Burial: The bedding and burial of pipe and fittings shall be in accordance with the project plans and specifications and the manufacturer's requirements.

B. Pipe Handling: Use textile slings, other suitable materials or a forklift. Use of chains or cables is not allowed.

C. Jointing

1. Clean ends of pipe and coupling components.

2. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.

3. Use suitable equipment and end protection to push or pull the pipes together.

4. Do not exceed forces recommended by the manufacturer for coupling pipe.

5. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.

D. Manhole Connections: Provide a water stop flange boot or gasket for connection of the fiberglass pipe to the manholes.

3.2 TESTS FOR GRAVITY SEWERS - GENERAL

A. Gravity sewers shall be required to pass a leakage test before acceptance. Leakage tests shall be as described in Section 33 05 01.

B. All polyvinyl chloride and fiberglass sewer pipe shall be subject to deflection testing assuring that the maximum deflection of 5% has not been exceeded. Any pipe failing this test is subject to removal and replacement at the CONTRACTOR's expense. Do not use pipe rounders.

3.3 TELEVISION INSPECTION

A. All sanitary sewer gravity lines shall be televiewed in accordance with Section 33 01 36.

END OF SECTION

SECTION 33 31 03

NONREINFORCED CONCRETE SEWER PIPE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Furnishing and installing nonreinforced concrete sewer pipe. Provide concrete sewer pipe less than 12 inches in diameter, and in other sizes when specifically called for, to be nonreinforced concrete pipe.

B. Related Work Specified in Other Sections Includes:

1. Section 33 05 01 - Leakage Tests
2. Section 33 05 03 - Laying and Jointing Buried Pipelines

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM C 14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
2. ASTM C 443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
3. ASTM C 497 - Test Methods for Concrete Pipe, Manhole Sections, or Tile

1.3 SUBMITTALS

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

B. Shop Drawings: Submit complete shop drawings of all plastic liner, details of installation and joints between pipes and structures, between other pipes and all other joints for approval.

C. Samples: Submit samples of the type of sheet and strip plastic liner plate for approval, together with a list of ingredients from which the sheets and strips are to be compounded. Submit the list to show the

percentage of each ingredient used in the formulation. No changes in formulation are permitted without prior approval.

D. Quality Control: Submit certified test results of all shop tests for approval.

1.4 QUALITY ASSURANCE

A. General: Provide concrete sewer pipe that is precast or machine made and of the product of a concern that can demonstrate by tests and installation records satisfactory experience in manufacturing concrete pipe of the quality and type specified.

B. Provide nonreinforced concrete pipe meeting the requirements of ASTM C 14 for Class 2 or Class 3 nonreinforced concrete pipe.

C. Classes: Provide the classes of concrete sewer pipe for the various pipelines as shown or specified.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all products and materials as specified in Division 1 (and as follows:)

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Pipe: Manufacture all nonreinforced concrete pipe in the longest lengths normally available except where shorter lengths are required for pipeline curves or at junctions with structures whose location cannot be adjusted.

1. Design: Cure all pipe by steam or membrane curing. Water curing is not permitted.

a. Do not deliver pipe to the site of the work until it has attained an age of at least 12 days.

B. Specials, Fittings and Accessories: Provide specials, fittings, and accessories where shown, specified or required, and manufactured in accordance with the applicable sections of the respective standard of the adjoining pipe. Provide joints the same as in the adjoining pipe.

Provide the interior surface of bends of the same smoothness and diameter as the adjoining pipe. Provide the center line radius of curvature to be equal, in dimension, to the inside diameter of the pipe.

1. Strength: Design all specials, fittings, and accessories to have the same strength as the class of the adjoining pipe. Submit working drawings in conjunction with those submitted for the entire pipeline.

C. Joints: Have nonreinforced concrete pipe manufactured with bell and spigot ends suitable for use with a rubber gasket joint.

1. Gaskets: Provide pipe ends for use with rubber gaskets that are suitably reinforced or of sufficient thickness to withstand the stresses caused by the compression of the gasket without cracking or fracturing, and provide surfaces that are smooth and free from spalls, cracks, fractures, and imperfections that would adversely affect the performance of the joint.

2. Gasket Design: Provide rubber gaskets of the 0-ring type. Provide the composition and physical requirements of the gasket for joints not normally subjected to internal pressure meeting the requirements of ASTM C 443. Do not stretch the gasket more than 20 percent when placed on the spigot of the pipe. Provide the gasket of such size that when the joint is off center sufficiently to cause the outer surface of the spigot end of the pipe and the inner surface of the bell end of the adjacent pipe to come into contact at some portion of their periphery, the deformation of the stretched rubber gasket is not more than 50 percent at the point of contact nor less than 20 percent at any point of the normal diameter or thickness of the gasket before deformation. Provide the gasket to be the sole element depended upon to make the joint watertight.

3. Bell and Spigot: Provide inside surfaces of the bell and outside surfaces of the spigot to be parallel with each other within one degree and, unless otherwise permitted, with an angle of not more than 2 degrees with the longitudinal axis of the pipe. Angles greater than 2 degrees will be approved only if plant or field hydrostatic tests show that the adjacent pipes can be properly joined and that the joint will not leak under a deflection sufficient to open one side of the joint 1/2-inch wider than the fully compressed position. In no case are angles of greater than 5 degrees

approved. Provide the spigot with a preformed groove of sufficient depth to hold the gasket securely in place and produce the proper compression in the gasket.

4. Grout: Fill the interior annular space of each joint, for pipe sizes 30 inches and larger in diameter, with cement grout as specified in Section 33 05 03.

2.2 SOURCE QUALITY CONTROL

A. Tests: Test concrete sewer pipe in accordance with the applicable provisions of ASTM C 497 as required by the ASTM Specification for the pipe. Test not less than three sections of each size and class of pipe.

B. Basis of Acceptance: Conform the basis of acceptance for nonreinforced concrete pipe with Section 5.1 of ASTM C 14.

C. Results: Have the manufacturer submit certified test results of these tests for approval. Provide the number of pipe tested equal to one percent of the number of pipe manufactured in any one size and class, except that not less than three pipes are to be tested unless otherwise approved.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install all nonconcrete sewer pipe in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

B. Install nonreinforced concrete sewer pipe in accordance with the requirements of Section 33 05 03.

3.2 FIELD QUALITY CONTROL

A. Tests: After installation of the nonreinforced concrete pipe and all appurtenances, subject the pipeline to a field running test, as specified in Division 1, under actual operating conditions.

B. Leakage Tests: Test the nonreinforced concrete pipelines for leakage after completion in accordance with Section 33 05 01.

3.3 SCHEDULES

A. Refer to the schedules contained in Section 33 05 03 Laying and Jointing Buried Pipelines for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 33 31 04

REINFORCED CONCRETE SEWER PIPE AND PRE-CAST WETWELL SECTIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Furnishing and installing reinforced concrete sewer pipe, fittings and specials and pre-cast wetwell sections.

B. Related Work Specified in Other Sections Includes:

1. Section 33 05 01 - Leakage Tests
2. Section 33 05 03 - Laying and Jointing Buried Pipelines

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM C 76 - Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
2. ASTM C 443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
3. ASTM C 497 - Specification for Testing Concrete Pipe and Tile.

1.3 SUBMITTALS

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

B. Shop Drawings: Submit complete shop drawings for all diameters and classes of reinforced concrete pipe, fittings and specials and pre-cast wetwell sections showing dimensions, strength and materials specifications and standards, joint details, and reinforcement position for approval prior to manufacture.

C. Materials Compliance: Submit notarized affidavits of all materials compliance with ASTM C 76.

D. Product Compliance: Submit notarized affidavit of pipe and pre-cast wetwell sections compliance with ASTM C 76 and these specifications.

E. Joint Compliance: Submit notarized affidavit of joint compliance with ASTM C 443 and these specifications.

F. Quality Control: Submit certified results of all shop tests for approval.

1.4 QUALITY ASSURANCE

A. General: Provide concrete sewer pipe, fittings and specials and wetwell sections that are precast or machine made and are the product of a concern that can demonstrate by tests and installation records satisfactory experience in manufacturing concrete pipe and pre-cast wetwell sections of the quality and type specified.

B. Reinforced Concrete Pipe and Pre-cast Wetwell Sections: Provide reinforced concrete pipe and pre-cast wetwell sections meeting the requirements of ASTM C 76 and these specifications.

C. Joints: Provide joints for pipe, fittings and specials meeting the requirements of ASTM C 443 and these specifications.

PART 2 PRODUCTS

A. REINFORCED CONCRETE PIPE AND PRE-CAST WETWELL SECTIONS

1. General: Manufacture all reinforced concrete pipe in lengths of not more than 16 feet and not less than 7-1/2 feet, except where shorter lengths are required for pipeline curves or at junctions with structures. Manufacture all reinforced concrete wetwell sections in lengths as shown or required. Do not use admixtures or blends in concrete without prior approval.

2. Design: Provide the classes of reinforced concrete sewer pipe and pre-cast wetwell sections as shown or specified. Conform designs with the following requirements.

a. Use diameter, wall thickness, compressive strength of concrete and area of circumferential reinforcement as prescribed for Classes I to IV in Tables 1 to 5 in ASTM C 76, except do not use Wall A thickness, elliptical reinforcing cages or quadrant reinforcing mats. Do not substitute modified designs for designs shown in the Tables.

b. Provide special designs only for pipe and pre-cast wetwell sections with diameters and loads beyond those shown in Tables 1 to 5, pipe diameters that do not have steel reinforcement areas shown in the Tables and pipe subject to thrust forces encountered in jacking operations. Design pre-cast wetwell sections for the loads specified in the Tables, using 5,000 psi reinforced concrete. Conform special designs with the requirements of Section 7.2.2 of ASTM C 76, except do not use Wall A thickness, elliptical reinforcing cages or quadrant reinforcing mats without prior approval. Retain a Registered Professional Engineer, licensed to practice structural engineering in the state in which the pipe will be installed, to prepare, sign and seal all special designs for pipe and pre-cast wetwell sections.

B. REINFORCED CONCRETE FITTINGS AND SPECIALS

1. General: Provide reinforced concrete fittings and specials where shown, specified or required, and manufactured in accordance with the applicable sections of the respective standard for the adjoining pipe. Provide joints the same as in the adjoining pipe. Provide the interior surface of bends of the same smoothness and diameter as the adjoining pipe. Provide the center line radius of curvature of bends to be equal, in dimension, to the inside diameter of the pipe.

2. Strength: Design all reinforced concrete fittings and specials to have the same strength as the class of the adjoining pipe. Retain a Registered Professional Engineer, licensed to practice structural engineering in the state in which the pipe will be installed to prepare, sign and seal all designs for fittings and specials.

C. JOINTS

1. Manufacture all reinforced concrete sewer pipe, fittings and specials and pre-cast wetwell sections with watertight joints using rubber gaskets in accordance with the requirements of ASTM C 443. Provide a preformed groove in the tongue or spigot of sufficient depth to hold the gasket securely in place and produce the proper gasket compression.

D. LINING

1. Provide lining as specified in Section _____.

E. CURING

1. Cure all pipe, fittings and specials by steam or membrane curing. Water curing is not permitted.

F. SHOP TESTING

1. General: Test concrete sewer pipe in accordance with the applicable provisions of ASTM C 497, as required by the ASTM Specification for the pipe and as specified herein.

2. Basis of Acceptance: Conform the basis of acceptance for reinforced concrete pipe with Section 5.1.1 of ASTM C 76 and these specifications.

3. Proof-of-Adequacy Tests for Special Designs: Prior to manufacturing production run pipe of special design, test one pipe of at least four feet in length of each diameter and class by the three-edge-bearing method to confirm that the pipe meets both the 0.01-inch crack and ultimate load requirements for which it is designed.

4. Joint Adequacy Tests: Prior to manufacturing production run pipe, fittings and specials, conduct all tests required by Sections 9 and 10 of ASTM C 443 for each diameter of pipe.

5. Finished Pipe Tests: Test two pipe sections of each diameter and class out of the first 100 pipe sections manufactured, or fraction thereof, by the three-edge-bearing method in accordance with Section 11.3 of ASTM C 76. Test one pipe section of each diameter and class from each subsequent lot of 100 pipe sections manufactured, or fraction thereof.

6. Submit manufacturing facility information for pre-cast wetwell sections for approval.

7. Properly locate pre-formed openings in pre-cast wetwell sections for pipe connections.

8. Submit concrete test results for pre-cast wetwell sections. The Owner will retain a testing laboratory to perform cores on the structure to verify steel reinforcement and concrete compressive strength.

9. Test Witnessing: Arrange for a qualified representative of an independent testing laboratory to witness all tests and provide certified test results.

10. Costs of Tests: Pay all costs associated with tests and test witnessing except as otherwise noted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all reinforced concrete sewer pipe, fittings and specials in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Do not deliver pre-cast wetwell sections to the job site until a minimum compressive strength 4,000 psi as determined by crushing tests on cured concrete cylinder has been obtained.

B. LEAKAGE TESTS

1. Test the reinforced concrete sewers and pre-cast wetwell for leakage after completion in accordance with Section 33 05 01.

C. SCHEDULES

1. Refer to the schedule contained in Section 33 05 03 for information on the piping that is to be constructed using the pipe materials and methods specified herein. Information on pre-cast wetwell sections is shown on the Plans.

END OF SECTION

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SECTION 33 34 00

BURIED POLYVINYL CHLORIDE (PVC) SEWER AND PRESSURE PIPE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Requirements for providing buried PVC pipe, fittings and appurtenances.

1. Provide PVC pipe and fittings complete with all necessary jointing facilities and materials, specials, adapters and other appurtenances required for installation in and completion of the pipelines to be constructed.

2. Provide plain end or rubber gaskets (push-on or mechanical joint) of the types, sizes and classes shown or specified.

B. Related Work Specified in Other Sections Includes:

1. Section 33 01 36 - Televising and Inspection of Gravity Sewer Systems
2. Section 33 05 01 - Leakage Testing
3. Section 33 05 03 - Laying and Jointing Buried Pipelines
4. Section 33 11 03 - Buried Ductile-Iron Pipe and Fittings
5. Section 33 11 12 - Disinfection

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM D 3034 Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings

2. ASTM F 679 Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings

3. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water Distribution

4. AWWA C905 Polyvinyl chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. through 36 In.

5. ASTM D 2321 Underground Installation of Flexible Thermoplastic Sewer Pipe

6. ASTM F 477 Elastomeric Seals (Gaskets) For Joining Plastic Pipe

7. ANSI A21.10 Ductile-Iron and Gray-Iron Fittings 3 inches through 48 inches, for Water and Other Liquids

8. ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings

1.3 SYSTEM DESCRIPTION

A. Design Standards: Provide 4-inch through 15-inch PVC gravity sewer pipe and fittings meeting the requirements of ASTM D 3034. Provide 18-inch through 27-inch PVC gravity sewer pipe and fittings meeting the requirements of ASTM F 679. Provide 4-inch through 36-inch PVC pressure pipe meeting the requirements of ANSI/AWWA C900. Provide mechanical ductile-iron pipe fittings for PVC pressure pipe meeting the requirements of Section 33 11 02.

1. Provide pipe of the various sizes and classes as specified in the schedule or shown. Restrain all pressure pipe joints.

2. Construct concrete encasements where shown.

1.4 SUBMITTALS

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

B. Submit the following shop drawings:

1. Pipe joints, fittings, sleeves and cleanouts. Where special designs or fittings are required, show the work in large detail and completely describe and dimension all items.

2. Fully dimensioned drawings of piping layouts, including fittings, couplings, sleeves, cleanouts, valves, supports and anchors. Label pipe size, materials, type, and class on drawings and include the limits of each reach of restrained joints. Provide cross sections showing elevations of cleanouts, pipes, fittings, sleeves, and valves.

3. Catalog data for pipe, joints, fittings, sleeves, harnessing and cleanouts.

C. Quality Control: Submit certificate of compliance for pipe, fittings, gaskets, coatings, specials, sleeves and cleanouts in accordance with this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all pipe, fittings and appurtenances as specified in Division 1 and Section 33 05 03.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fittings for Pressure Pipe: Provide all fittings meeting the requirements of ANSI A21.10, unless shown or specified otherwise. Provide fittings with cement mortar lining. Fittings 14 inches and larger require a pressure rating of 150 psi, or as specified, whichever is greater.

B. Joints and Fittings for Gravity Sewer Pipe: Provide all fittings meeting the requirements of ASTM D 3034 and ASTM F 679. Provide joints that are a molded integral part of the pipe section. Do not use joints or couplings furnished loose. Provide joints with elastomeric gasket joints.

C. Joints for Pressure Pipe: Provide pipe with bell ends in accordance with AWWA C900 and AWWA C905. Provide joints with elastomeric gasket joints.

D. Elastomeric Gasket Joints: Provide elastomeric gasket joints in accordance with ASTM F 477.

E. Rubber Gasket Joints: Provide mechanical joints meeting the requirements of ANSI A21.11.

F. Harnessing: See LCU Approved Materials List.

G. Color: Provide pipe made of 100 percent of the color specified. Provide green sewer or force main pipe. Provide blue potable water pipe. Provide pantone purple for reuse water pipe.

H. Pressure Pipe Outside Diameter: Provide pressure pipe of the outside diameter consistent with ductile-iron pipe.

I. Pipe Marking: Provide mark on each pipe at internals of 5 feet or less to designate compliance with applicable ASTM or AWWA specification.

J. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed and are not ready to connect.

1. Remove all temporary bulkheads when they are no longer needed.

K. Date of Manufacturer: Provide pipe and fittings manufactured no earlier than 12-month period preceding the date of the Agreement.

L. Wall Thickness for Gravity Sewer:

1. 4 through 15 inches diameter - provide SDR-26 conforming to ASTM D 3034 for depth of cuts through 18 feet.

2. 18 through 27 inches diameter - provide either T-1 or T-2 conforming to Table 1 in ASTM F 679.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all buried PVC pipe and fittings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1 and Section 33 05 03.

3.2 LEAKAGE TESTING

A. Cleaning: Flush clean and test all pipes after installation.

B. Testing: Test pipes for leaks and repair or tighten as required.

C. Procedures: Conduct tests in accordance with Section 33 05 01.

3.3 DISINFECTION

A. General: Disinfect all pipelines that are to carry potable water before they are placed in service as specified in Section 33 11 12.

3.4 SCHEDULES:

A. Refer to the Schedules contained in Section 33 05 03 Laying and Jointing Buried Pipelines for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION

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SECTION 33 34 01

POLYVINYL CHLORIDE (PVC) FORCE MAIN 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. Threaded joints can be used with PVC Schedule 80 pipe or stronger with diameters larger than 2 inches. At threaded joints between PVC and metal pipes, the metal shall contain a threaded socket end and the PVC threaded spigot end. A metal spigot shall not under any circumstances, be screwed into a PVC socket.

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.

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 force main pipe 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. Test force mains for leakage in accordance with Section 33 05 01.

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

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 45º 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 22" 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 42" 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.

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 as specified in the respective pipe sections in Division 15.

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 10KA AIC 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 installing contractor shall maintain an office with full time sales and service staff within a one hundred and fifty-mile radius of the site.

A. D. Provide the services of a qualified control system integrator that has demonstrated competence in providing controls system integration on this type of facility. Submit qualifications within 5 days of bid. Provide a list of ten (10) professional references of owners or clients of previous work. Include references from a minimum of three (3) governmental agencies that have contracted for similar type and size services, and three (3) engineering consultants whose design was incorporated or undertaken by the Contractor within the last five (5) years. The list shall include: Company name and address. Contracting officer and telephone number. Technical representative and telephone number. A written description of the project. Project value quoted for integration services work for each project. Include only projects utilizing the type and make of PLC (Allen Bradley), Scada Pack and HMI programming (Clear Scada) used on this project. Provide the services of a Lee County Utilities pre-qualified instrumentation and controls contractors for this project. The pre-approved contractors qualified through a RFQ process. This list can be found on the Procurement website. Any contractor that is not on the list will have to go through the same process as the RFQ qualified contractors.

E. 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.

F. 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.

1. 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.
2. Verify the calibration and adjustment of devices.
3. Verify proper control system interface and operation.
4. Start up and test to demonstrate proper control system interface and operation, in coordination with the equipment manufacturer.
5. The I&C contractor shall provide the electrical contractor with complete and coordinated VFD control drawings for manufacturer's use in the submittal approval process.
6. 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.

G. 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.

H. 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 supplier.

I. 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 that the particular activity has been accomplished.

1.03 SUBMITTALS-shall be submitted in accordance with Section 26 05 02 BASIC ELECTRICAL MATERIALS AND METHODS.

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 2014 or converted to Autocad version 2014. 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.

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 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 at his 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 controls contractor.

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.
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 pump 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
6. Assign pre-defined (or user-defined) faults, e.g. thermal overload, contactor fail, to any digital input
7. 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.

Fiber B. 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.

CellularB. 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.

C. Bi-directional communications between the fiber ready network and network connected equipment shall be provided by 10/100 base-T unmanaged Ethernet switches.

D. 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.

CellularE. 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 will be ___ feet above wetwell floor. High level alarm and start back up pump control for pump 1 is initially set to ___' above wetwell bottom. The backup pump control for the second and third pump is initially set to control at ___' above wetwell bottom. 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 over ride of motor monitor system auto shutdown. A 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 programmed into the VFD (initially 35hz) shall be set to maintain a flowrate with an initial value of ___gpm for all head conditions. 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 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 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 TRASMITTER

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.

2.09 ELECTROMAGNETIC FLOWMETER

A. Magnetic flow meter systems shall include a flanged spool piece style magnetic flow tube and a remote microprocessor based transmitter that is capable of converting and transmitting a signal from the flow tube. The magnetic flow meters shall utilize the characterized field principle of pulsed electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

B. Provide meters of 304 stainless steel material with a PFA or Polyurethane liner. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.

C. Provide flow tubes with flush mounted Hastelloy-C electrodes, or as recommended by the manufacturer. Size flow tube as shown on mechanical drawings.

D. Grounding rings shall be provided for all meters.

E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316L stainless steel or compatible with the process fluid for each meter in accordance with the manufacturer's recommendations.

F. Flow tube shall be rated for temperatures of up to 180°C and pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of 30 to +65°C. Meter shall meet IP68/NEMA-6P requirements for submersible service. Transmitter shall meet IP65/NEMA-4X requirements. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas.

G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4 20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self diagnostic routines and report errors via English language messages.

H. The transmitter's preamplifier input impedance shall be a minimum of 109-1011 ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external unpowered signal.

J. Accuracy shall be 0.5% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum rangeability shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be 10 to +50 degrees Celsius. Power supply shall be 115 VAC, 60 Hz.

K. Provide flow tubes that are factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes. Flow Meters shall be factory calibrated to NIST traceable standards. Provide certified factory calibration records.

L. Provide flow meter system with in-situ flow calibration verification. Provide field verification system (including hardware and software) that automatically tests the flow measurement system and is capable of producing a printed certificate of calibration verification that is traceable (Endress Hauser Proline Fieldcheck with Field Tool Software or equal by flowmeter manufacturer).

M. Manufacturer’s representative shall conduct a field inspection after installation, conduct start-up of the flow meters, certify in writing the meters’ proper installation, and verify calibration of flowmeters after installation.

N. Flow metering systems shall be Endress Hauser Proline Promag 400L, Siemens or equal with integral flow indicating transmitter.

O. Manufacturer to provide a written five year extended warranty from (a) date of issuance of “Certificate of Proper Installation” and Operation.

2.10 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.

2.11 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.

C. 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. The Engineer 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. When each test has been successfully completed, a copy of all test results shall be furnished to the Engineer 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 plant 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 technician 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.

B. Control system start-up and testing shall be performed to ensure that all plant 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 by Contractor and Engineer.

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 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. 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.

D. 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.

E. 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.

F. 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

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 cellular radio 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, Solid State Soft Starters, 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 B Duplex & Triplex IO List

E. Lee County Utilities will self-perform all work required to integrate the 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 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 10KA AIC 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 installing contractor shall maintain an office with full time sales and service staff within a one hundred and fifty-mile radius of the site.

H. 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 contractor.

I. 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 that the particular activity has been accomplished.

1.03 SUBMITTALS-shall be submitted in accordance with Section 26 05 02 BASIC ELECTRICAL MATERIALS AND METHODS.

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 2014 or converted to Autocad version 2014. 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.

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 RTU controller 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.

B. 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.

PART 2 - PRODUCTS

2.01 GENERAL

A. The pump station electrical control equipment shall be wall mounted NEMA 4X enclosures of approximately 48”High x 48" wide x 16” in depth. The cabinet shall be arranged to separate the incoming field terminal interface blocks and surge suppression from the SCADA Pack I/O signals in the cabinet. See drawing for arrangement details.

B. Control panel enclosures shall include the following features:
1. Internal Light with toggle-Switch
2. Internal Service Power Outlets
3. Uninterruptible Power Supply (UPS)
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. LEE county shall provide the Ladder Logic programming for use with the pump stations.

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 RTU 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 RTU and local control cabinets. Provide Erico UTB series for all analog signals entering or leaving the 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 control compartment door or 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 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. Units with up to 12 selection positions shall be Rundel-Idec Standard Cam Switch, Electroswitch 31, or equal.

2.02 SCADA PACKS

A. The control system integrator shall furnish RTU as specified herein and as shown on the Drawings. SCADA Packs shall be provided complete with instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein.

B. The RTU shall be designed to operate in an industrial environment. The controller shall operate over an ambient temperature range of -40°C to 70°C (-40°F to 158°F) with a relative humidity 5% to 95%, non-condensing. The controller shall operate from nominal power supplies 12-24 VDC, but shall tolerate a wider range than this. 115/240 VAC operation shall be provided through the use of an optional power supply. The controller shall include a built-in power supply with wide range input, at least 10VDC - 30VDC. The power supply must be capable of providing 24VDC output to power field transmitters. Diagnostic LEDs shall be included for the following: Controller Status, Wide area communication link activity such as transmit, receive, Local peripheral communication link activity, I/O point indication (All DI & DO points as a minimum, preferably including AI points)

C. System configuration shall be as shown on the drawings. SCADA Pack shall be Square D SCADAPack 334E or better with Ethernet Network port 10BaseT/100BaseT. The RTU shall include provisions for automatically updating time for changes in daylight savings time. Time shall be automatically synchronized with the plant SCADA system. Time changes shall be automatically sent from the plant SCADA system to the remote controller.

D. The SCADA controller shall be intelligent, modular unit, capable of both data acquisition and local data processing. It shall monitor and control local equipment in a standalone mode as well as being an intelligent node in a

distributed system. It shall be based on multiprocessor architecture, in which a co-processor is used for handling on-board input/output channels. To facilitate initial installation, maintenance and future expansion, all external input/output modules shall connect to the basic controller using a high-speed bus.

E. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the controller RTU level.

F. Provide a user interface for operations and configuration. Provide an C-MORE HMI 6" touchscreen display.

G. Provide a user interface for operations and configuration. Provide an C-More 6" Gray Scale touchscreen. 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.

2.03 CELLULAR ROUTER 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. Each connected device shall be equipped with its own network interface unit. The well RTU will communicate with an existing SCADA system via cellular routers using 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 stations.

B. 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.

C. Bi-directional communications between the fiber ready network and network connected equipment shall be provided by 10/100 base-T unmanaged Ethernet switches.

D. Each individual RTU shall be connected to the network via a dedicated 10/100 Base-T Ethernet port on its Ethernet module. The RTU Ethernet module shall be connected to the Ethernet switch located in the control panel cabinet. The RTU Ethernet Communication Interface shall provide for a minimum 100 M Baud TCP/IP network. True duplex peer-to-peer, networking shall be supported.

2.04 DATA ACQUISITION AND GENERAL CONTROL LOGIC

A. Not in AUTO Alarms: Before operating any field device, the RTU program shall

check to see that the device has been switched to the AUTO mode. If the device is not in AUTO, the RTU 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 RTU, the RTU 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 RTU timers shall be adjustable through the HMI software by the operator under security password clearance.

D. RTU Diagnostic Alarms: each RTU shall monitor its CPU and I/O modules. When the CPU or any I/O module fails, the RTU shall generate a RTU 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.

2.05 SUBMERSIBLE LEVEL TRANSDUCER (intrinsically safe)

A. Provide submersible level transmitters to sense the liquid level of the wetwell. The unit shall consist of a submersible sensor and encapsulated transmitter to provide a continuous monitoring of the wetwell level. Provide transducer housing fabricated of 316 stainless steel with oil filled diaphragm. Provide transducer with 1/2" NPT male thread for pipe mounting and stainless steel standoff to protect the diaphragm.

B. Provide transmitter with 4-20madc output, loop powered type, with output signal directly proportional to the measured level. Excitation range 9-36vdc.

C. Provide a NEMA-4X lockable weatherproof enclosure for the wiring termination. The enclosure shall house a sealed breather system that relieves the internal air

pressure of the sensor assembly to atmospheric pressure and a Permanent Desiccant Filter.

D. Provide unit with 24+/- foot 0.75” 316 stainless steel pipe and chain mounting provisions as detailed.

E. Provide Contegra model SLX 130 sensors with 0-5PSI (0-11.5’) or 0-10PSI (0-23.5ft) range.

2.06 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.

2.07 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.

2.08 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.

2.09 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; 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.

C. 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. The Engineer 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. When each test has been successfully completed, a copy of all test results shall be furnished to the Engineer 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 Control panel 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.

B. Control system start-up and testing shall be performed to ensure that all plant 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 by Contractor and Engineer.

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 on an individual basis from the primary element to the final element, including the RTU Controller I/O and 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. 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 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 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.

D. 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.

E. 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.

F. 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 RTU 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

SECTION 40 95 33

FIBER OPTIC COMMUNICATION SYSTEM

PART 1 – GENERAL

1.01 REFERENCED STANDARDS

A. The cable and installation shall meet all requirements stated in this specification as well as the latest edition of the following:
   1. Insulated Cables Engineers Association (ICEA); S-87-640 Standard for Fiber Optic Outside Plant Communication Cable
   2. United States Department of Agriculture Rural Development Utilities Program (RDUP); PE-90
   3. ISO/IEC:
      a. 24702 Information technology -- Generic cabling -- Industrial premises OS2 Single-mode fiber type 0.4db/km attenuation
      b. 11801 Information technology — Generic cabling for customer premises OM1 Multimode fiber type 62.5 µm core; minimum modal bandwidth of 200 MHz*km at 850 nm
   4. International Electrotechnical Commission (IEC):
      a. 60793-2-50 Type B1.3 Product specifications - Sectional specification for class B single-mode fibres
      b. 60793-2-10 Type A1b Product specifications - Sectional specification for category A1 multimode fibres
   5. International Telecommunication Union (ITU); T G.652.D Characteristics of a Single Mode Optical Fibre and Cable
   6. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) Standards:
      a. 455-78-B Measurements Methods and Test Procedures-Attenuation
      b. 492 CAAB Detail Specification for Class IVa Dispersion-Unshifted Single Mode Optical Fibers with low water peak
      c. 492 AAAA-A Detail Specification for 62.5 micrometer Core Diameter/125 micrometer cladding diameter Class IVa Graded-Index Multimode
      d. 568-C.3 Optical Fiber Cabling Component Standard
      e. 598-B Optical Fiber Cable Color Coding
   7. Restriction of Hazardous Substance (RoHS) Compliant
   8. Telcordia; GR-20-CORE

1.02 QUALITY ASSURANCE

A. Manufacturer
   1. The cable manufacturer shall be ISO 9001 or Quality Management System TL 9000 registered.

B. Installer
   1. The fiber optic cable installer shall be certified by the cable manufacturer and adhere to the engineering, installation and testing procedures and

utilize the authorized manufacturer components and distribution channels in provisioning the Project

2. The Contractor directly responsible for this work shall be a Premise Distribution contractor who is, and who has been, regularly engaged in the providing and installation of commercial and industrial telecommunications wiring systems of this type and size for at least the immediate past five years.
3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and have personnel who are adequately trained in the use of such tools and equipment.

1.03 SUBMITTALS-shall be submitted in accordance with Section 26 05 02 BASIC ELECTRICAL MATERIALS AND METHODS.

A. SHOP DRAWINGS shall include:
1. Cable schedule showing cable identification, fiber counts for each cable and identification of used fiber pairs.
2. Component Data:
a. Manufacturers and model number
b. Data sheets
3. System Block Diagram
4. Detailed Test Procedure to be implemented including all tests to be conducted and list of equipment to be used.

B. OPERATION and MAINTENANCE submittal shall include:
1. All shop drawing data revised for as built conditions
2. Manufacturers user manuals and installation instructions
3. Fiber Optic Cable Test Results

1.04 SYSTEM DESCRIPTION

A. Furnish and install complete with all accessories a TIA/EIA fiber optic, Cabling System (FOCS). The FOCS system shall serve as a vehicle for transport of data and video signals connecting designated demarcation points and other locations as indicated on the contract drawings and described herein.

B. The system shall utilize a network of fiber optic cabling. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings. Cables shall terminate on rack mounted Fiber Distribution Centers (FDC's) located as shown on the drawings. All cables, and terminations shall be identified at all locations. All terminations shall comply with, and be tested to TIA/EIA and Gigabit Ethernet fiber optic standards.

C. Major work items include but are not limited to:
1. Fiber optic cable and patch cords
2. Fusion splicing
3. Splice enclosures
4. Fiber Optic Patch Panels
5. Installation of fiber optic cable

6. Fiber optic terminations
7. Testing of the fiber optic cable including:
   a. OTDR testing on installed fiber optic cable.

D. Electrical Contractor to furnish and install conduit and pull boxes for fiber optic cable. Coordinate fiber optic cable and conduit requirements with electrical contractor.

E. Provide fiber optic cable for installation based on lengths provided by the electrical contractor.

F. Environmental Specifications:
1. Outside Plant Fiber Optic Cable operation and storage -40 degrees C to +70 degrees C.
2. Equipment Outside above ground -40 degrees C to +80 degrees C.

PART 2 – PRODUCTS

2.01 GENERAL

A. Multi-mode fiber optic cabling shall be provided between fiber racks as designated on the contract drawings. Cables placed below grade shall be certified by the manufacturer for that environment. Cables installed in vertical risers between floors shall be U.L. listed riser type cable. Cables installed in plenum spaces shall be listed for that environment.

2.02 MODE FIBER OPTIC CABLE

A. Provide 62.5/125-micron OM1 Class IVa Graded-Index Multimode Optical Fiber for use in the backbone and horizontal distribution system.

B. Fiber Characteristics:
1. Reduced Water Peak
2. Maximum Attenuation: 850/1300nm: 3.5/1.5dB/km
3. Color coded buffer tube
4. Color coded fiber
5. Loose Tube
6. Maximum Transmission: 1 Gbps Ethernet; 300m at 850nm and 600m at 1300nm
7. Minimum Bend Radius 4.1” longterm, 8.2” during installation.

C. Cable Characteristics:
1. Fiber Count-6 fibers per cable or as otherwise noted on the drawings.
2. Loose Tube Cable with diaelectric gel free water blocked buffer tubes
3. Up to 12 fibers per buffer tube
4. UV resistant Outer Jacket
5. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrinkback requirements.
6. Buffer tubes shall be stranded around a dielectric central member using a reverse oscillating lay.
7. Top and bottom ends of cable shall be available for testing.
8. Both ends of cable shall be sealed during shipping to prevent ingress of

moisture.

9. The jacket shall be free of holes, splits and blisters. It shall also contain no metal elements and shall be of consistent thickness.
10. Maximum Tensile Loading: 2700N(600lbf) during installation and 890N(200lbf) long term.

D. Manufacturers:
   1. Superior Essex Series 11
   2. Corning
   3. Berk-Tek

2.03 FIBER OPTIC TERMINATION PANELS

A. Rack Mounted Panels: Fiber optic cabling shall be terminated in fiber distribution centers as described herein. FDC's shall include plexiglass front doors with latching mechanism. Provide blanking modules in all unused connection ports. FDC's shall be provided in quantities and configurations as required complete with SC style connectors. All FDC's shall be provided with rack mounting hardware allowing the unit to be placed in a standard EIA 19" rack.

B. Control Panel Mounted Field Panels: Fiber optic cabling shall be terminated in wall mount fiber enclosures as described herein. Enclosures shall include swinging side doors with latching mechanism and routing guides. Provide blanking modules in all unused connection ports. FDC's shall be provided in quantities and configurations as required complete with SC style connectors. All FDC's shall be provided with mounting hardware allowing the unit to be mounted to a backplane.

C. General: Provide blanking modules in all unused connection ports on the panels. All panels shall include strain relief points where fiber optic cable strength members shall be securely attached.

D. Labels: Labeling for fiber cabling shall be by the color suffix designating which fiber is terminated. Die cut acetate labels or Kroy labels shall be considered acceptable the purpose

E. Accessories: Provide (6) six duplex fiber optic patch cords with ST connectors at each termination point.

F. Manufacturers:
   1. Lightwave
   2. Blackbox
   3. Corning

2.04 FIBER OPTIC CONVERTER

A. Control Network Switch
   1. Provide 120V hardened heavy duty 10-/100-Mbps copper to 1000 Mbps Single Mode switch with SC Connectors.

B. Manufacturers:
   1. Blackbox

2. Sixnet

2.05 FIBER OPTIC CONNECTORS

A. General: Provide field installable, single mode SC type connectors. Connectors shall be Glass-in-Ceramic, with a maximum loss of .2 dB.

B. Manufacturers:
1. Blackbox
2. Corning
3. Siemon

2.06 FIBER OPTIC PATCH CORDS

A. General: All patch cords shall be of the same manufacturer as provided with the FDU units and shall comply with manufacturers approved testing and warranty statements.

2.07 UNSPECIFIED EQUIPMENT AND MATERIAL

A. Any item of equipment or material not specifically addressed on the contract drawings or in this document and required to provide a complete and functional SCS installation shall be provided in a level of quality consistent with other specified items.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Fiber Optic Cable
1. Install cable in accordance with cable manufacturer recommendations for bend radius and pulling tension. Do not exceed limits specified by the manufacturer.
2. Utilize break away swivel set at 600lbs for straight pulls greater than 100' and all pulls which are not in a straight line.
3. Identify cable on both ends, in pull boxes and at all terminations.
4. Terminate all fibers in each cable to a connector.
5. Provide slack fiber coiled neatly in cable management at all fiber termination centers, converters and switches.
6. Terminate cables using manufacturer supplied break-out kits.
7. Fan out fiber to allow direct connection with connectors. Provide strain relief with fan out collar.

3.02 TESTING

A. Fibers in fiber optic cable shall be tested for correctness of termination and overall transmission loss using an approved fiber optic transmission loss test instrument (OLTS) and optical time domain reflectometer instrument (OTDR). System loss measurements shall be provided at 1310nm and 1550 nm for single mode fiber, at 850 and 1300 nanometers for multimode fiber. A certification report shall be provided listing both the calculated and measure loss for each

fiber optic circuit and submitted with the close out documents.

B. All cabled fibers greater than 1000 meters in length shall be 100% attenuation tested. The Attenuation of each fiber shall be provided with each cable reel.

C. Perform OLTS testing in both directions of installed backbone and horizontal fiber.
   1. Submit test report which includes:
      a. Fiber Identification
      b. Length of each fiber vs calculated length
      c. Copy of the OTDR printouts
      d. Pass or fail status of length under test.

D. Provide OTDR post installation tests for each installed fiber strand
   1. Test each installed fiber optic link for continuity and loss using an OTDR with disk storage capabilities.
   2. Submit test report for each cable which includes:
      a. Cable Identification
      b. ID of reel cable was taken from
      c. Copy of the OTDR printouts
      d. Pass or fail status of each fiber on the reel.

END OF SECTION

SECTION 44 31 21

PRE-ENGINEERED BIOFILTRATION ODOR CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Biofiltration odor control system and appurtenances as shown on the Drawings and specified in this Section.

1.2 SYSTEM DESCRIPTION

A. Furnish and install a pre-engineered biofiltration odor control system including all appurtenances necessary for a complete installation.

1. The following components of the biofiltration odor control system shall be furnished by the specified manufacturer of the biofiltration odor control system and installed by the CONTRACTOR:

    a. Biofiltration odor control units
    b. Moisture integrator bubblers
    c. Moisture separators
    d. Odor control system blower
    e. Odor control system electrical control panel
    f. Carbon Vessel (if specified in the drawings).

2. The following components of the biofiltration odor control system shall be furnished and installed by the CONTRACTOR: Connecting odor control air pipe, fittings, valves, and accessories

    a. Odor control system water supply pipe, fittings, valves, and accessories
    b. Odor control system drain pipe, fittings, valves, and accessories
    c. Piping support

3. Other Work required to complete the biofiltration odor control system shall be performed by the CONTRACTOR. Other Work required to complete the biofiltration odor control system includes, but is not necessarily limited to, the following:

    a. Conduit, wiring, and other field electrical work required for a complete odor control system.
    b. Excavation, backfill, grading, and site restoration required for a complete odor control system.

c. Concrete foundations, supports, and related Work required for a complete odor control system.
d. Masonry work required for a complete odor control system.

B. The biofiltration odor control system shall be designed in accordance with generally accepted criteria and shall meet all requirements of the State of Florida Department of Environmental Protection. The following minimum design parameters shall be incorporated into the design of the biofiltration system.

1. Duty: Continuous
2. Ambient Environment: Outdoor
3. Ambient Temperature Range: 20°F to 120°F
4. Ambient Relative Humidity: 10% to 100%
5. Project Site Elevation: [_____] feet above MSL
6. Service: Odorous air containing hydrogen sulfide, mercaptans and other gases from raw wastewater.
7. Design Air Flow and head: [_____] scfm at a vacuum of [____] inches WG
8. Average Influent H2S Concentration: [_____] ppm
9. Maximum Influent H2S Concentration: [_____] ppm
10. Required Effluent H2S Concentration: Greater than 99% removal, or less than 1 ppm H_2S, whichever is less

1.3 SUBMITTALS

A. General: As specified in:

1. General Conditions;
2. Supplementary General Conditions;
3. Section 01 33 00 Shop Drawings and Working Drawings;
4. This Section.

B. Submit the following prior to equipment manufacture:

1. Shop drawings and product data specified in Section 01 33 00, including the following:

a. Description and schematic diagrams of control systems to include overall biofiltration odor control unit wiring diagram and wire sizes. Complete control schematics, including coordination with electrical control devices, wiring diagrams, and suitable outline drawings shall be furnished for approval before proceeding with manufacture.

b. Data on the characteristics and performance of the blower. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for

pressure, capacity, efficiency, and horsepower. Curves shall be submitted on 8-1/2" x 11" sheets, at as large a scale as practical.

c. Complete motor data.

2. Manufacturer's outline of services specified in this Section.

C. Submit the following prior to equipment installation:

1. Manufacturer’s installation instructions.
2. Manufacturer’s Operation and Maintenance Data.
3. Special tools and spare parts list specified in Section 01 61 00 Material and Equipment

D. Submit the following prior to Substantial Completion:

1. System performance test data specified in this Section.
2. Written Warranties specified in this Section.

E. In the event that it is impossible to conform with certain details of the Specifications, describe and justify completely all non-conforming aspects.

F. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover all areas noted above and for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the specifications. Incomplete or partial submittals will not be reviewed.

1.4 OPERATING INSTRUCTIONS

A. Provide five (5) copies of an Operation Installation and Maintenance Manual. The Manual shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

B. A representative of the biofiltration odor control system manufacturer who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the OWNER on proper operation and maintenance. This work may be conducted in conjunction with the inspection and the installation and test run as specified in this Section. If there are difficulties in operation of the equipment due to the biofiltration odor control system manufacturer's design or fabrication, additional service shall be provided at no cost to the OWNER.

1.5 QUALITY ASSURANCE

A. The manufacturer of the biofiltration odor control system shall be responsible for the performance, and fabrication of the biofiltration odor control system units including the following:

1. Biofiltration Odor Control Units
2. Moisture Integrator Bubblers
3. Moisture Separators
4. Odor Control System Blower
5. Odor Control System Electrical Control Panel
6. Carbon Vessel (if specified in the drawings)

B. Selection and arrangement of all components of the biofiltration odor control system shall be coordinated by the biofiltration odor control system manufacturer with the ENGINEER.

C. Install the biofiltration odor control system with installation services by the biofiltration odor control system manufacturer as specified in this Section.

D. Biofiltration odor control system manufacturer shall be responsible for the structural and process integrity of the design; which must also be documented by a Professional Engineer registered in the State of Florida.

E. Biofiltration odor control system manufacturer shall provide initial gas sampling and laboratory testing.

1. Initial gas sampling and laboratory testing shall identify odorous compounds and their respective levels. Sampling and testing for odorous compounds shall include, but shall not necessarily be limited to, the following compounds and detection limits (DL):

a. Hydrogen sulfide (DL<20)
b. Dimethyl sulfide (DL<10)
c. Dimethyl disulfide (DL<10)
d. Ethyl mercaptan (DL<20)
e. Methyl mercaptan (DL<20)
f. Carbonyl sulfide (DL<20)
g. Carbon disulfide (DL<10)

2. Sampling shall be done between the hours of 7:00 A.M. and 10:00 A.M.

3. Do not exceed sample holding time limits.

4. Gas chromatography (GC) using the appropriate detector for the required detection limits shall be the basis of the laboratory testing.

5. Initial gas sampling and laboratory testing shall be done at no additional cost to the OWNER and shall be done to verify that the odor control system herein specified will provide the OWNER's level of accepted gas treatment.

6. A Letter of Guarantee, along with test results verifying this sampling and testing has been done, shall be submitted to the ENGINEER.

1.6 WARRANTY

A. Equipment Warranty and Media Warranty

1. Biofiltration odor control system shall be warranted to be free from defects in workmanship, design, and materials. If any part of the biofiltration odor control system should fail during the warranty period, it shall be replaced at no additional cost to the OWNER.

2. Warranties shall cover all components of the biofiltration odor control system for at least one year with the following exceptions:

a. Biofilter media shall be warranted by the biofiltration odor control system manufacturer to meet the required H_2S effluent concentration limitation specified in this Section without media change-out for a term of at least three years from the date of installation. The biofiltration odor control system manufacturer shall replace the media at the regular price of the media less the pro-rated amount based on the life of the original media; i.e. regular price less 33% if media last only two years. Replacement media shall be delivered and installed at no additional cost to the OWNER.

b. Structural integrity of the enclosures for biofiltration odor control units, the humidification units, and the dehumidification units shall be warranted for a period of at least five (5) years. If any cracks, leaks, or structural failure of these enclosures result in failure of the biofiltration odor control system to meet the required H_2S effluent concentration limitation specified in this Section, the biofiltration odor control system manufacturer shall repair or replace the enclosures at no additional cost to the OWNER.

B. Performance Guarantee

1. Biofiltration odor control system manufacturer shall guarantee the performance of the entire biofiltration odor control system for a period of 365 days from the date of final acceptance of the biofiltration odor control system.

2. If the biofiltration odor control system fails to meet the H_2S effluent concentration specified in this Section, the biofiltration odor control system manufacturer shall make the necessary adjustments, modifications, equipment

repair, equipment replacement, and H_2S testing at no additional cost to the OWNER.

PART 2 PRODUCTS

2.1 MANUFACTURER AND MODEL

A. Biofiltration odor control system shall be Siemens or BioAir Anaerobic (see LCU Approved Materials List).

B. No substitution is permitted.

2.2 BIOFILTRATION ODOR CONTROL SYSTEM, GENERAL

A. Biofiltration odor control system equipment shall be standard equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of such equipment. Equipment furnished shall be designed and constructed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. Equipment furnished shall be new and unused.

C. The biofiltration odor control system shall be totally enclosed, climate controlled per the operating temperature range specified in this Section and operate under vacuum with the blower downstream of the overall biofiltration odor control units and moisture separator. Non-enclosed systems, non-climate controlled systems, or systems operated under blower pressure in lieu of vacuum will not be considered.

D. Enclosures for the biofiltration odor control units, moisture integrator bubblers, and moisture separators shall be constructed of high density polyethylene (HDPE) with ESCR (100% Igepal F_{50}) of greater than 1,000 hours. All material used shall be corrosion resistant and suitable for operation in a moist atmosphere containing hydrogen sulfide, sulfuric acid, and other corrosive compounds. Concrete vessels and enclosures will not be considered. Metal vessels and enclosures will not be considered. Coated vessels and enclosures that are not corrosion resistant will not be considered.

2.3 BIOFILTRATION ODOR CONTROL UNITS

A. Biofiltration odor control units shall utilize odor metabolizing aerobic microorganisms to reduce the concentration of hydrogen sulfide in air flowing through the unit. Systems designed for the treatment of odors using any form of the addition of chemical agents will not be considered. Systems designed for the treatment of lift station odor control using chemical masking will not be considered.

B. The biofiltration odor control units shall be stacked, interlocking trays. Each unit shall consist of five active trays and one cover tray. The five active trays shall be filled with biologically active media. The cover tray shall provide a sealed top cover for the odor control unit.

1. Media tray and cover tray shall be identical construction.

2. Each tray shall be capable of holding 20 cubic feet of medium.

3. Each tray shall be approximately 6 feet in diameter and 14 inches high.

4. Each tray shall weigh approximately 120 pounds empty.

5. Trays shall be designed for flow rates of between 10 and 200 SCFM.

6. Trays shall be molded from High Density Polyethylene (HDPE) with ESCR greater than 1,000 hours.

7. Each tray shall have an integral plenum, inlet port and outlet port (3" FNPT).

   a. Inlet port of the top tray shall be used for introduction of the MIB-conditioned process stream.
   b. Outlet port of the bottom tray shall be used as an exhaust to the Moisture Separator.

8. The top tray shall contain a spray nozzle assembly that may be used to directly add water to the filter medium (3/4" MNPT connection).

C. Each stack of biofiltration unit trays shall be held together with stainless steel tie rods and wing nuts.

D. Each stack of biofiltration unit trays shall be factory mounted on a skid.

E. Overall dimensions of each stack of biofiltration odor control units mounted on a skid shall be 72 inches wide by 72 inches long by approximately 82 inches high.

2.4 MOISTURE INTEGRATOR BUBBLERS (MIB)

A. MIB shall provide process stream humidification and temperature control prior to introduction to the biofiltration odor control units. Water shall be added to the process stream as required to maintain the moisture concentration in the biofiltration odor control unit media at an optimum level for the odor reducing microorganisms. The process stream shall be heated as required to maintain the temperature in the biofiltration odor control unit media at or above the minimum temperature required for the odor reducing microorganisms to remain alive and active.

B. MIB shall be stacked, interlocking trays. MIB trays shall be identical to the biofiltration odor control unit trays.

C. Each MIB shall consist of three trays: two stacked and one inverted on top.

1. The bottom tray shall serve as the reservoir for the Moisture Integration Chamber formed by the two trays above.

2. The reservoir tray shall house a thermostatically controlled heating element for control of moisture integration water temperature.

D. Each MIB shall be connected to the facility water supply.

1. Water usage shall be approximately 1 gallon per 50 SCFM per hour of air processed through the biofiltration odor control system.

2. An automatic float valve system shall be provided for automated replenishing of the water reservoir.

3. Strainers, filters, or strainers and filters shall be provided as required to condition the water supply to the MIB.

2.5 MOISTURE SEPARATORS

A. Moisture separators shall separate condensate and excess moisture from the process stream after treatment in the biofiltration odor control units. Moisture separators shall protect the odor control system blower from damage by water ingestion.

B. Moisture separators shall be stacked, interlocking trays. Moisture separator trays shall be identical to the biofiltration odor control unit trays.

C. Each moisture separator shall consist of two trays: with the top tray inverted over the bottom tray.

D. Water collected in moisture separators shall be disposed of under normal O&M procedures.

E. Each moisture separator shall be mounted underneath the MIB that serves the same stack, or stacks, of biofiltration odor control units.

2.6 MOISTURE INTEGRATOR BUBBLER/MOISTURE SEPARATOR ASSEMBLY

A. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall provide humidity control, temperature control, and moisture separation for one to four stacks of biofiltration odor control units.

B. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall be held together with stainless steel tie rods and wing nuts.

C. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall be factory mounted on a skid.

D. Overall dimensions of each stack of Moisture Integrator Bubbler trays and Moisture Separator trays mounted on a skid shall be 69 inches wide by 72 inches long by approximately 68 inches high.

2.7 ODOR CONTROL SYSTEM BLOWER

A. The odor control system blower shall provide the motive force to move air through the entire biofiltration odor control system.

B. Odor control system blower shall be Siemens or BioAir Anaerobic (see LCU Approved Materials List).

C. Odor control system blower shall have a design capacity of 300 SCFM when drawing a vacuum of 27 inches of water.

D. Blower shall be driven by an electric motor with the following characteristics:

1. Motor Horsepower: [_____] HP
2. Motor Enclosure: TEFC
3. Electrical Characteristics: 230/460 volts, 60 Hertz, 3 phase

E. Blower and motor shall be designed for continuous operation.

F. Blower and motor shall be suitable for operation outdoors.

1. Provide all covers and other devices required to protect the blower and motor from direct contact with rainfall.
2. Provide all covers and other devices required to shield the blower and motor from sunlight.

2.8 ODOR CONTROL SYSTEM ELECTRICAL CONTROL PANEL

A. A stainless steel, NEMA 4X all-weather electrical control panel will be provided for wall mounting in a non-hazardous location.

B. The panel will provide branch circuit protection and controls for the regenerative blower and MIB heater.

C. Alarms shall be provided for high and low water fault conditions.

D. A main disconnect and security lock out shall be provided.

2.9 CARBON VESSEL

A. A carbon vessel shall be furnished by the biofiltration system supplier. This carbon vessel will be located on the discharge of the blower to remove any remaining traces of odor contaminants. The vessel containing the carbon shall be constructed of linear polyethylene with a 6-inch flanged inlet and outlet as shown in the drawings. Include 200 pounds of granular activated carbon (see LCU Approved Materials List) with the following specifications:

Sodium Hydroxide	
Weight % Virgin Carbon Basis, Minimum	10
Substrate Virgin Activated Carbon	
Iodine Number, mg/g, minimum	1050
Carbon Tetrachloride, wt%, minimum	60
U.S. Sieve, 90 wt%, minimum	4x10
Typical Physical Properties	
Bulk Density, lb/ft	337.4
Moisture (as packed), wt%	15

2.10 ODOR CONTROL SYSTEM PIPING

A. Process stream air piping shall be PVC, rated for temperatures to 160°F.

1. Pipe shall be Schedule 40.
2. Fittings shall be Schedule 40.

B. Piping shall be sized by biofiltration system manufacturer for minimal and negligible frictional losses and shall be provided by the CONTRACTOR.

C. Provision of pipe supports shall be the responsibility of the CONTRACTOR.

D. Exposed PVC pipe and fittings shall be field painted with UV-resistant white paint and black flow direction arrows as specified in the drawings.

2.11 SYSTEM WIRING

A. Biofiltration odor control system wiring shall be the joint responsibility of the CONTRACTOR and the biofiltration odor control system manufacturer.

B. Wiring shall be as specified in Division 16.

2.12 CLEANING AND PACKING

A. Thoroughly clean equipment, components, and subassemblies of water, sand, dirt, grit, grease, oil, and other foreign materials before preparation for shipment. Protect machined surfaces against physical damage and exposure to elements during shipping, handling, storage, and installation.

B. Equipment items shall be properly protected so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Finished surfaces of all exposed blower and equipment openings shall be protected.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. Proper care shall be taken to protect mechanical parts from the entrance of water during shipment, storage and handling.

F. Each box or package shall be properly marked to show its contents.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install odor control system in accordance with the biofiltration odor control system manufacturer's written instructions, in accordance with the Drawings, and as specified in this Section.

B. Align and adjust rotating equipment in accordance with the biofiltration odor control system manufacturer's written instructions. Lubricate bearings in accordance with the biofiltration odor control system manufacturer's written instructions.

C. Adjust valves and controls in accordance with the biofiltration odor control system manufacturer's written instructions.

D. Paint exposed PVC pipe and fittings with a coating containing UV inhibitors. Finish paint color shall be as specified on the drawings. Paint flow direction arrows in black on process air piping.

3.2 INSTALLATION INSPECTION

A. A representative from the biofiltration odor control system manufacturer shall be present during system installation and shall certify the system installation.

B. After the biofiltration odor control system has been installed and connected, an inspection of the system shall be performed in the presence of the ENGINEER. The system shall be accepted for equipment testing by the ENGINEER prior to starting the system equipment.

3.3 TESTING AND EQUIPMENT START-UP

A. A representative from biofiltration odor control system manufacturer shall perform equipment start-up.

B. Test odor control system blower and blower controls after the ENGINEER has accepted the biofiltration odor control system for equipment testing.'

C. Test odor control blower in accordance with blower manufacturer's written instructions. As a minimum do the following:

1. Start-up, check, and operate blower.

2. Verify blower is rotating in the proper direction.

3. Measure air flow rate through blower as follows:

4. Inlet valve 100% open

    a. Adjust inlet valve as required to reduce air flow rate through blower to design conditions and record valve setting.
    b. Adjust inlet valve as required to reduce air flow rate through blower to 75% of design air flow rate and record valve setting.
    c. Adjust inlet valve as required to reduce air flow rate through blower to 50% of design air flow rate and record valve setting.

5. Record concurrent readings for the following at the four points specified above:

    a. Motor voltage
    b. Motor amperage
    c. Blower discharge pressure
    d. Air flow rate through blower.

D. Check water supply system.

1. Demonstrate that float valve is functioning properly.

2. Measure and record water flow rate into Moisture Integrator Bubblers using the plant service water flow meter.

E. Check drain system.

1. Demonstrate that is there free flow of water through the drain system.

2. Demonstrate that drain system valves function properly.

F. Perform functional test of biofiltration odor control system controls.

1. Demonstrate that humidification control system is functioning properly.

2. Demonstrate that temperature control system is functioning properly.

3. Demonstrate that blower starter and controls are functioning properly.

4. Verify that alarms are functioning.

G. After blower, system water supply, system drains, and system controls have been accepted by the ENGINEER, place odor control system in operation.

3.4 PERFORMANCE TESTING

A. After biofiltration odor control system has been placed in operation, a bio-acclimation period of 2-4 weeks will be allowed prior to performance testing.

B. A representative from biofiltration odor control system manufacturer shall conduct performance testing.

C. Conduct a performance test of the biofiltration odor control system after the acclimation period. The performance test shall meet the following requirements:

1. The combined effluent H_2S concentration shall be continuously monitored over a period of four days. This effluent sampling location shall be at the discharge of the blower prior to the carbon vessel. One of the test days shall be a Monday. The H_2S concentration shall be monitored with a continuously reading H_2S data logger, with sampling intervals no less than five minutes.

2. In addition to the continuous H_2S monitoring above, four grab samples of influent air and two grab samples of effluent air from each stack of biofiltration unit trays shall be measured for H_2S concentration under peak sulfide loading conditions, which typically occur between the hours of 7:00 A.M. and 10:00 A.M. Influent H_2S sampling location is in the air piping between the wet well and the moisture integrator. Measurement of H_2S concentration by Draeger tube method is acceptable for these grab samples.

3. One matching set of Tedlar bag grab samples of the influent air, effluent air from the blower and effluent air from the carbon vessel shall be taken on one day between the hours of 7:00 A.M. and 10:00 A.M. to determine removal efficiency

of the organic sulfide compounds in addition to H_2S. Laboratory analyses of these samples shall be performed for organic sulfide compounds, inorganic sulfide compounds, and other odor producing compounds including, but not limited to, the following:

a. Hydrogen sulfide (DL<20)
b. Dimethyl sulfide (DL<10)
c. Dimethyl disulfide (DL<10)
d. Ethyl mercaptan (DL<20)
e. Methyl mercaptan (DL<20)
f. Carbonyl sulfide (DL<20)
g. Carbon disulfide (DL<10)

All sample holding times should be met.

D. If the effluent H_2S concentration does not meet the performance criteria specified in this Section, the CONTRACTOR shall make necessary adjustments and repeat the performance test for another four days. A total of four sets of four-day performance tests will be allowed. Should the biofiltration odor control system fail to perform as specified after four sets of four-day performance tests, the system shall be modified as required to meet the specified performance criteria. System modifications required to meet specified performance criteria shall be completed at no additional cost to the OWNER.

E. The ENGINEER will review the results of performance testing. Obtain ENGINEER acceptance of the biofiltration odor control system performance test prior to final acceptance of the biofiltration odor control system.

3.5 CLEANING

A. Clean grease, oil, and other debris and deposits from exterior surfaces of equipment and exposed piping.

B. Remove wire scrap, insulation scrap, and other debris from interior of control enclosures. Clean interior and exterior of control enclosures.

END OF SECTION