SUPPLEMENTAL CONTRACT DOCUMENTS

Lower Tamiami Well No. 408

City of Naples Utilities
380 Riverside Circle
Naples, FL 34102

OCTOBER 2023

PREPARED BY:
Agnoli, Barber & Brundage, Inc.
Professional Engineers, Planners & Land Surveyors
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AGNOLI BARBER & BRUNDAGE, INC.

FL. License# EB3664

PN: 21-0174

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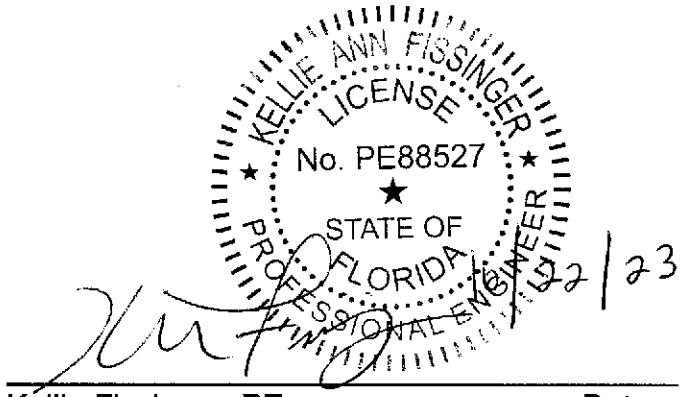
TECHNICAL SPECIFICATIONS
DIVISIONS 01 THROUGH 29
FOR THE CITY OF NAPLES, FLORIDA
LOWER TAMIAMI AQUIFER WELL NO. 408
OCTOBER 2023

The following Technical Specifications for the City of Naples Lower Tamiami Aquifer Well No. 408 project, which are dated October 2023, were prepared under my direction and supervision.

SECTION 00



Kellie Fissinger, PE Date
Florida Professional Engineer No. 88527

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TECHNICAL SPECIFICATIONS
DIVISIONS 01 THROUGH 29
FOR THE CITY OF NAPLES, FLORIDA
LOWER TAMIAMI AQUIFER WELL NO. 408
OCTOBER 2023

The following Technical Specifications for the City of Naples Lower Tamiami Aquifer Well No. 408 project, which are dated October 2023, were prepared under my direction and supervision.

DIVISION 29 – SITE & SPECIAL CONSTRUCTION

W. Kirk Martin, P.G.

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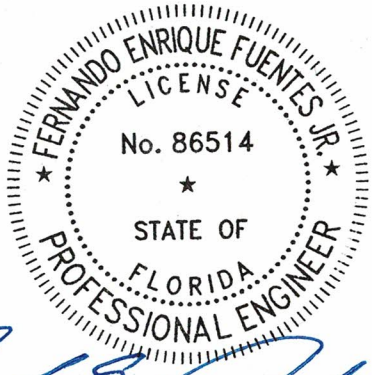
Certificate of Authorization No. FL PG 79

TECHNICAL SPECIFICATIONS
DIVISIONS 01 THROUGH 29
FOR THE CITY OF NAPLES, FLORIDA
LOWER TAMIAMI AQUIFER WELL NO. 408
OCTOBER 2023

The following Technical Specifications for the City of Naples Lower Tamiami Aquifer Well No. 408 project, which are dated October 2023, were prepared under my direction and supervision.

DIVISION 26



10-23-23

Fernando E. Fuentes, Jr., P.E. Date
Florida Professional Engineer No. 86514

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SECTION 001010

PROJECT SUMMARY, SPECIAL CONDITIONS, & SCHEDULE

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

A. The proposed project is located on 6th Ave SE on an existing well site owned by the City of Naples. The project consists of a new lower Tamiami aquifer Well No. 408, a new well house, driveway & parking area, pump, wiring, bonding & grounding, and instrumentation. Also included is the removal of the existing Well No. 408 and building that is located in the right-of-way.

B. Well pump specification is for a Goulds pump as detailed in the plans.

C. A connection to the existing 12" raw main wellfield line is proposed. CONTRACTOR will be responsible for coordination with the utilities department for any shutdown required.

D. The portion of the existing 12" raw main leaving the existing Well No. 408 building is to be grouted and abandoned. CONTRACTOR will be responsible for coordination with the utilities department for any shutdown required.

E. This main will be a complete DR-11 HDPE installation. If deflections are warranted; it is preferred that the deflections be accomplished without fittings by deflecting the pipeline.

F. The CONTRACTOR is required to take a digital 360° video of pre- and post-construction site conditions of the well site and surrounding area to allow for clear comparisons of site conditions before and after the work is conducted. All disturbed areas will be restored to pre-construction or better condition.

G. WELL

a. This project includes furnishing all labor, equipment, and materials for the installation and testing of the Lower Tamiami Aquifer Production Wells 408R for the City of Naples Utility Department. A project site map showing the proposed new and existing well locations is included as Figure 1. The CONTRACTOR shall provide and install 16-inch external diameter SDR 17 PVC well casing cement grouted in place to a depth of approximately 75 feet below land surface (BLS) and shall drill out the open hole via the direct-air method to a total depth of approximately 95 feet BLS. The proposed construction details of the new wells is provided as Figure 2.Geophysical logging surveys shall be performed at various stages of construction and shall include static and dynamic geophysical logs and final video surveys upon completion of the wells. Treatment of each well with 1,000 gallons of 32% hydrochloric acid will be performed

prior to final well development. Well development shall be performed for up to 16 hours by a combination of air-development and pumping during which testing for sand content and turbidity shall be conducted. Step-drawdown tests of each well shall be conducted using a submersible test pump and shall have a duration of 5 hours at pumping rates up to 1000 gallons per minute. Testing shall include sampling for Primary and Secondary drinking water standards.

b. The CONTRACTOR shall be required to plug and abandon the existing Well 408 prior to completing the open hole drilling of the new Well 408R. The plugging and abandonment details of Well 408 are shown in Figure 3.

1.2 SPECIAL CONDITIONS

A. The governing specifications for the construction of this work are listed on the plan cover sheet and include, but are not limited to, City of Naples Utilities Specifications and Standards Manual (USSM), Collier County Right-of-Way Ordinance, and Collier County Utility Standards Manual (USM). The relevant sections of the USSM and USM are not repeated in this document, and only those sections not included in the USSM and USM are provided herein.

B. OWNER will provide the following permit:
   a. FPL Meter Application

C. ENGINEER will provide the following permits:
   a. FDEP application to Construct PWS
   b. SFWMD 10-2 Permit

D. GEOLOGIST will provide the following permits:
   a. SFWMD Consumptive Use Permit

E. CONTRACTOR will provide the following permits:
   a. Building Permit
   b. Electrical Permit
   c. ROW Permit
   d. Well Construction Permit
   e. FDEP Generic Permit
      i. For the discharge of produced groundwater to allow discharge of water during direct-air drilling & development
   f. Any permit not listed above (1.2.C-E & 1.2.F.a - e) and required to complete the scope of the project.

F. Portions of the work may require dewatering. CONTRACTOR is required to apply to SFWMD for a no notice dewatering permit if dewatering is needed.

G. CONTRACTOR is required to maintain red line record drawings which detail all underground construction updated on a daily basis. This information will be provided to

engineer with each pay request and upon completion. This is in addition to the surveyed record drawing requirement.

H. Wherever feasible, CONTRACTOR is encouraged to deflect pipe without the use of fittings by deflecting the pipe in accordance with manufacturer specifications.

I. CONTRACTOR is to visit the site prior to preparing its bid. CONTRACTOR shall prepare its bid to include all incidental costs.

J. A geotechnical investigation may have been prepared by the CITY and ENGINEER in preparing the Contract Documents. The geotechnical investigation report may be examined for whatever value it may be considered to be worth. However, this information is not guaranteed as to its accuracy or completeness. The geotechnical investigation report is not part of the Contract Documents. The CONTRACTOR is to make any geotechnical investigations deemed necessary to determine actual site conditions.

1.3 SCHEDULE

A. The project will commence upon notice to proceed (NTP) from the CITY and be in effect until completion of the project as follows:

a. Substantial completion must be reached for all aspects of the project no later than two hundred forty (240) calendar days from the issued Notice to Proceed.

b. Final completion must be reached for all aspects of the project no later than two hundred seventy (270) calendar days from the issued Notice to Proceed.

END OF SECTION

SECTION 001026

MEASUREMENT AND PAYMENT

Applies to City of Naples Public Utilities Projects or Works and Utilities Portions of City of Naples Stormwater, Streets and Traffic Projects, but not to Private Developments

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 Schedule 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 Schedule or relieve the CONTRACTOR of the necessity of furnishing such as a part of the Contract. Measurement and payment for all the Contract items shall be made in accordance with this section or as modified by the Supplemental Terms and Conditions.

1.3 MEASUREMENT

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

1.4 PAYMENT

A. Make payment for the items listed on the Bid Schedule 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 Supplemental Terms and 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 Supplemental Terms and 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 items. 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.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 MEASUREMENT AND PAYMENT

A. Make payment 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.

1. (Item W1) Install Surface Casing: Payment will be at the Bid Schedule lump sum price per well to drill a nominal 12-inch diameter pilot hole by mud rotary method to

approximately 20 feet below land surface (BLS) or until the extent of surficial unconsolidated sediments is identified. Ream pilot hole to 30-inch diameter. Install and grout in place approximately 20 feet of 24-inch outer diameter surface casing. Note that casing material and depth for surface casing are at the discretion of the CONTRACTOR with ENGINEER's approval.

2. (Item W2) Drill 12-Inch Diameter Pilot Hole by Mud Rotary to 80ft Below Land Surface: Payment will be made at the bid schedule unit price per foot and for drilling of a 12-inch diameter hole by the mud rotary method for each well and shall include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work. All wellbores drilled as part of this contract shall meet the plumbness and alignment criteria.

3. (Item W3) Conduct Geophysical Logging to 80ft Below Land Surface: Payment will be made at the bid schedule lump sum price to conduct geophysical logging and shall include, but is not limited to, furnishing all equipment, labor and materials required to conduct geophysical logging of the entire pilot hole. The geophysical logging shall include Dual Induction and Caliper/Gamma.

4. (Item W4) Ream Pilot Hole Using a Nominal 22-inch Diameter Bit to Approximately 75ft Below Land Surface: Payment will be made at the bid schedule unit price per foot for reaming of the pilot hole using a nominal 22-inch diameter bit to approximately 75 Feet BLS and shall include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work. All wellbores drilled as part of this contract shall meet the plumbness and alignment requirements.

5. (Item W5) Run Caliper Log Prior to Casing Install & Install 16-Inch Diameter SDR 17 PVC Casing in Well to Approximately 75 Feet Below Land Surface: Payment will be made at the bid schedule unit price per foot for installing 16-inch outside diameter SDR 17 PVC well casing and shall include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work. A caliper log of the borehole immediately prior the casing installation is included in this pay item.

6. (Item W6) Grout Annular Space Between Casing & Borehole to Land Surface: Payment will be made at the bid schedule unit price per cubic foot for grouting the annular space between the 16-inch casing and the borehole to land surface and will include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work.

7. (Item W7) Plug & Abandon the Existing Well 408 with Cement Grout Containing up to 5% Bentonite Grout: Payment will be made at the bid schedule unit price per cubic foot for plugging and abandonment of the existing Well 408 beside the site of the proposed new Well 408R. This work will include furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified.

8. (Item W8) Drill Nominal 15-Inch Diameter Hole by Direct-Air Method from Approximately 75 to 95 Feet Below Land Surface: Payment will be made at the bid schedule unit price per foot for direct-air drilling of a nominal 15-inch diameter open hole by the direct air method and shall include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work.

9. (Item W9) Collect & Analyze Water Samples at Depths of 80 Feet, 90 Feet, & at Total Depth During Open-Hole Drilling: Payment will be made at the bid schedule unit price per sample for collection of water samples during open-hole drilling for dissolved chlorides, color, and conductivity for analysis by a FDH certified laboratory and shall include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work.

10. (Item W10) Conduct HCI Acidification Treatment of the Open-Hole Portion of the Well: Payment will be made at the bid schedule lump sum price to conduct acidification of the open-hole portion of the well. The acidification shall be performed using 900 gallons of 32% hydrochloric acid to be blended with approximately 6300 gallons of potable or approved raw water and injected via tremie pipe into the open hole portion of each well. The injection rate shall not exceed 50 gallons per minute. The acid is to remain in the well for a period of no less than 12 hours and no longer than 24 hours.

11. (Item W11) Develop the Well with Air for 8hrs: Payment will be made at the bid schedule unit price per hour to airlift develop the well and will include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified.

12. (Item W12) Develop the Well with Pump for 8hrs. Conduct Sand Content & Turbidity Testing: Pumping development of the test and observation wells shall be paid at the specified unit price per hour and include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified. Testing during pumping development shall include sand content, silt density index, and turbidity as specified.

13. (Item W13) Conduct Specific Capacity Pumping Tests: Conducting specific capacity pumping tests in each test well shall be paid for on a lump sum basis and include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified.

14. (Item W14) Collect & Analyze Water Samples & Submit to Laboratory for Primary & Secondary Drinking Water Standards Plus Additional Parameters: Payment will be made at the bid schedule lump sum price for collection and analysis of water samples for primary and secondary standards plus additional specified parameters by a FDH certified laboratory and will include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified.

15. (Item W15) Conduct Geophysical & Video Logging from Land Surface to 95 Feet Below Land Surface: Payment will be made at the bid schedule lump sum unit price to conduct geophysical and video logging and shall include, but is not limited to, all equipment, labor and materials required to conduct geophysical and video logging of the entire interior of the cased and open-hole sections of the well. The work shall also include, but is not limited to,

    a. Conducting the geophysical logging: a) Dual Induction, b) Caliper, c) Flowmeter (Static and Dynamic), d) Borehole Compensated Sonic, e) Fluid Resistivity (Static and Dynamic), f) Temperature, and g) Video (Static and Dynamic);

    b. Provide the OWNER and/or the OWNER's Representative four (4) high quality field hard copies of the geophysical logs, (2) copies of the video survey, and four (4) final copies of the geophysical logging along with an electronic version in a format acceptable to the OWNER all in DVD format for which separate payment is not provided under other items in the Bid Schedule. (Item W16) Install Wellhead Flange: Installation of a wellhead flange at an elevation to be provided by the ENGINEER, set at a minimum of 1.0 foot above the 100-year flood elevation, will be paid at the Bid Schedule lump sum price.

    This work will include the furnishing of all material, labor, tools, taxes, and equipment necessary to complete the work as specified.

16. (Item W16) Install Wellhead Flange: Payment will be made at the bid schedule lump sum price for provision and installation of a 16-inch wellhead flange at an elevation to be provided by the ENGINEER, set at a minimum of 1.0 foot above the 100-year flood elevation.

17. (Item W17) Well Disinfection: Disinfection of the wells as per Section 13015, Part 3F – DISINFECTION, will be paid at the Bid Schedule Lump Sum price.

18. (Item W18) Standby with Rig & Drilling Crew on Site: If standby time is required with the rig and drilling crew on site, payment will be made at the specified unit price based on the number of hours required.

19. (Item W19) Standby with Rig on Site & Drilling Crew Off Site: If standby time is required with the rig on site and drilling crew off site, payment will be made at the specified unit price based on the number of hours required.

20. (Item C1) Aboveground Well Head Assembly: Payment for furnishing and installing all wellhead assembly components (see sheet 03 of civil plans) will be made for at the Bid Schedule lump sum price. This item includes all necessary fittings, labor, equipment for installation, dewatering, excavation of all material encountered (including rock

excavation), sod, clearing and grubbing, landscaping, and other surface materials not specifically designated in the bid. Also includes coordination with other contractors, clean-up, disinfection and sterilization. CONTRACTOR is responsible for any fittings not provided on the material list provided at the time of the bid.

21. (Item C2) Cut in 12in Tee & to Existing Water Main: Payment for connecting to the existing raw water main will be made at the Bid Schedule lump sum price. This item includes all necessary fittings, labor, equipment, dewatering, excavation of all material encountered (including rock excavation) and other surface materials not specifically designated in the bid. Also includes coordination with other contractors, clean-up, disinfection and sterilization, temporary facilities for blow-offs and testing. CONTRACTOR is responsible for any fittings not provided on the material list provided at the time of the bid.

22. (Items C3 – C4) Install Pipelines: Payment for furnishing and installing pipelines (6in and 12in DR-11 HDPE) will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes clearing and disposal of trees and bushes, all necessary fittings, pipe coatings and linings, 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, detectable tape, clamps, harnessing, plugs and caps, adapters, excavation of all material encountered, including rock, backfill, replacement of grass, sod, clearing and grubbing, landscaping, pavement, driveways, sidewalks, mailboxes, culverts, storm sewers, and other surface materials not specifically designated in the Bid, coordination with other contractors, stubs and valves for future connections to existing pipes, clean-up, disinfection and sterilization, temporary facilities for testing and tests. Also includes coordination with other contractors, subs and valves for future connections to existing pipes, clean-up, disinfection and sterilization, temporary facilities for blow-offs and testing. Pipe material to be purchased by the CONTRACTOR for this item. CONTRACTOR is responsible for any fittings not provided on the material list provided at the time of the bid. Measure pipe to the nearest foot along the centerline including the lengths of manholes, valves and fittings. Measure lineal footage horizontally. Measure cuts from proposed grade to the invert elevation of the pipe. Pipe installed within casing pipe is included in this item. Pipe installation bedded and backfilled in accordance with these specifications will be paid for at a maximum of 75% of the contract unit price for pipelines prior to testing, and the remaining 25% of the contract unit price will be paid after successful hydrostatic and leakage testing.

23. (Items C5 - C8) Install Tee, Reducer, & Valves: Payment for furnishing and installing tees, reducers, and gate valves will be made at the appropriate Bid Schedule lump sum price as acceptably installed. These items includes the labor to install, and all labor and materials to install boxes, the vault or housing, concrete work, operators, incidentals, and all necessary materials and equipment for installation, including valve stem, valve box extensions and adjustments. This item also includes the installation of base material below the valve in accordance with the detail shown in the Plans.

24. (Items C9) Fire Hydrant Assembly: Payment for furnishing and installing the fire hydrant will be made at the Bid Schedule lump sum price as acceptably installed. This item includes the tee installed on the utility main, all necessary fittings, joint restraint from the valve to the tee, necessary piping from the tee to the hydrant location with the installation of barrel section to meet finished grade, control gate valve, valve box and any concrete work. CONTRACTOR will be responsible for setting the hydrant to grade in accordance with the detail shown on the plans.

25. (Item C10) Goulds 8FDHC 3 Stage Submersible Pump 316 SST: Payment for furnishing and installing the well pump as specified will be made at the Bid Schedule lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

26. (Item C11) Franklin Electric Submersible Motor: Payment for furnishing and installing the submersible motor as specified will be made at the Bid Schedule lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

27. (Item C12) 6in Inline SST Check Valve: Payment for furnishing and installing the 6in inline check valve as specified will be made at the Bid Schedule lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

28. (Item C13) Pump Testing, Start-up, & Training: Payment for all pump testing, start-up, and training will be made at the Bid Schedule lump sum price as acceptably completed. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

29. (Item C14) 6in SST Flanged Drop Pipe: Payment for furnishing and installing all drop pipe will be made at the Bid Schedule lump sum price as acceptably installed. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

30. (Items C15) Chain Link Fence & Gate: Payment for furnishing and installing all chain link fence and gates will be made at the Bid Schedule lump sum price. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

31. (Item C16) Type “C” Catch Basin: Payment for furnishing and installing the FDOT Type “C” Inlet will be made at the Bid Schedule lump sum price as acceptably installed.

32. (Item C17) 15in Mitered End: Payment for furnishing and installing the 15in mitered ends will be made at the Bid Schedule lump sum price as acceptably installed.

Calculations shall be based upon plan dimensions and quantities. The mitered end shall be made of concrete, cast in place with finished surfaces sloped to match proposed grade.

33. (Item C18) 15in RCP: Payment for furnishing and installing the 15in diameter RCP will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes clearing and disposal of trees and bushes, labor, equipment for the laying of the pipe, dewatering, compaction and density testing, pipe bedding, backfilling, sheeting, restrained joint piping, excavation of all material encountered (including rock excavation), sod, clearing and grubbing and other surface materials not specifically designated in the bid. Also includes coordination with other contractors and clean-up. Pipe material to be purchased by the CONTRACTOR for this item.

34. (Item C19) Rip Rap: Payment for furnishing and installing all riprap will be made at the bid schedule lump sum price as acceptably installed. This work shall include the installation of geo-fabric underlayment and all labor, tools, equipment, materials, and incidentals necessary to complete the work. Calculations shall be based upon plan dimensions and quantities.

35. (Item C20) 6in Limerock Base: Payment for furnishing and installing all limerock base and stabilized subgrade for concrete sidewalks and asphalt/pavement area will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

36. (Item C21) 6in Concrete Sidewalk: Payment for furnishing and installing all concrete sidewalk will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

37. (Item C22) 3in Perimeter Gravel: Payment for furnishing and installing all perimeter gravel will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all items in gravel section detail, labor, tools, equipment, materials, and incidentals necessary to complete the work.

38. (Item C23) 6in Lime Rock Drive: Payment for furnishing and installing the lime rock drive will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

39. (Item C24) Asphalt Drive Applied in Two ¾in Lifts: Payment for furnishing and installing all asphalt will be made at the Bid Schedule lump sum price as acceptably installed.

Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

40. (Item C25) Over-excavation of Building Footprint: Payment for over-excavation of building footprint will be made at the contract lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. Calculations shall be based upon plan dimensions and quantities.

41. (Item C26) Backfill of Building Footprint with 57 Stone: Payment for backfill of building footprint with 57 stone will be made at the contract lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. CONTRACTOR shall furnish all truck tickets with each pay request. Payment will not be made without this backup documentation. Calculations shall be based upon plan dimensions and quantities.

42. (Items C27) Structural Fill for Building: Payment for structural fill for building will be made at the contract lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. CONTRACTOR shall furnish all truck tickets with each pay request. Payment will not be made without this backup documentation. Calculations shall be based upon plan dimensions and quantities.

43. (Item C28) Rock Excavation Payment for rock excavated and exported will be made at the contract lump sum price in the event that the excavated materials do not meet the requirements for suitable backfill. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. CONTRACTOR shall furnish all truck tickets with each pay request. Payment will not be made without this backup documentation. Calculations shall be based upon plan dimensions and quantities.

44. (Item C29) Unsuitable Backfill Exported Payment for unsuitable backfill exported will be made at the contract lump sum price in the event that the excavated materials do not meet the requirements for suitable backfill. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. CONTRACTOR shall furnish all truck tickets with each pay request. Payment will not be made without this backup documentation. Calculations shall be based upon plan dimensions and quantities.

45. (Item C30) Suitable Backfill Imported: Payment for suitable backfill will be made at the contract lump sum price in the event that the excavated materials do not meet the requirements for suitable backfill. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. CONTRACTOR shall furnish all truck tickets with each pay request. Payment will not be made without this backup documentation. Calculations shall be based upon plan dimensions and quantities.

46. (Item C31) Site Fill for Grading: Payment for fill will be made at the Bid Schedule lump

sum price and will be based on truck tickets furnished with any pay request. Payment will not be made without this backup documentation. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. Calculations shall be based upon plan dimensions and quantities.

47. (Item C32) Grout & Abandon Existing 12in Raw Water Main: Payment for pipe abandoned in place and grouted will be made at the contract lump sum price. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work. Calculations shall be based upon plan dimensions and quantities.

48. (Item C33) Remove Existing Well 408 Site & Stabilize with Grass: Payment for removing the existing well 408 site and restoring area with stabilized grass will be made at the contract lump sum price. This item includes all but not limited to removal of aboveground well and appurtenances, building structure, concrete pad, all labor, tools, equipment, materials, and incidentals necessary to complete the work. Calculations shall be based upon plan dimensions and quantities.

49. (Item C34) Signing & Striping: Payment for furnishing and installing all project signage and striping will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

50. (Item C35) Clearing & Grubbing: Payment for clearing and grubbing will be made at the lump sum Contract unit price for full compensation for all clearing and grubbing activities. The CONTRACTOR shall consider plan grades and field conditions when preparing its bid cost for this item. Work for this item should also include the removal of any debris from the site as well as the removal of all necessary irrigation lines and cutting and capping all remaining pipes at the work area edge. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

51. (Item E1) Conduit & Wire Installation: Payment at the lump sum price bid for this item shall be full compensation for all labor, equipment, materials, and incidentals as specified in Divisions 1 through 40, but excluding those items for which measurements and payments are separately specified, necessary to construct the complete Conduit and Wire System associated with the well. Measurement shall be in accordance with accepted schedule of values.

52. (Item E2) Bonding & Grounding: Payment at the lump sum price bid for this item shall be full compensation for all labor, equipment, materials, and incidentals as specified in Divisions 1 through 40, but excluding those items for which measurements and payments are separately specified, necessary to construct the complete Bonding and Grounding System associated with the well. Measurement shall be in accordance with accepted schedule of values.

53. (Item E3) Electrical Equipment: Payment at the lump sum price bid for this item shall be full compensation for all labor, equipment, materials, and incidentals as specified in Divisions 1 through 40, but excluding those items for which measurements and payments are separately specified, necessary to construct the complete Electrical Equipment associated with the well. Measurement shall be in accordance with accepted schedule of values.

54. (Item E4) Field Instrumentation & Controls Equipment: Payment at the lump sum price bid for this item shall be full compensation for all labor, equipment, materials, and incidentals as specified in Divisions 1 through 40, but excluding those items for which measurements and payments are separately specified, necessary to construct the complete Instrumentation and Control System associated with the well. Measurement shall be in accordance with accepted schedule of values.

55. (Item E5) FPL Install: Payment at the lump sum price bid for this item shall be full compensation for all labor, equipment, materials, and incidentals as specified in Divisions 1 through 40, but excluding those items for which measurements and payments are separately specified, necessary to construct the complete the FPL install associated with the well. Measurement shall be in accordance with accepted schedule of values.

56. (Item E6) 80 kW Generac Generator: Payment for furnishing and installing 80 kW Generac Generator will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

57. (Item S1) General Conditions & General Requirements: Payment for furnishing and installing items consistent with General Conditions & General Requirements will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

58. (Item S2) Concrete & Concrete Block: Payment for furnishing and installing Concrete & Concrete Block will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

59. (Item S3) Stucco & Finishing: Payment for furnishing and installing Stucco & Finishing will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

60. (Item S4) Trusses & Framing: Payment for furnishing and installing Trusses & Framing

will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

61. (Item S5) Doors, Roll-up Doors, & Louvers: Payment for furnishing and installing Doors, Roll-up Doors, & Louvers will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

62. (Item S6) Roofing: Payment for furnishing and installing Roofing will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

63. (Item S7) Painting & Finishes: Payment for furnishing and installing Painting & Finishes will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

64. (Item S8) Specialties: Payment for furnishing and installing Specialty items will be made at the Bid Schedule lump sum price as acceptably installed. Calculations shall be based upon plan dimensions and quantities. This item includes all labor, tools, equipment, materials, and incidentals necessary to complete the work.

65. (Item M1) Mobilization/Demobilization: Payment for mobilization and demobilization will be made at the Contract lump sum price. Payment for mobilization shall include all necessary meetings for the project, including but not limited to: all meetings deemed necessary by the CITY and all other public meetings required to complete the project in accordance with the contract documents, preparatory work and operations in mobilizing for the beginning work on the project and demobilizing for ending work on the Project. The CONTRACTOR shall submit invoices substantiating the cost of mobilization with each pay request. This payment cannot exceed more than 10% of the total base bid.

66. (Item M2) Erosion Control: Payment will be made at the Contract lump sum price for full compensation for all erosion and sedimentation control per CITY and specified herein. This work includes any best management practice (BMP) that the project requires.

67. (Item M3) 360 Pre/Post Site Videos & Still Photos: Payment for providing pre- & post-construction videos will be made at the full lump sum contract price for the item, which price and payment shall be full compensation for a complete project pre-construction video, a wet weather video (in addition to a dry weather video) to document flood conditions that will take place during normal business hours. Pre-construction videos

must be provided to the CITY a minimum of ten (10) days prior to beginning construction. Two copies of the Video will need to be provided to the CITY in between substantial and final completion. No more than 50% of the contract unit price will be paid for the Pre video and stills. The remaining 50% will be paid upon completion of the work and subsequent video/stills.

68. (Item M4) Restoration, Grade, Seed & Stabilize Over Disturbed Areas (Bahia): Measurement for various items covered under Restoration, Grade, Seed & Stabilize Over Disturbed Areas (Bahia) will not be made for payment, and all items shall be included in the Contract lump sum price. Payment shall be made at the appropriate Contract Unit price per lump sum, and will be prorated based on percent complete. This item includes all labor and materials required for complete restoration including clearing and grubbing, clean-up, grading (outside of swales), replacement of grass, sod, seeding and stabilization, landscaping, and other surface materials not specifically designated in the Bid. This line item shall include all seeding and stabilization over disturbed areas including swales. Please note that the CONTRACTOR is responsible for the upkeep and maintenance of all landscaping and stabilized area during construction, including maintaining existing public and private irrigation systems in service. Areas where vegetation is damaged or destroyed during construction shall be replaced at no additional cost to the CITY. All landscaping damaged or removed as part of the Contractor's operations must be replaced unless directed otherwise in writing by the CITY. Additionally, the Contractor must repair and replace all private and public irrigation facilities that are damaged or destroyed during construction. Any and all costs incurred by private parties shall be paid for by the Contractor. Additional payment will not be made for any accommodation and should be accounted for in the restoration pay item.

69. (Item M5) Survey Layout, As-built Survey, & Maintain Record Drawings: Payment for providing all survey and as-built drawings will be made at the Contract lump sum price in accordance with the specifications. A digital AutoCAD file of the as-built survey shall be provided to the Engineer of Record. Contractor shall maintain redline markups throughout the course of the project and shall provide to Engineer of Record.

70. (Item M6) Permitting: Payment for obtaining required permits listed in Section 001010 at the Contract lump sum price and will be prorated based on percent complete.

B. Prior to submitting first monthly Application for Payment, Contractor shall submit to the Owner and Engineer, for review and approval, a schedule of values based upon the Contract Price, listing the major elements of the Work and the dollar value for each element. After its approval, this schedule of values shall be used as the basis for the Contractor's monthly Applications for Payment.

C. Prior to submitting first monthly Application for Payment, Contractor shall submit to The City a complete list of all its proposed subcontractors and materialmen, showing the work

and materials involved and the dollar amount of each proposed subcontract and purchase order. The first Application for Payment shall be submitted no earlier than thirty (30) after the Commencement Date.

D. If payment is requested on the basis of materials and equipment not incorporated into the Project, but delivered and suitably stored at the site or at another location agreed to by the City in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that the City has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances, together with evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the City's interest therein, all of which shall be subject to the City's satisfaction.

E. Contractor shall submit Applications for Payment to the Owner and Engineer for approval. Contractor shall include supporting documentation that includes the following, but is not limited to: redline markups, truck tickets, material invoices, etc. Invoices received after the 25th day of each month shall be considered for payment as part of the next month's application. Within ten (10) calendar days after receipt of each Application for Payment, the Engineer shall either:

1. indicate his approval of the requested payment;

2. indicate his approval of only a portion of the requested payment, stating in writing his reasons therefore; or

3. return the Application for Payment to the Contractor indicating, in writing, the reason for refusing to approve payment.

In the event of a total denial and return of the Application for Payment by the Engineer, the Contractor may make the necessary corrections and resubmit the Application for Payment. The City shall, within thirty (30) calendar days after the Engineer's approval of an Application for Payment, pay the Contractor the amounts so approved. Provided, however, in no event shall the City be obligated to pay any amount greater than that portion of the Application for Payment approved by the Engineer.

F. The City shall retain ten (10%) of the gross amount of each monthly payment request or ten percent (10%) of the portion thereof approved by the Engineer for payment, whichever is less. Such sum shall be accumulated and not released to the Contractor until final payment is due.

G. Monthly payments to Contractor shall in no way imply approval or acceptance of Contractor's work.

H. Contractor agrees and understands that funding limitations exist and that the expenditure of funds must be spread over the duration of the Project at regular intervals based on the Contract Amount and Progress Schedule. Accordingly, prior to submitting its first monthly

Application for Payment, Contractor shall prepare and submit for the Engineers review and approval, a detailed Project Funding Schedule, which shall be updated as necessary and approved by the City to reflect approved adjustments to the Contract Amount and Contract Time. No voluntary acceleration or early completion of the Work shall modify the time of payments to Contractor as set forth in the approved Project Funding Schedule.

3.2 PAYMENTS WITHHELD

A. The Engineer may decline to approve any Application for Payment, or portions thereof, because of subsequently discovered evidence or subsequent inspections. The Engineer may nullify the whole or any part of any approval for payment previously issued and the City may withhold any agreement between the City and Contractor, to such an extent as may be necessary in the City's opinion to protect it from loss because of:

1. Defective Work not remedied;

2. Third party claims filed or reasonable evidence indicating probable filing of such claims

3. Failure of Contractor to make payment properly to subcontractors or for labor, materials or equipment;

4. Reasonable doubt that the Work can be completed for the unpaid balance of the Contract Amount;

5. Reasonable indication that the Work will not be completed within the Contract Time;

6. Unsatisfactory prosecution of the Work by the Contractor; or

7. Any other material breach of the Contract Documents.

B. If these conditions in Subsection 5.1 are not remedied or removed, the City may, after three (3) days written notice, rectify the same at Contractor's expense. The City also may offset against any sums due Contractor the amount of any liquidated or unliquidated obligations of Contractor whether relating to or arising out of this Agreement or any other agreement between Contractor and the Engineer.

3.3 FINAL PAYMENT

A. The City shall make final payment to Contractor within thirty (30) calendar days after the Work is finally inspected and accepted by both the City and the Engineer in accordance with Section 20.1 herein provided that Contractor first, and as an explicit condition precedent to the accrual of Contractor's right to final payment, shall have furnished the City with any and all documentation that may be required by the Contract Documents and the City.

B. Contractor's acceptance of final payment shall constitute a full waiver of any and all claims by Contractor against the City arising out of this Agreement or otherwise relating to the Project, except those previously made in writing and identified by Contractor as unsettled at the time of the final Application for Payment. Neither the acceptance of the Work nor payment by the City shall be deemed to be a waiver of the City's right to enforce any obligations of Contractor hereunder or to the recovery of damages for defective Work not discovered by the Engineer at the time of final inspection.

END OF SECTION

SECTION 260500

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: General requirements for providing basic electrical materials and methods and specific work included as follows:

B. The work required includes all materials, labor and auxiliaries required to install a complete and properly operating electrical system. The electrical system required under this Division consists basically of, but is not limited to the following:

1. Purchase, installation and startup of (1) custom Control Panel.

2. Complete distribution system for power, including feeders and connections to control panels, pumps and other power loads.

3. Complete Lightning Protection, Bonding and Grounding Systems

4. Power, instrumentation & control Surge Suppression systems.

5. Installation of new conduit or extension of existing conduit, wire and field connections for all motors, control devices and electrical equipment.

6. Installation of new conduit or extension of existing conduit, wiring and terminations for all field mounted instruments.

7. On site Startup and Training for proposed VFD.

8. Concrete work for pad mounted equipment.

9. Verification of RTU I/O signals over telemetry system. Owner will build screens and integrate station into existing SCADA.

10. Complete coordination and scheduling of the electrical service with FPL and facilitation of all invoicing from FPL to the County project manager.

11. Standby power system and automatic transfer System.

12. Electronic and hard copy project record drawings, vendor operation and maintenance manuals.

C. 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.

D. 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.

E. 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.

F. Drawings are diagrammatic. Correlate final equipment locations with governing Architectural, Structural, Process Mechanical and Instrumentation and Control drawings. Lay out before installation so that all trades may install equipment in spaces available. Provide coordination as required for installation in a neat and workmanlike manner. Provide layout shop drawings for engineers review for all MCC and electrical equipment rooms.

1.02 DEFINITIONS (NOT USED)

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.

B. Substitutions:

1. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.

2. No substitutions will be considered unless written request has been submitted to the Engineer for approval at least ten days prior to the bid date. Submittal shall include the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for the Engineer to determine that the equipment meets all specification and requirements. If the Engineer approves any proposed substitutions, such approval will be set forth in an addendum.

3. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor's expense.

C. 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 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.

6. Provide an adequately sized, hard-cover, 3-ring binder for 8-1/2" X 11" for all submittal sheets. Provide correct designation on outside cover and on end of binder. First sheet in the brochure shall be a photocopy of the Electrical Index pages used as a table of contents and tabbed accordingly. The second tab shall be the electrical cost breakdown "Schedule of Values" for electrical work. Cost of material and labor for each major item shall be shown. Provide reinforced separation sheets tabbed with the appropriate specification reference number. Provide Technical Information consisting of marked catalog sheets or shop drawings shall be inserted in the brochure in proper order on all items herein specified or shown on drawings.

D. 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.

E. 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. Provide detailed shop drawings for all electrical equipment to be supplied. Provide detailed plan view shop drawings at expanded scale indicating how actual size of equipment to be provided is to fit into space available; show NEC required working space clearances on plan. Provide detailed elevation views at expanded scale of actual equipment to be provided and how it fits into available wall spaces. Drawings shall be on 11" X 17" or 22" X 34" paper and drawn with a computer aided design (CAD) package. The computer aided design package shall be Autocad or converted to Autocad format. Engineering plan backgrounds of the facility shown on the contract documents will be available to the contractor on request. Submittals shall include hard copy and CD-ROM media electronic copies. Additional shop drawing requirements: Includes 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.

F. 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:

1. 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.

2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

3. Approved substitutions, and actual equipment and materials installed.

4. 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.

5. 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.

6. 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.

7. 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)

G. 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 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 by terms of County purchase order. 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 to allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated. To provide for ease of disconnecting the equipment with minimum interference to other installations. To allow the right of way for piping and conduit installed at the required slope. To clear connecting raceways, cables, wireways, cable trays, and busways of obstructions and of the working and access space of other equipment. 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. Coordinate electrical testing of electrical, mechanical, and architectural items, so that functionally interdependent equipment and systems demonstrate successful interoperability.

E. 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 - NOT USED

PART 3 - EXECUTION

3.01 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. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

5. 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.

6. 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.

7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

8. 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.

9. Furnish and install reinforced concrete pads for transformers, switchgear, and motor control centers, of size as shown on the drawings or required. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by three (3) inches on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment. Chamfer top edges 1". Trowel all surfaces smooth. Reinforce pads with 6" X 6" X 6/6 welded wire fabric. Conduit stub up area within the pad area shall remain void. Coordinate with equipment shop drawings stub up areas.

10. Install access panel or doors where units are concealed behind finished surfaces.

11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.02 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. 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.

3.03 EXISTING CONDITIONS:

A. Investigate site thoroughly and reroute all conduit and wiring in area of new construction in order to maintain continuity of existing circuitry. Existing conduits shown on plans show approximate locations only. Contractor must verify and coordinate existing site conduits and pipes to any excavation on site.

B. Special attention is called to the fact that work involved is in connection with existing facilities that must remain in operation while work is being performed. Work must be done in accordance with the owner's priority schedule as required. Schedule work for a minimum outage to Owner. Request written permission and receive written approval from Owner 48 hours, 2 business days, in advance of commencing work. Perform work required at other

than standard working hours where owner cannot approve outages during regular working hours.

C. Provide temporary power and temporary wiring as required to maintain operation as directed by the owner or engineer to facilitate construction. Protect existing buildings and equipment during construction as required.

END OF SECTION

SECTION 260511

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 City of Naples Utilities 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. Provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings, indicated to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner including but not limited to electrical work required for roll-up doors, control panel installation, instrumentation and control installation, etc.

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. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions of these specifications.

2. The drawings and specifications describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Wherever the contractor provides power consuming equipment which differs from, the basis of design, drawings and specifications, the wiring and associated circuit components for such equipment shall be changed to proper sizes to match at no additional expense to the Owner.

3. Provide Concrete work for pad mounted equipment.

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. Locate all openings required for work performed under this section.

F. Provide sleeves, guards or other approved methods to allow passage of items installed under this section.

G. A single manufacturer shall provide panelboards, main breakers, transformers, disconnect switches, etc.

H. 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.

1.02 QUALIFICATIONS:

A. The electrical contractor shall have regularly engaged in the installation of industrial electrical power systems for a minimum period of ten (10) 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 licensed in Florida who has had a minimum of ten (10) 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.

1.03 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. Florida Building Code
15. Local Codes and Ordinances

B. All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., or a nationally recognized Electrical Testing Agency 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.

C. All materials shall be new and free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved. Where no labeling or listing service is available for certain types of equipment, test data shall be submitted to prove to the Engineer that equipment meets or exceeds available standards.

1.04 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 for all outdoor locations, rooms below grade (buried vaults), "DAMP" and "WET" locations.
4. NEMA 4X 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.

1.05 CODES, INSPECTION AND FEES:

A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. The installation shall comply with the governing state and local codes or ordinances. Completed electrical installation shall be inspected and certified by all applicable agencies that it is in compliance with all codes. Comply with latest utility company regulations.

B. Obtain all necessary permits and pay all fees required for permits and inspections. 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 included in this contractor's bid price.

1.06 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 Acceptance Testing section and the individual equipment sections for additional specific testing requirements.

B. Make adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.

C. In addition to the specific testing requirements listed and the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing.

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 equipment’s 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, motor control centers, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Owner.

1.07 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.

1.08 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
°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
Recpt.	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.

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.

3.03 MANUFACTURERS SERVICE:

A. Provide manufacturer's services for testing and start-up of all major electrical equipment: VFDs, ATS, Gensets, MCCs, Switchboards, 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: 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.

END OF SECTION

SECTION 260519

LOW VOLTAGE WIRES AND CABLES

PART 1 – GENERAL

1.01 GENERAL:

A. Referenced Standards:

1. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI):

2. Standard for Flame Testing of Cables for Use in Cable Tray in Industrial and Commercial Occupancies.

3. National Electrical Manufacturers Association (NEMA): ICS 4, Industrial Control and Systems: Terminal Blocks.

4. 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.

5. National Fire Protection Association NFPA-70, National Electrical Code (NEC).

6. 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.

B. Definitions:

1. Building Wire: Copper single conductor, cross link polyethylene insulated; type XHHW-2;

2. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

3. Instrumentation Cable (Analog signal cable): Multiple conductor, polyethylene 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. 16 AWG conductors. Common Types, TSP: Twisted shielded pair, TST: Twisted shielded triad.

4. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires,

No. 14, 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.

5. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 12 AWG and larger. Rated XHHW-2

6. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc. Common Types: Ethernet STP-unshielded twisted pair.

1.02 POWER CONDUCTORS:

A. Branch circuits and feeder conductors for electric power shall be stranded copper type XHHW-2 cross-link polyethylene (XLP) 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. 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.

C. 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 exiting or expansion projects, comply with existing color coding established within the facility.

1.03 INSTRUMENTATION AND CONTROL CABLE:

A. Multiconductor and Multi pair Process instrumentation cable shall be #16 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 #14 AWG 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 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.

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.

7. No splices shall be made within a conduit run or in manholes.

1.04 CABLE LABELING AND SEPARATION:

A. 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).

B. 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.

1.05 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.

END OF SECTION

SECTION 260526

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 00, Basic material and methods: General electrical requirements.

B. Section 26 05 19, Low Voltage Wires and Cables

1.03 SUBMITTALS

A. Submit in accordance with Section 26 05 00

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):
Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

C. National Fire Protection Association (NFPA):
National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):
Thermoset-Insulated Wires and Cables
Thermoplastic-Insulated Wires and Cables
Grounding and Bonding Equipment
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.

3.03 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.

3.04 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.

3.05 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system.

3.06 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.

C. Below-grade connections shall be visually inspected by the Project Engineer prior to backfilling. Provide ground inspection wells at all ground rod locations.

3.07 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 260529

SUPPORTING DEVICES

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 non metallic 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 or plastic tie straps 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 SUBMITTALS: Product Data: Provide data for support channel & hardware.

1.03 QUALITY ASSURANCE: 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. 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 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 stainless steel or galvanized 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 260551

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 trapped underground without slab above or 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 may 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 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

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:

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.

2.03 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. Cantex

2. J.M. Eagle

3. Queen City Plastics

2.04 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.

2.05 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.

F. Conduit locknuts shall be aluminum throughout except steel is acceptable within air conditioned spaces.

G. 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.

H. 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 steel 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. Insulated bushings shall be used on all rigid steel conduits terminating in panels, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these bushings must not melt or support flame.

I. 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.

J. 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.

K. Raceways which do not have conductors furnished under this Division of the specifications shall be left with an approved nylon pullcord in raceway.

L. Rigid Metallic Conduit, electrical metallic tubing, flexible steel conduit and PVC conduit shall be manufactured within the United States.

M. 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 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.

N. 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.

O. 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.

P. Electric metallic tubing (thin wall) where installed inside air conditioned buildings above grade shall be joined with steel fittings and steel compression connectors.

Q. Rigid metallic conduit installed underground shall be coated with waterproofing black mastic before installation, and all joints shall be recoated after installation.

R. 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.

S. 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.

T. 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 penetration into panels & cabinets shall be accomplished utilizing aluminum or stainless steel conduit Hubs consistent with the conduit type utilized.

END OF SECTION

SECTION 260553

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:
Basic Electrical Materials and Methods; Wires and Cables; 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

2. 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 black letters on white background with lettering etched through the outer covering and fastened with corrosion resistant brass or 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.

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, non-fading, 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 dark-gray 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.

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 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 describe the function of 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. Rework or reuse of existing equipment will require new identification tags for some existing equipment.

G. 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.

H. Raceway Tags
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 brass tags and nylon straps for attachment.

I. 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.

J. 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.

K. 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.

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 4th 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 00.

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 furnished with aluminum while-in-use pad-lockable covers.

2.03 PLUG CAPS & CORDS: Provide and install a matching plug cap and properly sized cord for equipment items noted on the drawings.

2.04 DEVICE PLATES: 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. 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 262200

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 16051, Special Electrical Requirements
B. Section 16110, Conduit Systems
C. Section 16120, Low-Voltage Wire and Cables
D. Section 16450, Grounding and Bonding For Electrical Systems:

1.03 SUBMITTALS

A. In accordance with Section 26 05 00 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:

    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 3R stainless steel.
    c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has 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 designated for 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 262416

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 00, 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 MANUFACTURERS

A. Provide panelboards by Square-D, Cutler Hammer or GE

2.02 RATINGS

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 240V ac 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 480V ac 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. Fully rated panels only, series ratings are not acceptable.

2.03 CONSTRUCTION:

A. All lighting and power distribution panels shall have copper bus bars density rated for maximum of 1000amps/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 coordinated with the identification of equipment as shown on the contract drawings and clearly indicating the serving load.

END OF SECTION

SECTION 262713

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.

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 480V 3 phase, 4 wire service from power company pole based handhole to main service equipment. Seal conduit with duct-seal where entering a 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 Owner Project manager for payment.

1. This project was coordinated with FPL Distribution Engineer: Hector Martinez at 239-248-7058 or Hector.Martinez2@fpl.com. He was provided a set of the final plans and specs for the project.

1.05 SUBMITTALS

A. Submit product data on:

1. Meter base and CT, cabinet if applicable.
2. Copy of Contractors notice to FPL
3. Copy of Contractors transmittal of FPL invoice to the Owner

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 262811

CIRCUIT BREAKERS AND FUSIBLE SWITCHES – low voltage

PART 1 – GENERAL (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide Cutler Hammer, Square-D or GE 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 2017 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' devise 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 service.
5. Submit installation, mounting, and anchoring details for all components.

C. Operation, Maintenance and Repair Manuals:

1. Submit operation and maintenance manuals.

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) 2017,
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 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 Wall Mount NEMA Type 4X dead-front enclosure constructed of not less than 304 stainless steel 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 wall mount or flat bottom NEMA 1 painted steel). Provide data pocket. Bottom entry ONLY of cables shall be permitted. 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 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. Mounting studs shall be welded to the enclosure. 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 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, thru door mounted handles are not acceptable.

E. Control transformers shall be installed where shown to provide 120V ac 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 copper, minimum size #14 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.

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 one spare emitter 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 feed through type to Schneider NSYTRV42. 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. 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 AA Electric or equal.
2. Time delay functions shall be accomplished with time delay relays. 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, or 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. Front Panel Operating Controls and Instruments:

1. All operating controls and instruments shall be securely mounted on the door. 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) modules, as manufactured by as manufactured by Square D or approved equal. 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 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 Square D Type K or approved equal. Units with up to 12 selection positions shall be Rundel-Idec Standard Cam Switch, Electroswitch 31, or equal.

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 variables; Pressure, level and flow as indicated equal to Precision Digital, or ABB or equal.

M. Magnetic Flow Meter Systems:

1. Fabricated Tube: Stainless steel with stainless steel flanges.

2. Accuracy: +/-0.5% of actual flow.

3. Accuracy Tests: 5-Point wet flow calibration of every complete flow tube with its signal converter. Traceable to the National Institute of Standards & Technology. Uncertainty relative to flow is +/-0.15%.

4. Repeatability +/- 0.05% or +/- 0.0008ft/s (+/-0.25mm/s), whichever is greater.

5. Temperature Range: Sensor operating -10 degrees to 77 degrees C (14 degrees to 140 degrees F).

6. Electronics: Operating and storage temperature: -4 degrees to 140 degrees F (-20 degrees to 60 degrees C).

7. Velocity Range: 0.2 to 32 FPS

8. Bi-directional Flow: forward and reverse flow indication and forward, reverse, net totalization.

9. Conductivity: 5us/cm.

10. Liner: UltraLiner NSF approved, fusion bonded epoxy.

11. Electrodes: type 316 stainless steel.

12. Power Supply: 100-240VAC/45-66Hz (20W/25VA).

13. M series microprocessor based signal converter or better.

14. Outputs: Dual 4-20mA outputs. Galvanically isolated and fully programmable for zero and full scale (0-22mA). Four separate digital programmable outputs.

15. Empty Pipe Sensing: zero return when electrodes are uncovered.

16. Ratings: Metering tube NEMA 6P/IP68 with remote converter. Electronic enclosure IP67.

17. Certifications: CE Certified (Converter only). Listed by CSA to 61010-1. Certified by CSA to UL61010-1 and CSA C22.2 No.61010-1-04. ISO 9001:2008 certified quality management system.

18. 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.

19. Magnetic flow meter systems shall as manufactured by McCrometer/Water Specialties model UM06. No other manufacturers will be considered acceptable. Manufacturer to provide a written 2 year extended warranty from (a) date of issuance of "Certificate of Proper Installation" and Operation.

PART 3 EXECUTION

3.01 Installation and Startup Services

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. 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. Provide services of panel manufacturer to test the completed system after installation to assure that all components are operating with 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.

C. 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. 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. The Contractor shall guarantee that installation of the system is in accordance with the manufacturer's instructions. The supplier shall construct and verify proper operation of each assembled system before shipment to the site. These performance tests shall be repeated once the system is installed and re assembled at the site. The service technician shall calibrate all gauges and instruments. A documented calibration and settings report shall be included in the O&M manuals.

E. 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.

F. System verification marking end of suppliers 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 engineering error on the part of the supplier.

G. All products mentioned herein must be warranted by the supplier for a period of two (2) years from the date of system verification. The system supplier shall also provide (2) days of training instruction to the Owners personnel to include; operator training, system repair and maintenance.

END OF SECTION

SECTION 262923

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 Heavy Duty rated Square D Altivar 660, no equal.

C. Provide VFD with necessary modifications to provide AUTO RESET on power up upon power loss.

D. Provide all drives with conventional analog and digital control interface for control.

E. Provide equipment purchased from the manufacturer's representative authorized to represent the manufacturer in the projects territory, City of Naples 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 to be installed in NEMA 4X Stainless Steel, gasketed, 3 point latch, pad-lockable door, enclosure with fan-cooled enclosure and as herein specified and shown on the drawings. 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.

1.03 QUALITY ASSURANCE

A. Reference Standards – Latest Edition

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, National Electric Code (NEC).

b. NFPA-70E 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. Drawing must be project specific and not a generic manufacturers standard drawing.

3. A complete drive programmers 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.

PART 2 - PRODUCTS

2.01 GENERAL:

A. 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 two-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.

B. 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.

C. The manufacturer shall supply variable frequency drives which must be 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.

D. 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 4X Stainless Steel, gasketed, 3-point latch, ventilated and filtered enclosure properly sized to dissipate the heat generated by the power electronics.

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. 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.

G. All VFD's must be tested/run under load until rated operating temperatures is achieved.

H. All low voltage (logic control) circuitry (12Vdc, 24Vdc and 120Vac) shall be physically and electrically isolated from medium voltage (480 Vac, 600Vdc) power circuitry to insure safety to maintenance personnel.

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 unit shall include an incoming, UL listed, circuit breaker. A two position switch (hand-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/Off/Auto switch.

4. VFD Run indicating light.

2.05 OPERATING CHARACTERISTICS

A. The variable frequency drive shall convert 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. Instantaneous overcurrent trip capability. 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.

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.

L. 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.

M. Motor overload protection. Provide electronic motor overload and single phase protection integral to the inverter.

O. 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.

2.05 CONTROLS

A. Provide an operator panel with keypad and 2-line 20-character alphanumeric display. 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: Drive control connections for new drives are indicated on the drawings. As a minimum provide the following hardwired inputs and outputs for remote operator control from the plant computer system.

1. Drive Digital inputs
   a. Drive Hard Reset
   c. Start/Stop Command
2. Drive Digital outputs
   c. Remote Ready (In Auto)
   d. Run
   e. VFD Fault(Internal Fault)
   f. Local (In Hand)
3. Drive Analog Outputs
   a. Speed Feedback
4. Drive Analog Inputs

a. Speed Command.

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.

D. Compile a list of all documented settings, highlight settings that have been changed from the default. Include list in Operating and Maintenance manuals as well as in the drive.

END OF SECTION

SECTION 263213

STANDBY DIESEL ENGINE DRIVEN POWER SYSTEM

PART 1 - 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. Installation materials include but are not limited to concrete slab, sub-base tank, sound attenuated enclosure, 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. The project scope includes 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 Generac Industrial Power or an approved equal with a standby rating of 80kw, 100kva, 1800RPM, 0.8 power factor, 277/480Volt, 3 phase, 60 Hertz, 4 wire including radiator fan and all parasitic loads.

1.02 DESCRIPTION OF SYSTEMS

A. A complete package shall be provided by the generator set distributor, maintaining single source responsibility. 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 shown 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 unit shall be shipped to the jobsite by an authorized engine distributor having a parts and service facility within a 200 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 ninety five percent (95%) 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.

1.03 SUBMITTALS

A. Submit to the Engineer for review in accordance with division 1 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.

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.

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.

b. Control panel schematics

c. Legends for all devices on all diagrams

d. 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).

9. Sound Data

10. Emissions Certification

11. Warranty Statement

D. Submit to the Engineer operating and maintenance data as specified in division 1 Sections of this specification. Submit to the Engineer the equipment Manufacturer's Certificate of Installation, Testing and Instruction as specified in division 1 of these specifications.

1.04 SPECIAL TOOLS AND SPARE PARTS

A. The Manufacturer shall furnish one (1) complete spare replacement sets of all filter elements required for the generator unit.

B. Fuses: One spare set

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.

2.02 ENGINES

A. ENGINE RATING AND PERFORMANCE

a. The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4-cycle design. It will have adequate horsepower to achieve rated kW output with at an operating speed of 1800 RPM.

b. The engine shall support a 100% load step.

c. The generator system shall support generator start-up and load transfer within 10 seconds.

B. ENGINE OIL SYSTEM

a. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).

b. The engine shall operate on mineral based oil. Synthetic oils shall not be required.

c. The oil shall be cooled by a oil cooler which is integrated into the engine system.

C. ENGINE COOLING SYSTEM

a. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The radiator shall be designed for operation in 122 degrees F, (50 degrees C) ambient temperature.

b. The engine shall have (a) unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer.

c. Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.

d. A radiator fan guard must be installed for personnel safety that meets UL and OSHA safety requirements.

D. ENGINE STARTING SYSTEM

a. Starting shall be by a solenoid shift, DC starting system.

b. The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations.The batteries supplied shall meet NFPA 110 cranking requirements of 90 seconds of total crank time. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.

c. The genset shall have an engine driven, battery charging alternator with integrated voltage regulation.

d. The genset shall have an automatic dual rate, float equalize, 10 amp battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the generator controller to support remote monitoring and diagnostics. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

E. ENGINE FUEL SYSTEM

a. The engine fuel system shall be designed for operation on #2 diesel fuel and cold weather diesel blends.

b. The engine shall include a primary fuel filter, water separator, manual fuel priming pump, and engine flexible fuel lines must be installed at the point of manufacture. Element shall be replaceable paper type.

c. The engines suction line shall be fitted with a check valve to secure prime for the engines injection pump.

d.

F. ENGINE CONTROLS

a. Engines that are equipped with an electronic engine control module (ECM), shall monitor and control engine functionality and seamlessly integrate with the genset controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers NFPA 110 alarm and warning requirements. All ECM fault codes shall be displayed at the genset controller in standard language – fault code numbers are not acceptable.

b. For engines without ECM functionality or for any additional genset controller monitoring, sensors are to be conditioned to a 4-20ma signal level to enhance noise immunity and all sensor connections shall be sealed to prevent corrosion.

c. Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.

G. ENGINE EXHAUST & INTAKE

a. The engine exhaust emissions shall meet the EPA emission requirements for standby power generation.

b. The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.

c. The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements (reference section 1.1), the silencer shall be selected to achieve site sound levels.

d. For gensets in a weather or sound attenuated enclosure, all exhaust piping from the turbo-charger discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure.

e. The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.

2.03 ALTERNATOR

A. The alternator shall be the voltage and phase configuration as specified in section 1.01.

B. The alternator shall be a 4 pole, revolving field, stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter.

C. The alternator shall include a permanent magnet generator (PMG) for excitation support. The system shall supply a minimum short circuit support current of 300% of the rating (250% for 50Hz operation) for 10 seconds.

D. The alternator shall support 360 skVA with a maximum voltage dip of 35 %.

E. Three phase alternators shall be 12 lead, broad range capable of supporting voltage reconnection. Single phase alternators shall be four lead and dedicated voltage designs (600v) shall be six lead. All leads must be extended into a NEMA 1 connection box for easy termination. A fully rated, isolated neutral connection must be included by the generator set manufacturer.

F. The alternator shall use a single, sealed bearing design. The rotor shall be connected to the engine flywheel using flexible drive disks. The stator shall be direct connected to the engine to ensure permanent alignment.

G. The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H" capable of withstanding 150 degrees C temperature rise.

H. The alternator shall be protected against overloads and short circuit conditions by advanced control panel protective functions. The control panel is to provide a time current algorithm that protects the alternator against short circuits. To ensure precision protection and repeatable trip characteristics, these functions must be implemented electronically in the generator control panel -- thermal magnetic breaker implementation are not acceptable.

I. An alternator strip heater shall be installed to prevent moisture condensation from forming on the alternator windings. A tropical coating shall also be applied to the alternator windings to provide additional protection against the entrance of moisture.

2.04 CONTROLS

A. The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of NFPA 110 level 1.

B. The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine's electronic engine control module (ECM) if so equipped. Generator controller's that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.

C. Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.

D. The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.

E. Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.

F. A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.

G. Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .2 msec data logging capabilities.

H. In addition to standard NFPA 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.

I. The control system shall provide pre-wired customer use I/O: 4 relay outputs (user definable functions), 4 contact inputs, 2 analog inputs, communications support via RS232, RS485, or an optional modem. Additional I/O must be an available option.

J. Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the generator controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.

K. The control panel shall include a digital display for all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; fuel level (where applicable); engine speed; DC battery voltage; run time hours; generator voltages, amps, frequency, kilowatts, and power factor; alarm status and current alarm(s) condition per NFPA 110

2.05 ENGINE / ALTERNATOR PACKAGING

A. The engine/alternator shall be bolted directly to the genset frame and the entire frame shall be mounted on spring isolators. The engine/alternator shall be isolated from the generator frame with rubber isolators. The packaging shall not require the addition of external spring isolators.

B. A mainline, thermal magnetic circuit breaker carrying the UL mark shall be factory installed. The breaker shall be rated between 100 to 125% of the rated ampacity of the genset. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.

C. SUB-BASE FUEL TANK

a. The packaging shall include a double wall, sub-base mounted, UL142 listed fuel tank. The tank shall be sized to provide 48 hours of run time.

b. The tank shall include fuel suction and return connections, normal and emergency vents, secondary containment emergency vent and rupture basin sensor, mechanical fuel level indication and a stub-up area convenient for electrical conduit entry.

c. The fuel tank shall use an electric fuel sensor to provide an analog indication of fuel level. The controller shall have a warning indication on low fuel level and provide optional shutdown functionality for low, low fuel level.

d. For applications 500 kW and larger, the fuel tank shall have a built-in catch basin to secure genset coolant and oil against an accidental spills.

e. The fuel tank must be supplied by the engine-generator set manufacturer and be installed before shipment.

2.06 REMOTE E-STOP

A. Provide emergency stop operation station with NEMA 3R break glass to release button. Model Series ST120SN3RSL or equal.

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 Contractor 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.

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 three and a half (3.5) continuous hours. Any defects which become evident at this time shall be corrected before acceptance.

C. Verify voltage & frequency stability.

D. Verify transient voltage & frequency dip response.

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 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 263600

AUTOMATIC TRANSFER SWITCH UTILITY TO GENSET

PART 1-GENERAL

1.01 GENERAL

A. Transfer switches shall be UL 1008 listed for application in their intended enclosures at 100% of continuous ampere rating and shall meet or exceed UL 1008 endurance test criteria to include rate of operation and number of operation cycles.

1. The transfer switch shall be designed and intended for switching the load connection between two power sources.

2. The transfer switch shall include electrical and mechanical interlocks to prevent unintentional paralleling of the power sources.

3. The transfer switch shall be of double throw construction and the dual electrical operators shall be equipped with a reliable two-step stored energy mechanism to charge the closing springs. The closing springs shall be capable of being charged electrically or manually. The closing of the main contacts shall automatically charge the opening springs to ensure quick-break operation. After closing the main contacts, the closing springs shall be capable of being re-charged.

4. The transfer switch shall include a mechanical coupling to facilitate completion of an open in-phase transition such that any inrush current is equal to or less than normal starting current for inductive loads.

5. The transfer switch main contacts shall be of silver composition, electrically operated and mechanically held in position. Inspection of the main contacts shall be possible from the front of the transfer switch without major disassembly.

6. The transfer switch shall include removable arc chutes, housed within an arc chamber constructed of high-dielectric high-strength material, that are mounted over each set of main contacts. Arc chutes shall be constructed of metal plates and a baffle cover designed to extinguish an electrical arc and protect the main contacts.

7. The transfer switch shall include pushbutton controls, mounted on the power switch device, to perform manual operation with an electrical load connected.

8. The transfer switch shall provide colored mechanical indication of main contact position (open, closed), mounted on the power switch device, for source 1 and source 2.

9. The transfer switch shall provide colored mechanical indication of closing spring charge state (charged, discharged), mounted on the power switch device, for source 1 and source 2.

B. Transfer switches shall be open transition and provide a time delay in the "neutral position" adjustable from 0 to 120 seconds that will permit a delayed transition and provide an in-phase monitor that will permit an in-phase transition between two live sources that have a phase angle difference of +/- 8 degrees or less. In the event that the sources do not synchronize to complete an in-phase transition within a time delay period adjustable from 1 to 60 minutes, the transfer switch shall be capable of defaulting to a delayed transition adjustable from 0 to 120 seconds.

C. The transfer switch shall include a means of deriving control power for electrical operation. Control power transformers shall be multi-tap for ease of voltage adjustment in the field. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.

E. Transfer switches requiring a solid neutral shall include a fully rated, solid neutral plate.

F. Power conductor connections shall be provided as source 1 at the top, source 2 at the bottom, and load at the top (field adjustable as bottom).

G. For safety and serviceability, a continuous steel barrier shall be provided between the power conductor connections and the electrical control components including the automatic controller, control power transformer, relays, user controls, and indication lights. Together, the continuous steel barrier and enclosure front door shall form an isolated control compartment.

H. Provide transfer switches by the genset manufacturer or as indicated on the drawings. The generator set manufacturer shall warranty transfer switches to provide a single source of responsibility.

I. Provide transfer switch by generator supplier; Generac Industrial Power or an approved equal.

1.02 ENCLOSURE

A. Each automatic transfer switch shall be provided in a NEMA 3R enclosure suitable for use in environments indicated in the drawings.

B. NEMA 1, 12, and 3R enclosures shall be painted with the manufacturer's standard light gray ANSI 61 paint. NEMA 4X shall be 304 stainless steel.

C. Internal floor-mount anchors shall be provided to minimize footprint and facilitate integration into an equipment line-up.

1.03 MICROPROCESSOR CONTROLLER LOGIC

A. The transfer switch microprocessor controller logic shall be an ATC-300+ automatic controller. Operation of the transfer switch and monitoring of both sources shall be managed by the controller. The controller shall be hardened against transient voltages.

B. The automatic transfer switch controllers shall meet or exceed the following standards:

1. IEC 61000-4-2 - EMC Testing and Measurement Techniques - Electrostatic Discharge Immunity Test

2. IEC 61000-4-3 - EMC Testing and Measurement Techniques - Radio-frequency, Electromagnetic Field Immunity Test

3. IEC 61000-4-4 - EMC Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test

4. IEC 61000-4-5 - EMC Testing and Measurement Techniques - Surge Immunity Test

5. IEC 61000-4-6 - EMC Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-frequency Fields

6. IEC 61000-4-11 - EMC Testing and Measurement Techniques - Voltage Dips, Short Interrupts and Voltage Variations Immunity Tests

7. CISPR11, Class A - Industrial, Scientific and Medical Radio-frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement

8. FCC Part 15, Subpart B, Class A

C. The controller shall have an operating temperature range from -20 to +70 degrees C (-4 to +158 degrees F) and a storage temperature range from -30 to +85 degrees C (-22 to +185 degrees F). The controller faceplate shall be UV resistant.

D. The controller shall be capable of accepting 120Vac supply power from two (2) different sources.

1.04 CONTROLLER DISPLAY AND KEYPAD

A. The microprocessor-based controller faceplate shall be UV resistant and include a 2-line, 16-character, backlit display. The controller shall be capable of displaying transfer switch status, parameters, setpoints, and diagnostic data. All set point parameters shall be password protected.

B. The microprocessor-based controller shall include one (1) unit status LED (3mm) and a mimic power bus consisting of four (4) LED's (3mm) for indicating the following:

1. Availability status of Source 1
2. Availability status of Source 2
3. Connection status of Load to Source 1
4. Connection status of Load to Source 2

C. The controller keypad shall include the following pushbutton controls:

1. ENGINE TEST, for use with a generator source.
2. PREVOUS, and NEXT for ease of navigation
3. INCREMENT, DECREMENT, and ENTER for programming.
4. HELP/LAMP TEST, for operator assistance and diagnostics
5. BYPASS TIMER, to bypass time delay countdown

D. The controller shall display voltage and frequency for source 1, source 2, and the load.

E. The controller shall display the voltage dropout and pickup setpoints, for source 1 and source 2, in volts.

F. The controller shall display the frequency dropout and pickup setpoints, for source 1 and source 2, in hertz.

1.05 CONTROLLER VOLTAGE AND FREQUENCY MONITORING

A. The controller shall monitor voltage and frequency for source 1 and source 2.

B. The controller shall have a voltage range of 0-790 Vrms with an accuracy of +/- 1%. Nominal voltage shall be adjustable in 1 volt increments from 120 to 600 Vac.

C. The controller shall have a frequency range of 40-70 Hz with an accuracy of +/- 0.3 Hz. Nominal frequency shall be adjustable as 50 or 60Hz.

D. The normal and emergency sources shall include phase reversal protection. The preferred rotation is programmable as ABC or CBA.

E. Voltage and frequency dropout and pickup setpoints, for source 1 and source 2, shall be adjustable as a percentage of nominal per the table below. Pickup and dropout setpoints for overvoltage, underfrequency, overfrequency, and voltage unbalance / phase loss shall be capable of being disabled.

Setpoint	Sources	Dropout	Pickup
Undervoltage	Source1 and 2	70 – 97%	(DO + 2%) - 99%
Overvoltage	Source 1 and 2	105 – 110%	103% - (DO – 2%)
Underfrequency	Source 1 and 2	90 – 97%	(DO + 1Hz) – 99%
Overfrequency	Source 1 and 2	103 – 105%	101% - (DO – 1Hz)
Voltage Unbalance	Source 1 and 2	5 – 20%	3% to (DO – 2%)

1.06 CONTROLLER TIME DELAYS

A. A time delay shall be provided for transfer from source 1 to source 2, adjustable from 0 to 1800 seconds.

B. A time delay shall be provided on retransfer from source 2 to source 1, adjustable from 0 to 1800 seconds.

C. A time delay shall be provided for actuation of an engine start signal, adjustable from 0 to 120 seconds, for overriding momentary power fluctuations.

D. A time delay shall be provided allowing the load connection to remain in the “neutral position” (disconnected from source 1 and source 2), adjustable from 0 to 120 seconds.

E. A time delay shall be provided that allows the generator to run unloaded, adjustable from 0 to 0-1800 seconds, for cool-off prior to shut down.

F. A time delay shall be provided to postpone the generator source from being declared unavailable, fixed at 6 seconds, for overriding momentary power fluctuations.

G. A time delay shall be provided for actuation of a pre-transfer signal, adjustable from 0 to 120 seconds. The contact shall be a form-c contact rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc.

H. A time delay shall be provided to allow synchronization of sources, adjustable from 0 to 60 minutes (0 to 600 seconds), for use with in-phase transition transfer.

I. A time delay shall be provided for voltage unbalance, adjustable from 10 to 30 seconds.

J. All time delays shall be programmable, using the controller keypad, without the use of special tools.

1.07 CONTROLLER ADDITIONAL FEATURES

A. A setpoint shall be provided for entering a four-digit password, adjustable from 0000-9999, for controlling user access to programmable time delays, inputs, outputs, and other system settings.

B. A setpoint shall be provided for configuring retransfer operation mode, adjustable as [automatic, manual].

C. A setpoint shall be provided to change date, time, and enable daylight saving time (DST).

D. A setpoint shall be provided for configuring in-phase transition operation, adjustable as [disabled, enabled].

E. A setpoint shall be provided for configuring a frequency difference range between sources for in-phase transition, adjustable from 0 to 3 hertz nominal.

F. A setpoint shall be provided for configuring serial communication baud rate [9600-19200] and Modbus address [1-247].

1.08 CONTROLLER DATA LOGGING

A. The controller shall record, store and display a cumulative counter history of the following parameters. Each counter shall have the ability to be reset and indicate the last reset date.

1. Source 1 Available time

2. Source 2 Available time

3. Source 1 Connected time

4. Source 2 Connected time

5. Engine Run time

6. Load Energized Time

7. Number of Transfers

8. Date, Time and Reason for Last Sixteen (16) transfers

1.09 CONTROLLER PLANT EXERCISER

A. The controller shall provide a programmable engine plant exerciser.

B. Each engine plant exerciser shall provide the following user programmable setpoints that are only applicable during an engine test:

1. Test schedule, adjustable to [disabled, daily, 7-day interval, 14-day interval, 28-day interval].

2. Start time in hours and minutes, AM or PM.

3. Day of the week (Sun, Mon, Tues, Wed, Thurs, Fri, Sat)

4. Test mode, adjustable to [disabled, no load transfer, loaded transfer].

5. Run time, adjustable from 0 to 600 minutes (0 to 6000 seconds).

C. A failsafe shall initiate an automatic retransfer to source 1 if source 2 should fail during an engine test.

1.10 CONTROLLER INPUTS

A. The controller shall include two (2) dedicated inputs for monitoring the position of the main contacts (source 1 and source 2).

B. The controller shall include five (5) control inputs that provide 10mA @ 24-Vdc. Each input shall be capable of accepting an external dry contact and will be configured with following functionality:

1. Monitor mode – disable automatic operation of the controller while continuing to display status information and allow set point programming.

2. Lockout – disable automatic operation of the controller and lock-out an integral overcurrent protection device (circuit breaker).

3. Manual retransfer - remotely initiate a retransfer from source 2 to source 1.

4. Go to emergency - initiate a transfer of the load to the emergency source (source 2). A failsafe shall initiate an automatic retransfer to source 1 if source 2 should fail.

5. Emergency inhibit/shed – remotely inhibit transfer of the load to the emergency source (source 2) or shed the load from the emergency source (source 2) if already connected.

1.11 CONTROLLER OUTPUTS

A. The controller shall provide four (4) dedicated Form A relay outputs for controlling the power switch device.

B. The controller shall provide one (1) dedicated Form A relay output for an engine start signal, for use with a generator source. The contact shall be rated for 5A @ 250-Vac / 5A @ 30-Vdc.

C. The controller shall provide one (1) dedicated Form C relay output for Pre-transfer and the contacts shall be rated for 10A @ 250-Vac / 10A @ 30-Vdc.

D. The controller shall provide one (1) dedicated Form C relay output for General Alarm and the contacts shall be rated for 10A @ 250-Vac / 10A @ 30-Vdc.

1.12 CONTROLLER COMMUNICATION

A. Serial communication (RS-485) with support for Modbus RTU protocol shall be provided with an integral network termination resistance that can be switched on/off.

1.13 WITHSTAND AND CLOSING RATING

A. Short-circuit

1. The transfer switch shall be UL1008 listed and rated for use in a circuit capable of delivering the short-circuit current shown on the contract drawings.

2. The transfer switch shall have a short-circuit withstand and closing rating of 100KA at 480 volts when protected by a specific circuit breaker.

3. The transfer switch shall have a short-circuit withstand and closing rating of 100KA at 480 volts for a time duration of 0.05 seconds.

B. Short-time

1. The transfer switch shall be UL1008 listed and rated for use in a circuit capable of delivering the short-time current shown on the contract drawings.

2. The transfer switch shall have a short-time withstand and closing rating of 85KA at 480 volts for a time duration of 0.5 seconds.

1.14 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 preformed 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.

END OF SECTION

SECTION 263613

SAFETY SWITCHES AND DISCONNECTS

1.01 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 enclosure provide NEMA 4X switches with aluminum enclosure as manufactured by Bryant. 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 arc suppressors, pin hinges and be horsepower rated at 600 volts.

E. All disconnect switches shall be furnished from the manufacturer with (2) normally open and (2) normally closed interlock contacts. Motor space heater shall be wired through one set of contacts. The other contact shall be wired through the local off/remote motor switch at the disconnect location.

F. 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.

1.02 SUBMITTALS

A. Submit product data on all major types of disconnects.

END OF SECTION

SECTION 264100

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 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 00.

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.

1.03 SYSTEM DESIGN

A. The system shall be an effective, aesthetically acceptable lightning protection system to the standards of Underwriters Laboratories UL 96 & UL96A. 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.

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 blunt tip type. All air terminals shall complying with the weight and construction requirements for Class II lightning protection systems. 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 and have a minimum 3/16” ball shaped tip.

B. Air Terminals shall be manufactured by Thompson Lightning Protection, Inc, Lightning Master Corporation or Altec Global.

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 (115,000 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 copper, and 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.

B. Provide copper grounding system below 18” AFG or AFF. Radius of bends shall not be less than 8 inches.

C. Counterpoise loop ground conductors shall be tinned copper and be a minimum size equal to the main roof conductor size (115,000cm) or 2/0.

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 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' minimum 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 Thompson Lightning Protection, Inc. Independent Protection Company, Inc., Heary Brothers Lightning Protection, Harger Lightning Protection, Robbins Lightning Protection, Altec or Lightning Master Corporation.

END OF SECTION

SECTION 265000

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. 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.

2. 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.

3. The conductors between ballasts and lampholders shall have an approved insulation for 1,000 volts. This includes conductors to and from remote ballasts.

4. High-intensity discharge ballasts shall be constant wattage autotransformer type with built-in thermal protection, minimum power factor of 80%. 12" min. leads.

5. 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.

6. Ballasts for control of lamps in one housing or fixture unit may control lamps of an adjoining unit, except as otherwise noted.

7. 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.

8. Provide dimming ballasts as shown on the drawing for fixtures controlled by individual dimming or dimming systems.

9. 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 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 290000

GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 CONTRACTOR'S LICENSURE REQUIREMENT

The CONTRACTOR's firm shall hold a valid Florida Water Well Drilling License.

1.2 PROJECT SCHEDULE

The CONTRACTOR shall submit a detailed schedule prior to the commencement of any site work. The schedule shall include a proposed mobilization, completion, and demobilization date. The CONTRACTOR shall schedule all work or tests during daylight hours (7:00 a.m. to 7:00 p.m.), unless prior approval from the ENGINEER has been obtained. The CONTRACTOR shall be required to complete the project within 180 days from the notice to proceed.

1.3 WORK EQUIPMENT

Equipment utilized for this project shall be in first-class working order. The CONTRACTOR shall use his own drilling equipment having the minimum capabilities necessary to do the described work. No unnecessary delays or work stoppages will be tolerated because of equipment failure. Equipment failure shall not be considered a valid reason for extending the length of the Contract. The CONTRACTOR shall be held responsible and payment may be withheld for damages to the well due to any cause of negligence, faulty operation, or equipment failure.

1.4 REMEDIAL WORK

If remedial work proves to be necessary to make the well acceptable to the OWNER to comply with the regulations and/or Specifications because of accident, loss of tools, defective material, or for any other cause, the CONTRACTOR shall propose a method of correcting the problem, in writing. Suggested methods shall be reviewed and approved by the ENGINEER before work proceeds. Such work shall be performed at no additional cost to the OWNER and it shall not extend the length of the Contract. The CONTRACTOR is notified that all specifications shall be met, including hole straightness and setting of casings to the points designated by the ENGINEER.

1.5 DAILY LOG

The CONTRACTOR shall maintain a detailed daily log of the well construction and testing operations. The logs shall be on printed forms and shall give a brief description of all field activities and pertinent data as may be required by the ENGINEER. Two copies of each daily log shall be submitted to the ENGINEER (or ENGINEER's representative) on a daily basis.

1.6 SAFETY

The CONTRACTOR is expected to perform the proposed work in a safe manner. In the event that the CONTRACTOR has safety concerns regarding the proposed work, alternate methods may be proposed by the CONTRACTOR in writing prior to commencement of work, which need to be approved from the ENGINEER before execution. The CONTRACTOR shall use every precaution necessary to ensure a safe work area and shall comply with all U.S. Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (USEPA) regulations regarding the types of work described in this Specifications.

The CONTRACTOR shall provide a written Health and Safety Plan (HASP) to the ENGINEER which shall include but not be limited to the following: emergency contact information, location maps to the nearest hospital emergency room, lists of know hazards associated with the work, material safety data sheets, personal protective equipment requirements, contact information for the CONTRACTOR's designated safety officer, etc. The CONTRACTOR shall perform the proposed work in a safe manner and shall adhere to the approved HASP.

1.7 MAINTENANCE OF TRAFFIC

As applicable, and as directed by the ENGINEER, the CONTRACTOR shall file a traffic control plan and obtain approval within the appropriate local, county, or state traffic departments. When work will occur within the Department of Transportation rights-of-way or easements, the CONTRACTOR shall submit to the ENGINEER, a Maintenance of Traffic Plan that shows the measures for traffic management during the well installation. This Plan shall include appropriate signage, barricades and/or temporary striping in accordance with the Florida Department of Transportation, Roadway and Traffic Design Standards, (Topic #625-010-003-6) and/or the Manual on Uniform Traffic Control Devices (MUTCD), Part VI, Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility, and Incident Management Operations.

1.8 ABANDONMENT

If the CONTRACTOR voluntarily stops work, and/or fails to complete in a satisfactory manner, in accordance with the regulations and/or Specifications and approved changes, the OWNER shall consider the project to be abandoned by him. If the OWNER declares the project abandoned by the CONTRACTOR, then no payment will be made. All salvageable material furnished by the CONTRACTOR may be removed and remain his property. Written approval from the OWNER shall be required before the CONTRACTOR is allowed to proceed.

1.9 GUARANTEE

The CONTRACTOR guarantees that the work and service to be performed under the Contract and all workmanship, materials, equipment performed, furnished, used, or installed in the work shall be free from defect and flaws, and shall be performed and furnished in strict accordance with the Contract documents; that the strength of all parts of all manufactured equipment shall be adequate and as specified; and that the performance test requirements of the Contract documents shall be fulfilled.

The CONTRACTOR shall repair, correct or replace all damage to the work resulting from failures covered by the guarantee.

1.10 STANDBY TIME

The OWNER may ask the CONTRACTOR to stop operations so that extra work not included in these Specifications, such as testing and additional data collection, can be performed. The OWNER and ENGINEER shall schedule the request so it causes a minimum of delay. All standby time for which extra payment will be made shall be approved by the ENGINEER in writing in advance. The CONTRACTOR shall be reimbursed at hourly rates listed in the unit cost bid form.

1.11 REGULATORY REQUIREMENTS

The CONTRACTOR shall comply with all requirements and conditions of all permits related to the work of this contract and shall comply with provisions of any permits issued. The CONTRACTOR shall be responsible for obtaining any necessary licenses and permits, and for complying with any applicable federal, state, and municipal laws, codes and regulations, in connection with the execution of the Work. The CONTRACTOR shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.

1.12 REFERENCE STANDARDS

All design, material and work shall be in strict accordance with all applicable governmental, regulatory and testing organizations including, but not limited to the following:

ANSI – American National Standards Institute
ASTM – American Society of Testing and Materials
AWWA – American Water Works Association
FDOH – Florida Department of Health
FDEP – Florida Department of Environmental Protection
FDOT – Florida Department of Transportation
NSF – National Sanitation Foundation
OSHA – Occupational Safety and Health Administration
CCHD – Collier County Health Department
Florida Building Code 2001 and Companion Codes as amended
TSSS – Recommended Standards for Sewage Works
TSSW – Recommended Standards for Water Works

1.13 NOISE CONTROL

Noise produced by field operations shall be kept to a minimum. Noisy operations shall be conducted whenever possible during daylight hours and scheduled to minimize duration. The CONTRACTOR shall comply with all applicable federal, state, and Collier County noise pollution control regulations. Noisy equipment shall be kept as far as possible from noise sensitive site boundaries. Equipment shall be properly maintained to reduce noise from excessive vibration, faulty mufflers, or other sources. No equipment shall be left idling unnecessarily.

1.14 RESPONSIBILITY AND HANDLING OF MATERIALS

The CONTRACTOR shall be responsible for all materials furnished by it and shall replace at its own expense all such materials found to be defective in manufacture or damaged in handling. The CONTRACTOR shall be responsible for the safe storage of materials. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times. All materials shall be delivered and distributed at the site by the CONTRACTOR. All casing, fittings, and accessories shall be loaded and unloaded so as to avoid shock or damage. Handling of casings and fittings shall conform to all manufacturers' recommendations. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

1.15 MONTHLY PROGRESS MEETINGS

The CONTRACTOR shall prepare for and provide a qualified representative to attend a monthly Construction Progress Meeting to be held at the construction site and attended by representatives of the ENGINEER and the OWNER. The CONTRACTOR shall provide an updated schedule and detail of work completed during the previous month and work anticipated to be completed during the upcoming month.

1.16 PROTECTION OF PROPERTY

The CONTRACTOR shall take special precautions to reduce to a minimum the nuisances and damage to property which could result from working in remote areas, residential areas, and adjacent to roads. As applicable, and as directed by the ENGINEER, the CONTRACTOR shall file a traffic control plan and obtain approval within the appropriate local, county, or state traffic departments. Any damage to public or private property shall be immediately repaired and paid for by the CONTRACTOR at no expense to the OWNER. Equipment, tools, and materials shall be located in places where they will produce a minimum of nuisance.

The remote location of the construction site presents an increased risk of vandalism and/or theft. The CONTRACTOR should take all measures to secure his equipment and to deter any criminal activity. Appropriate warning signs, including lighted warnings, shall be posted on the streets and the Collier County Sheriff's Department shall be informed of the location of the construction site.

1.17 CERTIFICATION OF CHEMICALS

All chemicals used during the project shall show approval of either USEPA or the U.S. Department of Agriculture (USDA) for use in and around public water supply wells. The CONTRACTOR shall submit the most recent Material Safety Data Sheets (MSDS's) in accordance with OSHA Rule 29 Code of Federal Regulations (CFR) 1910.1200 for each chemical to be used during the project. Two copies shall be furnished to the ENGINEER.

1.18 SITE VIDEO

The CONTRACTOR is required to take a digital video of pre- and post- construction site conditions of the well sites and surrounding areas to allow for clear comparisons of site conditions before and after the work is conducted.

1.19 SUBMITTALS

The CONTRACTOR is required to submit the following at least 10 days prior to the commencement of work:

1. Detailed work schedule
2. Well Contruction Pemits from Collier County Growth Management Division
3. FDEP Permit to Discharge Produced Groundwater
4. Health and Safety plan for the project
5. List of personnel that will be working on the project and their contact information
6. Relevant MSDS sheets for all chemicals to be used for the project
7. Name and address of any subcontractors used for the job
8. Name and site address of site for disposal of drilling fluids
9. Name and address of certified laboratory to be used for water testing
10. Manufacturer's specifications for all materials including casings, centralizers, and cement
11. Information on the type of well drilling rig to be used for the project
12. Calibration certificates for flow and water quality meters
13. Manufacturer's specifications on testing equipment including Submersible Test Pump, Rossum Sand Tester, Pressure Transducer/Datalogger, Turbidimeter, and calibration certificates for flowmeters.
14. Digital copy of pre-construction site video

The CONTRACTOR is required to submit the following at within 30 days after completion of all construction and testing.

1. CONTRACTOR's Daily Logs
2. Final copies of geophysical logs and videos
3. Water quality sampling results
4. Copies of all deliver tickets for cement if applicable
5. Digital copy of post-construction site videos
6. Certificates of Completion from Collier County Growth Management
7. Well Completion Reports

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

01

SECTION 290010

PERMIT AND FEES

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

The CONTRACTOR shall comply with all requirements and conditions of all permits related to the work of this contract and shall comply with provisions of any permits issued. The CONTRACTOR shall be responsible for obtaining any necessary licenses and permits, and for complying with any applicable federal, state, and municipal laws, codes and regulations, in connection with the execution of the Work. The CONTRACTOR shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.

The CONTRACTOR shall obtain and pay for any permits and licenses required to complete the project except for those permits obtained by the OWNER as listed below.

The CONTRACTOR shall schedule all necessary inspections with the regulatory agencies to be in compliance with the permits.

1.2 PERMITS BY OWNER

The OWNER has secured or will secure the following permits:

1. South Florida Water Management District – Consumptive Use permit

1.3 PERMITS BY CONTRACTOR

The CONTRACTOR shall be responsible for obtaining the Well Construction Permits from the Collier County Growth Management Division.

The CONTRACTOR shall secure the FDEP Generic Permit for the Discharge of Produced Groundwater Permit to allow discharge of water during direct-air drilling and development.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 290015

SITE PREPARATION

PART 1 – GENERAL

1.1 SITE PREPARATION

Access to the site shall be provided by the OWNER. The CONTRACTOR shall coordinate site access with the OWNER. Clearing of bushes for equipment setup at the well site may be necessary. The CONTRACTOR shall take precautions to avoid damage to OWNER's property. Any damage to public or private property shall be repaired or paid for by the CONTRACTOR at no expense to the OWNER.

1.2 MOBILIZATION

Mobilization shall include all items required for the proper completion of the work. The CONTRCTOR shall bring to the site all necessary equipment required for the first month's operation. Work elements pertaining to mobilization shall include, but not limited to:

- Installation of silt fences around the construction site and where surface drainage discharges to existing surface water bodies
- Establish a safety protocol
- Secure construction utility requirements (water supply, electrical, etc.)
- Install onsite sanitary facilities
- Submit all insurance and bond requirements
- Secure all necessary permits
- Post all notices required by regulatory agencies (OSHA, FDEP, etc.)
- Post the "No Trespassing" sign and other relevant project signs
- Submit a detailed project schedule acceptable to the ENGINEER
- Submit a Hurricane Preparedness Plan if required by the ENGINEER
- Prepare and implement traffic maintenance and control plans

1.3 SEDIMENTATION AND EROSION CONTROL

The CONTRACTOR shall not discharge any fluids generated during this project to any surface water body without first obtaining an NPDES permit for the discharge of produced groundwater. The CONTRACTOR will be responsible for containment of all fluids within the existing stormwater swales and insuring that produced turbid water does not run off into adjacent protected or environmentally sensitive areas or private land. The CONTRACTOR will be responsible for installation of appropriate erosion and sedimentation control measures such as silt fencing, hay bales, ditch blocks, temporary sediment traps, and/or containment berms. All erosion and sedimentation control measures employed shall be installed to the standards set forth by the Florida Stormwater Erosion and Sedimentation Control Inspector's Manual and shall be approved by ENGINEER.

1.4 DRILLING FLUID AND DRILL CUTTINGS HANDLING AND DISPOSAL

Disposal of drilling fluid onsite is not permitted. A closed-circulation system shall be used for the drilling fluids, employing suitable devices such as screens, shale shakers, and settling tanks to remove cuttings. Drilling fluid shall be removed from the drilling site and disposed of at an approved location. The CONTRACTOR shall furnish to the ENGINEER and OWNER, prior to beginning construction, the name and location of the disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. The fluid displaced from the borehole during cementing operations shall be considered excess drilling fluid and shall be disposed of in an approved manner. All costs of disposal shall be included in the unit cost for borehole drilling.

1.5 SITE RESTORATION AND DEMOBILIZATION

Upon completion of the work, the CONTRACTOR shall disassemble all temporary piping and equipment modifications from the site and demobilize. The CONTRACTOR shall remove all equipment which is not part of the well and leave the site in a condition acceptable to the OWNER. The CONTRACTOR shall broom clean exterior paved surfaces and rake clean other adjacent surfaces of the grounds. The CONTRACTOR shall return the Site to original condition as defined by the ENGINEER.

Restoration of surface features, removal and resetting of any private or public signs, markers, mailboxes, fences, repair and replacement of existing sprinkler pipe and heads and other appurtenances, filling and final grading of all disturbed areas within the project to provide positive drainage, removal of trees (upon approval by the OWNER), removal and replacement of existing shrubs, bushes and other vegetation, surface preparation, fertilizing, restoration of lawn areas to include sodding to match existing grass surface, rolling/seating, seeding, mulching, hauling watering, watering, maintaining area until sod/grass is established and project or portion thereof is accepted by the OWNER shall be required.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 290020

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 UTILITY REQUIREMENTS

A. WATER SUPPLY

The CONTRACTOR shall provide the OWNER and ENGINEER a description of his water supply needs at a required pre-construction meeting. The CONTRACTOR shall provide for himself any clean, fresh water that he requires for the work described in these Specifications. If the OWNER provides water, the CONTRACTOR is responsible for metering the volume of water supplied by the OWNER to the OWNER's satisfaction. CONTRACTOR shall maintain any temporary supply line with backflow prevention as required by the OWNER. The CONTRACTOR shall be responsible for securing any other permits, licenses, or approvals that shall be obtained from the South Florida Water Management District, Collier County, or any other local regulatory entity.

B. SANITARY FACILITES

The CONTRACTOR shall provide a portable toilet facility at the site for field workers to utilize during the construction. The portable toilet shall be regularly cleaned and disinfected at the expense of the CONTRACTOR during the couse of the project.

C. ELECTRICITY

All electric current required by the CONTRACTOR shall be furnished at his own expense. All temporary lines shall be furnished, installed, connected, and maintained by the CONTRACTOR in a workmanlike manner satisfactory to the OWNER and ENGINEER and shall be removed by the CONTRACTOR in like manner at his expense at the completion of the work. All temporary electrical fixtures, lines, and related equipment and installation shall be in accordance with applicable county and state regulations.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 290025

PRODUCTION WELLS

PART 1 – GENERAL

1.1 SCOPE OF WORK

The Scope of Work for this project includes furnishing all labor and materials for the installation and testing of two Lower Tamiami Aquifer Production Wells, Well 426 and Well 40R for the City of Naples (refer to Figure 1 for well locations). The CONTRACTOR shall provide all the materials and equipment required to accomplish the work as described below. All work is to be completed in the presence of the ENGINEER.

The CONTRACTOR is advised and should be aware of difficult drilling conditions and problems he may encounter during the drilling, construction, and testing of the wells. Difficult drilling conditions and problems include, but are not limited to, lost circulation, cavities, potential squeezing zones and sand intervals, along with attendant caving problems.

PART 2 – PRODUCTS

2.1 SURFACE CASING

All casings shall be new, approved for use in municipal public supply wells and to specifications as outlined under Construction Sequence for Wells section. The contract will indicate an estimate of the amount of casing for the well; however, actual field conditions will dictate the exact amount of casing.

A surface casing shall be installed with an inside diameter sufficient to accommodate a nominal 22-inch drilling bit capable of drilling the specified borehole dimensions. The material, length, and method of installation shall be at the CONTRACTOR's option subject to approval by the ENGINEER.

2.2 FINAL CASING

The final casing string shall be nominal 16-inch external diameter, SDR 17 PVC well casing as manufactured by the North American Pipe Company (NAPCO) or equivalent 16-inch external diameter casing approved for use in public supply production wells. The casing shall be of uniform 0.941 inch wall thickness and shall use a spline and groove mechanical joining system. The casing shall be approved by the National Sanitation Foundation (NSF) for use with potable water. The casing shall be of sufficient collapse resistance and tensile strength to withstand downhole stress during construction and development of the well or an equivalent approved by the ENGINEER and shall be free of defects in workmanship and handling. The 16-inch PVC casing joints shall be made in accordance with manufacturer's recommendations and shall have an internal pressure rating of a minimum of 150 psi and a collapse resistance pressure minimum of 224 psi.

2.3 CEMENT GROUT

Sulfate resistant cement shall be used for all casing cementing operations. The final well casing grout shall be sulfate resistant API Class B (ASTM Type II) Portland cement mixed with no more than 5.2 gallons of water per sack of cement. Surface casing grout may be API Class A (ASTM Type I) cement mixed with no more than 5.2 gallons of water per 94 pound sack. Only fresh water may be used for grout mix. A cementing plan for each stage of cement shall be submitted to the ENGINEER for approval prior to emplacement of any cement grout. The first stage of each cementing operation shall be performed using the pressure grout method. For all subsequent stages, performed using the tremie method, the top of cement shall be accurately tagged and the bottom of the tremie pipe shall be set no more than five (5) feet above the bottom of the interval to be grouted.

Cement with up to 5% bentonite gel additive shall be used for plugging and abandonment. All cement blends shall be approved by the ENGINEER in advance of placement, and the CONTRACTOR shall make provisions to pump more or less cement during specific stages as directed by the ENGINEER.

2.4 CENTRALIZERS

All final casings shall be fitted with PVC bow-spring type centralizers with vertical bow straps at 0, 90, 180, and 250 degrees around the casing at each position. Shop drawings of the centralizers shall be submitted to the ENGINEER for approval prior to installation. The centralizers shall be located as follows: one set 5 feet above the base of casing, one set at 50 feet BLS, and one set at 20 feet BLS.

2.5 DRILLING FLUID

No drilling fluid other than clear potable water will be used in the open hole section of the well below the final casing. Drilling fluids used during drilling of the pilot hole and the reaming of the cased portion of hole shall be approved for use in construction of municipal public supply wells and shall be bentonite based. The addition of drilling additives such as polymers or surfactants shall require pre-approval by the ENGINEER.

2.6 HYDROCHLORIC ACID

The acid used for well treatment shall be 32% inhibited hydrochloric acid (HCl) from a source and carrier approved by the ENGINEER. Certification from the acid supplier will be required to verify materials and acid quantities on the same working day as acid delivery to site.

PART 3 – EXECUTION

3.1 CONSTRUCTION SEQUENCE

1. Perform pre-construction site video, mobilize equipment and prepare site.

2. Drill a nominal 12-inch diameter pilot hole by mud rotary method to approximately 20 feet BLS and collect formation sampes every 10 feet during drilling. Ream pilot hole to a nominal 30-inch diameter. Install and grout in place approximately 20 feet of 24-inch diameter surface casing to the satisfaction of the ENGINEER.

3. Drill a nominal 12-inch diameter pilot borehole to a depth of approximately 80 feet BLS using the mud rotary method and collect formation samples every 10 feet during drilling. All wellbores drilled as part of this contract shall meet the plumbness and alignment conditions set forth in Section 3.5 below.

4. Prepare the hole for geophysical logging by circulation of the drilling fluid until it is uniform and free of drill cuttings. Perform geophysical logging (Dual Induction, Gamma Ray/Caliper) as per Section 290030 GEOPHYSICAL LOGGING

5. Ream pilot hole using a nominal 22-inch diameter bit to approximately 75 feet BLS.

6. Prepare the hole for geophysical logging by circulation of the drilling fluid until it is uniform and free of drill cuttings. Perform geophysical logging (Caliper). Immediately set 16-inch SDR 17 PVC well casing with centralizers as per Section 290030 GEOPHYSICAL LOGGING.

7. Grout the annular space to land surface in stages, with the first stage being neat cement by the pressure grout method. The basal 50 feet of grout shall be neat. Subsequent cementing stages shall be by the tremie method and may contain up to 5% bentonite. The cement grout shall meet the specifications within Section 290025, Part 2.3 ANNULAR GROUT, and shall be installed per Section 290025, Part 3.3 CEMENTING PROCEDURES.

8. Well 426 Site: Plug and abandon 4-inch diameter PVC test well onsite. The 4-inch well is cased to 60 feet BLS and has a total depth of 95 feet BLS. Plugging and abandonment materials shall consist of cement containing up to 5% bentonite. Cement must be installed via the internal tremie method and shall fill the open hole and casing from the bottom of the open hole to the top of the well casing. The use of other fill materials other than bentonite and cement are not allowed. The well casing shall be cut off flush with land surface. Plugging and abandonment shall be conducted in accordance with Section 290025 Part 3.9 WELL PLUGGING AND ABANDONMENT.

9. Well 408 Site: Plug and abandon existing supply well 408 onsite. The 14-inch diameter well is steel cased to 42 feet BLS and has a total depth of 133 feet BLS. Plugging and abandonment materials shall consist of cement containing up to 5% bentonite. Cement must be installed via the internal tremie method and shall fill the open hole and casing from the bottom of the open hole to the top of the well casing. The use of other fill materials other than bentonite and cement is not allowed. The well casing shall be cut off flush with land surface. Plugging and abandonment shall be conducted in accordance with Section 290025 Part 3.9 WELL PLUGGING AND ABANDONMENT.

10. Drill a nominal 15-inch diameter hole by the direct-air method to approximately 95 feet BLS and conduct formation and water sampling as specified during open-hole drilling.

11. Collect water samples at 80 feet BLS, at 90 feet BLS, and at total depth for laboratory analysis final during open hole drilling Refer to Section 290035 WELL TESTING, D. WATER QUALITY TESTING for specific testing requirements.

12. Conduct HCl acidification treatment of the open borehole section of new well using 900 gallons of 32% hydrochloric acid. Prior to injection, the acid shall be diluted to a strength of approximately 4% by mixing with 6300 gallons of potable water. The acid shall be injected according to the procedures specified in SECTION 290025, PART 3.7 ACIDIFICATION TREATMENT.

13. Airlift develop the well for 8 hours. Airline is to be installed to a depth within 5 feet of the total depth of the well. The airlift discharge at the surface shall have restrictions of no less than 12-inches during airlift development. Water shall be clear and free of sediment after development as per SECTION 290025, PART 3.8 WELL DEVELOPMENT A. DEVELOPMENT WITH AIR.

14. Install a temporary submersible test pump with intake depth at 70 feet BLS capable of pumping up to 1000 gpm and conduct high rate pumping and surging for up to 8 hours. Discharge assembly will include throttling valve and totalizing flowmeter. Testing for sand content and turbidity will be conducted during pump development as per Section 290025, Part 3.8 WELL DEVELOPMENT B. DEVELOPMENT WITH PUMP and Section 290035 WELL TESTING D. WATER QUALITY TESTING.

15. Conduct a five-step specific capacity pumping test for one hour per each step pumping rate using a temporary submersible test pump with the intake at an approximate depth of 70 feet BLS,. Refer to Section 290035 WELL TESTING C STEP DRAWDOWN TESTING for specific testing requirements.

16. Collect water samples for primary and secondary drinking water standards plus additional listed parameters, deliver samples to a laboratory approved by the ENGINEER, and submit complete laboratory analysis results to the ENGINEER within 1 month of completion of the sampling. Sampling for required field parameters shall be conducted by a representative of the approved laboratory and shall be according to FDEP approved SOP *FS 2200 Groundwater Sampling.* Refer to Section 290035 WELL TESTING PART 3D. WATER QUALITY TESTING for specific testing requirements.

17. Conduct geophysical logging and video survey from total depth to land surface, to include Dual Induction, Gamma Ray/Caliper, Flowmeter (Static and Dynamic), Conductivity/Temperature (Static and Dynamic), Borehole Compensated Sonic and Video logs as per Section 290030 GEOPHYSICAL LOGGING.

18. Install a wellhead flange at an elevation to be provided by the ENGINEER. The flange shall be set at a minimum of 1.0 foot above the 100-year flood elevation.

19. Disinfect the well as per Section 290035, PART 3F - DISINFECTION.

20. Perform post-construction site video, demobilize equipment and restore site. Remove all drill cuttings and drilling fluids for disposal at a location approved by the ENGINEER. The wells shall be left clean, free of oils, grease, or other substances used during well construction and testing.

3.2 DRILLING METHODS

The conventional mud-rotary method shall be employed for all drilling through the final casing setting depth. During all reaming operations, the CONTRACTOR shall either incorporate the use of a lead bit or stinger and staged drilling assembly to facilitate the tracking of the holes or install a stabilizer assembly with the same nominal diameter as the bit. Portable mud systems shall be used by the CONTRACTOR during mud rotary drilling. No in-ground pits will be allowed.

The direct-air method shall be employed for all drilling below the final casing setting depth. Cleaning the borehole of cuttings is of upmost importance during this phase of drilling and the returns of cuttings shall be demonstrated by the CONTRACTOR before drilling is allowed to proceed below the casing. Drilling mud will not be permitted to be used in the open hole drilling. The CONTRACTOR shall provide adequate size and capacity of drill pipe, airline, and air compressor to insure complete cuttings removal during direct-air drilling. The CONTRACTOR will be required to make at least two wiper passes of the previously drilled section of borehole and demonstrate that cuttings are fully removed before proceeding with drilling.

It is essential that turbid water produced from any source during the drilling operations is prevented from entering surface water features unless a discharge permit is in place and the required best management practices for sedimentation and erosion control are utilized. Any water produced during drilling shall be confined in a closed-circulation system. Alternatively, the CONTRACTOR may route the produced water to a storm water discharge location if approved by the regulatory agencies and necessary permits are obtained.

3.3 CEMENTING PROCEDURES

Cementing shall be performed using a collarless tremie pipe. Prior to all stages of cementing, the CONTRACTOR shall circulate drilling fluid through the tremie pipe until at least one annular borehole volume of fluid has been circulated to insure that the annulus is free of sediment. During all stages of cementing, the CONTRACTOR shall pump a pre-flush or spacer. Cement shall be placed in such a manner that no voids shall exist between the outer well casing and the formation.

For the casing cementing operations, the first stage shall be pressure grouted in a manner consistent with the American Water Works Association (AWWA) Standard for Water Wells (AWWA A100-84), Section B.4 (or the most recent version) by the Interior Method – Without Plug. The CONTRACTOR shall wait for the cement to cure for a minimum of 12 hours after the completion of each cementing operation before conducting subsequent cementing stages of the same casing.

After the initial pressure-grout stage, the annular space outside of well casing shall be cemented in a manner consistent with the AWWA Standard for Water Wells (AWWA A100-84), Section B.3 (or the most recent version) by the Positive Placement - Exterior Method. After each stage of cementing (except when returns are observed at the land surface), and before the next stage, the CONTRACTOR shall tag the top of the cement with a collarless tremie pipe. This method of cementing applies to all cementing procedures on all casings.

Cementing procedures shall be continuous for each stage after cementing begins. If loss of circulation or no return of cement is encountered, the ENGINEER shall be notified immediately of what remedial measures are underway to re-establish the circulation and complete the cementing program according to the well design and specifications. The CONTRACTOR shall submit cement-mix designs to the ENGINEER for approval, including volumes for the pre-flush and the cementing procedures with calculations, prior to the commencement of cementing operations for each stage of cementing.

All cement blends shall be approved by the ENGINEER in advance of placement, and the CONTRACTOR shall, upon request by the ENGINEER, make provisions to pump more or less cement during specific stages as directed by the ENGINEER. The CONTRACTOR shall also submit to the ENGINEER cement plans for each stage of cement mixture to be emplaced; the cementing plan shall contain the cement slurry density, the proposed volume of cement to be emplaced, and the theoretical lift in linear feet of the cement stage based on the annular borehole volume measurements provided by the caliper logging of the reamed hole.

After cementing the final casing reaches land surface, a minimum of 24 hours shall elapse before drilling or any other work in the well resumes, to allow the cement to harden without disturbance. No standby time shall accumulate during this time period. When casing is being set and cemented in place, it is the CONTRACTOR's responsibility to ensure that these operations are conducted in such a manner that the collapse and burst strengths (with safety factor) are not exceeded and the casing is not caused to fail.

3.4 FORMATION AND WATER SAMPLES DURING DRILLING

The CONTRACTOR shall collect formation and water samples during open-hole drilling as follows; formation samples shall be collected continuously and bagged every 10 feet, water samples shall be collected every 10 feet during direct-air drilling from the discharge point and at the total depth of the borehole and shall be tested by a certified laboratory.

3.5 WELL PLUMBNESS AND ALIGNMENT

The completed well shall be sufficiently plumb and straight so that there will be no interference with installation, alignment, operation, or removal of the test pump. Plumbness and alignment testing shall be at the discretion of the ENGINEER. The testing, should it be required, will be according to AWWAA 100-06 Standards for Plumbness and Alignment.

Should the ENGINEER request, the alignment shall be tested by lowering into the well to a depth of at least 70 feet, a section of pipe 20 feet long or a dummy of the specified pump length. The outer diameter of the test pipe or dummy shall not be more than 1-inch smaller than the inside diameter of that part of the casing or hole being tested. The lowered unit shall pass freely through the entire tested depth.

3.6 WELL TOP TERMINATIONS

At all times during the progress of the work and at completion, the CONTRACTOR shall use reasonable precautions to prevent either tampering with any of the wells or the entrance of foreign material into

any of the wells. At the end of each work day, the well shall be sealed to prevent introduction of any foreign material. Refer to Figures 1 and 2 for well location and construction details. The final flange elevation shall be at a height of 1.0 foot above the hundred-year flood elevation, final elevation to be provided by the ENGINEER.

3.7 ACIDIFICATION TREATMENT

After completion of drilling the well to the specified total depth, the CONTRACTOR shall conduct acidification treatment of the open borehole section using 900 gallons of 32% hydrochloric acid. The acid is to be diluted prior to injection to a strength of 4% by mixing with approximately 6300 potable water or raw water from an approved source. The diluted acid shall be be injected into the open-hole section via perforated tremie at a rate not to exceed 60 gallons per minute. If the acid is mixed inline with the water, then the rate of acid injection will be 7 gpm and the rate of water injection well be 50 gpm. The duration of injection is expected to be approximately 2 hours. The acid solution is to remain in the well for no less than 12 hours and no longer than 24 hours after the injection is completed. The spent acid solution shall be neutralized (if necessary) prior to discharge. The discharge shall be maintained onsite if the pH is less than 6.5 pH units. The CONTRACTOR is required to follow all applicable health and safety regulations related to storage and handling of the acid. No acid containers shall be stored on the project site unattended overnight to minimize risk of tampering.

3.8 WELL DEVELOPMENT

A. DEVELOPMENT WITH AIR

The CONTRACTOR shall air develop each well, using straight air in the open hole, until, to the satisfaction of the ENGINEER, the discharge water is free of sediment. The CONTRACTOR shall utilize an air compressor with a minimum capacity of 375 cubic feet per minute at 125 pounds per square inch (psi). The CONTRACTOR shall place the drill stem in the open-hole section and vary this height from the bottom of the borehole to the base of the casing during direct air development to enhance development of the entire open-hole section. The CONTRACTOR shall frequently and regularly surge the well during airlift development.

B. DEVELOPMENT WITH PUMP

The CONTRACTOR shall install a test pump capable of 1000 gpm with the intake at a depth of 70 feet below top of casing at the direction of the ENGINEER and conduct high rate pump development for up to 8 hours. The contractor shall frequently and regularly surge the well using the test pump. The CONTRACTOR will supply, install, and operate all of the equipment required for sand content and turbidity testing during pump development. An acceptable criteria for a developed well includes a sand level of less than 5 milligrams/liter and a turbidity level of less than 5 NTU when pumped; however, the ENGINEER has the discretion to decide when the development should stop. Refer to Section 290035, WELL TESTING PART 3D WATER QUALITY TESTING for the testing requirements.

3.9 WELL PLUGGING AND ABANDONMENT

The specified wells shall be plugged and abandoned by a licensed water well contractor according to Florida Department of Environmental Protection (FDEP) regulations F.A.C. 40E-3.531. The CONTRACTOR shall install tremie tubing to the bottom of each well and shall fill the well with cement grout containing up to 5% bentonite as specified in Section 290025-1, PART 2 – PRODUCTS 2.3 CEMENT GROUT. Grout will be pumped via the tremie pipe and shall fill the well from the bottom to the top. The well casing shall be cut off flush with land surface.

END OF SECTION

SECTION 290030

GEOPHYSICAL LOGGING

PART 1 – GENERAL

1.1 REQUIREMENTS

The CONTRACTOR shall provide all work, materials, and equipment necessary to prepare the borehole/well for geophysical logging. If a geophysical logging company is utilized as a subcontractor, the CONTRACTOR may be required to provide documents to show that the geophysical logging specialist has adequate experience to perform the specified logging and shall be approved in advance by the ENGINEER. When the boreholes have been drilled to the specified logging depth, they shall be prepared for geophysical logging. Borehole preparation shall include, but not be limited to: 1) continuation of circulation until drill cuttings have been removed from the borehole; and 2) during mud drilling, circulation of the drilling mud in the borehole until it is uniform. The CONTRACTOR shall make all reasonable efforts to leave the borehole free from obstructions in preparation for geophysical logging. The log(s) field copies shall be printed immediately following the completion of logging unless otherwise stipulated by the ENGINEER.

The following sequence of logging shall be performed by the geophysical logging company:

1. Following the 12-inch diameter pilot hole drilling to 80 feet BLS, perform the following geophysical logs:

    - Dual Induction
    - Gamma Ray
    - Caliper

2. Following the 22-inch diameter borehole reaming to 75 feet BLS and immediately prior to the final casing installation, perform the following geophysical logs:

    - Caliper

3. Following the final casing installation and 15-inch diameter open hole drilling to 95 feet BLS, perform the following geophysical logs:

    - Dual Induction
    - Gamma Ray
    - Caliper
    - Flowmeter (Static and Dynamic)
    - Fluid Resistivity (Static and Dynamic)
    - Temperature (with differential plot)
    - Sonic (Borehole Compensated)

- Television Survey (Static and Dynamic)

The CONTRACTOR shall be responsible for the preparation of the borehole/well for geophysical logging. The CONTRACTOR shall assist the ENGINEER during geophysical logging and data collection as needed.

PART 2 – PRODUCTS

The CONTRACTOR shall provide the ENGINEER with four (4) original hard field copies and four (6) hard final copies of each geophysical log completed and electronic versions of the logs as required by the ENGINEER. Electronic copies of logs will be provided to the ENGINEER in both pdf and ASCII format. The pdf formatted logs shall be formatted to print on multiple 8.5 x 11" pages. Four (4) digital copies of each video survey will also be provided to the ENGINEER.

PART 3 – EXECUTION

3.1 LOGGING

Geophysical logging shall be done as soon as possible after the drilling and preparation of the pilot hole. The logging interval shall be the total depth of the pilot hole or as determined by the ENGINEER. All logging shall be done during daylight hours unless approved by the ENGINEER. The CONTRACTOR shall notify the ENGINEER 24 hours in advance of any logging event.

The CONTRACTOR shall remove all drill cuttings in the borehole and condition the hole to prevent the formation from collapsing. The CONTRACTOR shall be responsible for keeping the borehole open and free from obstruction during geophysical logging and shall remove any obstruction to the logging tools at his/her own expense. In the event that the logging tools do not reach to within five feet of the hole bottom, as measured by the length of the drill pipe, the CONTRACTOR shall then clean the hole to the original depth at his/her own expense. The logs shall then be re-run at the CONTRACTOR's expense. The CONTRACTOR shall provide access down the well for data collection and geophysical logging, if requested by the ENGINEER. The CONTRACTOR is required to install and run the specified temporary test pump and install a calibrated flowmeter to facilitate static and dynamic logging and video surveys.

All video surveys refer to radial surveys using a camera tool equipped with both down-hole and side-view rotating lenses. The means and methods of obtaining a clear television image is at the discretion of the CONTRACTOR, subject to good construction practices and existing regulations. The CONTRACTOR should anticipate and allocate a sufficient period of time to achieve the water clarity necessary to obtain an acceptably clear video survey.

END OF SECTION

SECTION 290035

WELL TESTING

PART 1 – GENERAL

1.1 TEST REQUIREMENTS

The CONTRACTOR shall furnish and install the necessary appurtenances and pumping equipment capable of pumping 1000 gpm with a throttling device so that the discharge may be reduced to 500 gpm. The CONTRACTOR shall furnish a gate valve and flowmeter (or orifice plate and manometer), to control and measure discharge. The CONTRACTOR shall provide access ports on the well for use of an electrical water level meter and install pressure transducers capable of collecting barometrically compensated data for step-drawdown testing. The discharge rate may be varied at the ENGINEER'S direction. Discharged water shall be conveyed from the pumped well to the nearest stormwater drainage or ditch, as approved by the ENGINEER and as permitted by an applicable NPDES permit. Storm drains shall be protected by sediment screens and hay bales.

PART 2 – PRODUCTS

2.1 EQUIPMENT REQUIRMENTS

A. ROSSUM SAND TESTER

The CONTRACTOR shall provide, install, and operate a Rossum Sand Tester at manufactured by the Roscoe Moss Company or equal during pump development and during step drawdown testing.

B. TURBIDITY METER

The CONTRACTOR shall provide and operate a turbidity meter during pump development and during step drawdown testing. The meter shall be capable of reading turbidity in nephelometric turbidity units (NTUs) in a range between 0 and 100 NTUs. The meter equipment shall include factory calibration standards including 0 and 100 NTU samples which shall be within the manufactures expiration dates.

C. ELECTRONIC WATER LEVEL MEASURING TAPE

The CONTRACTOR shall provide an electronic water level tape to manually measure the water level in the well from the top of the casing. The measuring tape shall have markings in increments

of 1 foot, 1/10th foot, 1/100th foot and shall have an audible signal and a light to indicate the probe is in contact with water.

D. DATA LOGGER

The CONTRACTOR shall provide an In-Situ Level Troll 700 data logger or equal to measure the barometrically compensated drawdown in the well. The data logger shall be capable of being programmed for data collection frequency in an incremental series and at differing collection intervals. The data logger shall be capable of providing the data in Excel format.

E. FLOW METER

The CONTRACTOR shall provide an inline flowmeter capable of measuring instantaneous flow and providing totalized readings on the discharge line. A flowmeter certificate of calibration performed within a 3 month period prior to the testing shall be submitted by the CONTRACTOR to the ENGINEER prior to use of the flow meter.

F. TEST PUMP

The CONTRACTOR shall use a submersible test pump capable of pumping 1000 gpm. The CONTRACTOR shall provide the necessary power for the test pump with an appropriate generator and all necessary electric controls for safe operation of the test pump. The CONTRACTOR shall submit the pump manufacturer specifications and pump curve to the ENGINEER for approval prior to installation of the test pump. The test pump shall be installed on minimum 6-inch diameter riser pipe to a depth of about 70 feet below land surface. The test pump shall be equipped with a minimum ¼ inch diameter stainless steel support safety cable connected to the wellhead at the surface and to the pump or motor body.

PART 3 – EXECUTION

A. SAND CONTENT TESTING

Prior to initiating pumping development, the CONTRACTOR shall install a Rossum Sand Tester on the pump discharge piping at an accessible location and according to manufacturer's guidelines. The sand tester shall be installed at a location of turbulent flow immediately (within 1 foot) downstream of a 90 degree elbow or other flow restriction. The mounting location and configuration of the sand tester shall be approved by the ENGINEER prior to installation. There shall be adequate backpressure on the sand content tester to achieve a minimum of ½ gallon per minute flow through the device and there shall be a control valve between the tester and the discharge piping. Sand content tests will be conducted on an hourly frequency during pumping

development. The CONTRACTOR shall be responsible for measuring and recording the sand content testing results and providing the results to the ENGINEER.

B. TURBIDITY TESTING

The CONTRACTOR shall provide a calibrated turbidity meter as specified and shall collect grab samples for turbidity at ½ hour intervals during the final 4 hours of pump development. The CONTRACTOR shall be responsible for measuring and recording the turbidity levels of each sample and providing the results to the ENGINEER.

C. STEP DRAWDOWN TESTING

The step-drawdown shall consist of 5 one-hour steps to be run at rates to be determined by the ENGINEER (range is expected to be between 500 gpm and 1000 gpm). The CONTRACTOR shall collect background water level data for a minimum of 2 hours prior to the test using the datalogger. The test will be conducted to incrementally increase the well discharge rate for the five steps. After a minimum 2 hour idle period, the step rate test will commence with the pump operated to maintain a constant pumping rate specified for each interval. Water levels in the pumping well shall be measured and recorded by the driller using an electric water level measuring tape and a data logger. Water levels measurements shall be made at a minimum of once every 5 minutes for the duration of the test. Upon completion of the test, recovery measurements shall be made for a period of 2 hours using the datalogger. The frequency of datalogger readings shall be determined by the ENGINEER.

D. WATER QUALITY TESTING

The CONTRACTOR shall contract with a laboratory approved by the Florida Department of Health to collect and analyze the required Primary and Secondary drinking water standard samples according to FDEP SOP *FS 2200 Groundwater Sampling*. The CONTRACTOR will ensure that the laboratory representative performs the required stabilization parameter measurements prior to sampling for Primary and Secondary Drinking Water Standards. The CONTRACTOR shall collect direct-air water samples and utilize a licensed laboratory for analysis of selected water quality parameters as follows.

1. During open hole drilling, a water sample shall be collected by the CONTRACTOR from the well every 10 feet for analysis of dissolved chlorides, color, and conductivity. The CONTRACTOR shall provide the results of laboratory analysis of these samples.

1. At the end of the step-drawdown test, the well shall be sampled and analyzed for Primary and Secondary drinking water standards listed in F.A.C 62-555.340 and 62.345, including

the Volatile Organic Contaminants (VOCs), Synthetic Organic Contaminants (SOCs, aka Pesticides and PCBs), Radionuclides (Gross Alpha, Radium-226, Radium-228, Uranium), Alkalinity, Dissolved Iron, Dissolved Oxygen, pH, Total Sulfide, Turbidity, Color, Calcium, Manganese, Potassium, Ammonium, Strontium, Carbonate, Bicarbonate, Hydrogen Sulfide, pH, Temperature (field), and total suspended solids (TSS). **Table 1** (below) includes a listing of the parameters required to be sampled and analyzed from the completed new supply wells:

2. Additional parameters may be required in the specific conditions of the FDEP permit for this new PWS.

Table 1. List of Water Quality Parameters Required for Sampling and Analysis

Primary and Secondary Drinking Water Standards		
Maximum Contaminant Levels for Inorganic Compounds		
Federal Contaminant ID	**Contaminant**	**MCL (mg/L)**
1074	Antimony	0.006
1005	Arsenic	0.010
1010	Barium	2
1075	Beryllium	0.004
1015	Cadmium	0.005
1020	Chromium	0.1
1024	Cyanide (as free Cyanide)	0.2
1025	Fluoride	4.0
1030	Lead	0.015
1035	Mercury	0.002
1036	Nickel	0.1
1040	Nitrate	10 (as N)
1041	Nitrite	1 (as N)
	Total Nitrate and Nitrite	10 (as N)

1045	Selenium	0.05
1052	Sodium	160
1085	Thallium	0.002
1094	Asbestos	7 MFL

Maximum Residual Disinfectant Levels

Federal Contaminant ID	Disinfectant Residual	MRDL (mg/L)
1012	Chlorine	4.0 (as Cl_2)
1006	Chloramines	4.0 (as Cl_2)
1008	Chlorine Dioxide	0.8 (as ClO_2)

Maximum Contaminant Levels for Volatile Organic Contaminants

Federal Contaminant ID	Contaminant (CAS NUMBER)	MCL (mg/L)
2977	1,1-Dichloroethylene (75-35-4)	0.007
2981	1,1,1-Trichloroethane (71-55-6)	0.2
2985	1,1,2-Tricholoroethane (79-00-5)	0.005
2980	1,2-Dichloroethane (107-06-2)	0.003
2983	1,2-Dichloropropane (78-87-5)	0.005
2378	1,2,4-Tricholorobenzene (120-82-1)	0.07
2990	Benzene (71-43-2)	0.001
2982	Carbon tetrachloride (56-23-5)	0.003
2380	cis-1,2-Dichloroethylene (156-59-2)	0.07
2964	Dichloromethane (75-09-2)	0.005
2992	Ethylbenzene (100-41-4)	0.7
2989	Monochlorobenzene (108-90-7)	0.1
2968	o-Dichlorobenzene (95-50-1)	0.6
2969	para-Dichlorobenzene (106-46-7)	0.075
2996	Styrene (100-42-5)	0.1

2987	Tetrachloroethylene (127-18-4)	0.003
2991	Toluene (108-88-3)	1
2979	trans-1,2-Dichloroethylene (156-60-5)	0.1
2984	Trichloroethylene (79-01-6)	0.003
2976	Vinyl chloride (75-01-4)	0.001
2955	Xylenes (total) (1330-20-7)	10
Maximum Contaminant Levels for Synthetic Organic Contaminants		
Federal Contaminant ID	**Contaminant (CAS NUMBER)**	**MCL (mg/L)**
2063	2,3,7,8-TCDD (Dioxin) (1746-01-6)	3×10^{-8}
2105	2,4-D (94-75-7)	0.07
2110	2,4,5-TP (Silvex) (93-72-1)	0.05
2051	Alachlor (15972-60-8)	0.002
2050	Atrazine (1912-24-9)	0.003
2306	Benzo(a)pyrene (50-32-8)	0.0002
2046	Carbofuran (1563-66-2)	0.04
2959	Chlordane (57-74-9)	0.002
2031	Dalapon (75-99-0)	0.2
2035	Di(2-ethylhexyl)adipate (103-23-1)	0.4
2039	Di(2-ethylhexyl)phthalate (117-81-7)	0.006
2931	Dibromochloropropane (DBCP) (96-12-8)	0.0002
2041	Dinoseb (88-85-7)	0.007
2032	Diquat (85-00-7)	0.02
2033	Endothall (145-73-3)	0.1
2005	Endrin (72-20-8)	0.002
2946	Ethylene dibromide (EDB) (106-93-4)	0.00002
2034	Glyphosate (1071-83-6)	0.7

2065	Heptachlor (76-44-8)	0.0004
2067	Heptachlor epoxide (1024-57-3)	0.0002
2274	Hexachlorobenzene (118-74-1)	0.001
2042	Hexachlorocyclopentadiene (77-47-4)	0.05
2010	Lindane (58-89-9)	0.0002
2015	Methoxychlor (72-43-5)	0.04
2036	Oxamyl (vydate) (23135-22-0)	0.2
2326	Pentachlorophenol (87-86-5)	0.001
2040	Picloram (1918-02-1)	0.5
2383	Polychlorinated biphenyls (PCBs)	0.0005
2037	Simazine (122-34-9)	0.004
2020	Toxaphene (8001-35-2)	0.003

Secondary Drinking Water Standards

Federal Contaminant ID	Contaminant	MCL (mg/L)
1002	Aluminum	0.2
1017	Chloride	250
1022	Copper	1
1025	Fluoride	2.0
1028	Iron	0.3
1032	Manganese	0.05
1050	Silver	0.1
1055	Sulfate	250
1095	Zinc	5
1905	Color	15 color units
1920	Odor	3 (threshold odor number)

1925	pH	6.5 - 8.5
1930	Total Dissolved Solids	500
2905	Foaming Agents	0.5
Disinfection Byproducts		
Federal Contaminant ID	**Contaminant**	**MCL (µg/L)**
1009	Chlorite	1000
1011	Bromate	10
2450	Monochloroacetic Acid	NA
2451	Dichloroacetic Acid	NA
2452	Trichloroacetic Acid	NA
2453	Monobromoacetic Acid	NA
2454	Dibromoacetic Acid	NA
2456	Total Haloacetic Acids (HAA5)	60
2941	Chloroform	NA
2942	Bromoform	NA
2943	Bromodichloromethane	NA
2944	Dibromochloromethane	NA
2950	Total Trihalomethanes (TTHM)	80
Radionuclides		
Federal Contaminant ID	**Contaminant**	**MCL (units)**
4000	Gross Alpha (Excl Uranium)	15 pCi/L
4002	Gross Alpha (Incl Uranium)	NA
4006	Combined Uranium (U-234, U-235, & U-238)	See FDEP Rule 62-550.310 (6)
4020	Radium-226	5 pCi/L
4030	Radium-228	5 pCi/L

Additional Parameters	
Contaminant	**Units**
Alkalinity	mg/L
Dissolved Iron	mg/L
Dissolved Oxygen	mg/L
Total Sulfide	mg/L
Temperature (Field)	Degrees C
Turbidity (Field)	NTU
Calcium	mg/L
Potassium	mg/L
Ammonium	mg/L
Strontium	mg/L
Carbonate	mg/L
Bicarbonate	mg/L
Hydrogen Sulfide	mg/L
Total Suspended Solids	mg/L

Abbreviations Used: MCL = maximum contaminant level
mg/L = milligrams per liter. pCi/L = picoCuries per liter
MRDL = maximum residual disinfectant level
CAS Number = Chemical Abstract System Number

E. DISINFECTION

The CONTRACTOR shall thoroughly disinfect the well to inactivate any microbiological contaminant that may have been introduced into the well during construction and testing. The well shall be disinfected to remove contamination that may cause well water supply to be unsafe for human consumption, in accordance with Sections 1. through 4. and Section 5.2 of American Water Works Association (AWWA) Standard C654 as incorporated into Rule 62-555.330, FAC. The water in the well casing shall be treated with chlorine approved by the state and local regulatory agencies. The quantity of chlorine used for disinfection shall be sufficient to produce a minimum of 100 ppm and not more than 200 ppm residual chlorine in the solution when mixed with the total volume of water in the well. This may be done by using sodium hypochlorite solution in the amounts shown in Table A.1, AWWA C654. The disinfectant shall be delivered to the site of the work in original closed containers bearing the original label indicating the percentage of available chlorine. The disinfectant shall be furnished or prepared in liquid form and pumped into the well in sufficient volume to assure that the entire cased and open-hole portions of the well come into contact with the disinfection solution. A minimum of two well volumes of chlorine solution should be pumped into the well. An alternative disinfection method may be used with ENGINEER's written approval; however, it is the CONTRACTOR responsibility to ensure that a uniform concentration of chlorine solution comes in contact with the well casing and open-hole portions of the well and that the well is adequately disinfected to regulatory standards. The chlorine solution should stay in the well for a period of 24 hours after which the well shall be pumped free of chlorine as indicated by a negligible chlorine residual, and in preparation for water quality sampling if requested by the OWNER. All equipment and material to be installed in the well shall be chlorinated/disinfected prior to its installation. The CONTRACTOR shall take adequate measures to collect the chlorinated water and dispose in a proper manner as per regulatory guidelines without impacts to natural systems. Measures shall include, but not limited to, impoundment of the highly chlorinated water or dechlorination before disposal. If bacteriological evaluation shows the presence of coliform after disinfection, then the CONTRACTOR shall perform corrective actions as determined by the ENGINEER.

END OF SECTION

FIGURES

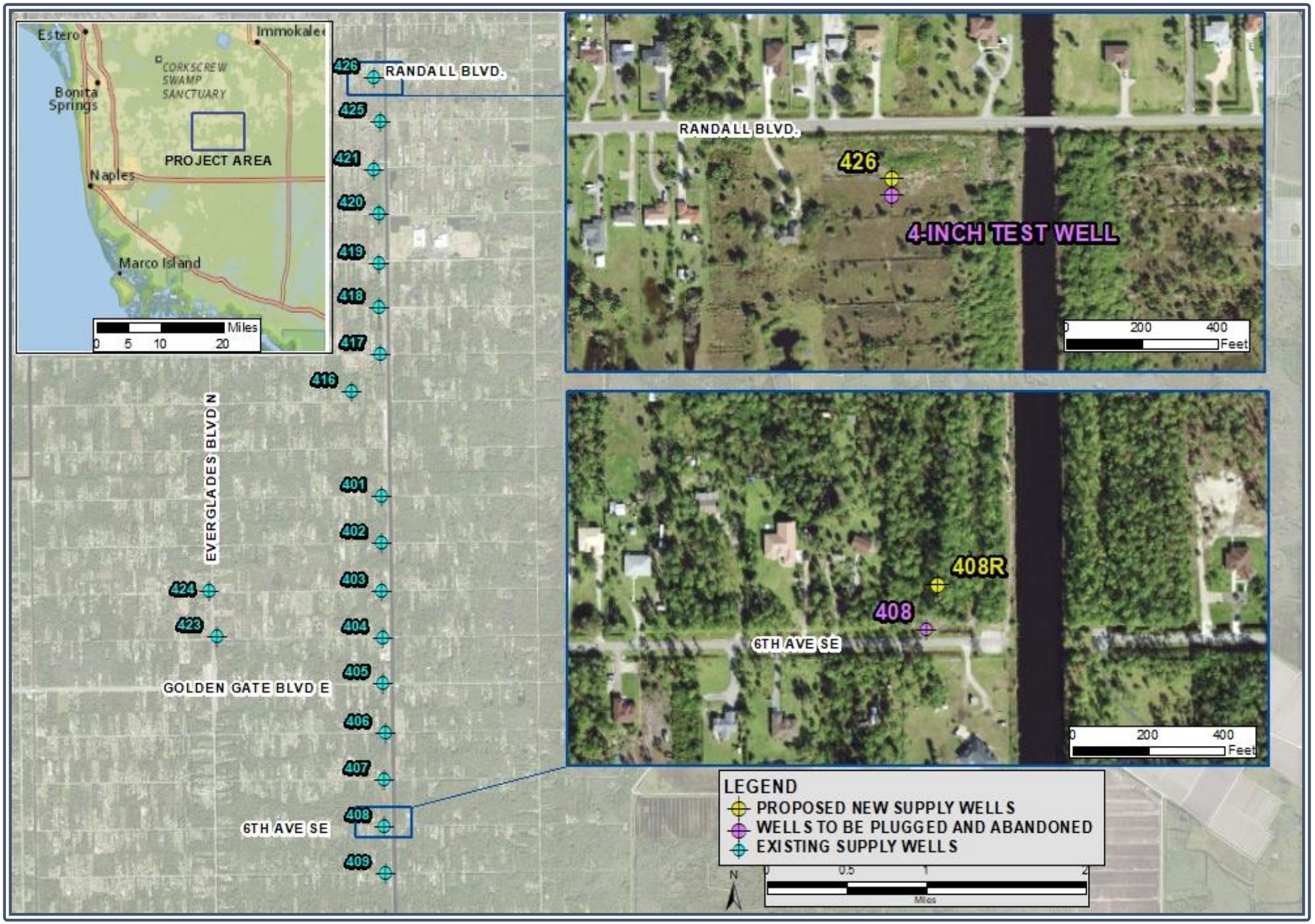

Figure 1. Map Showing Project Sites and Well Locations

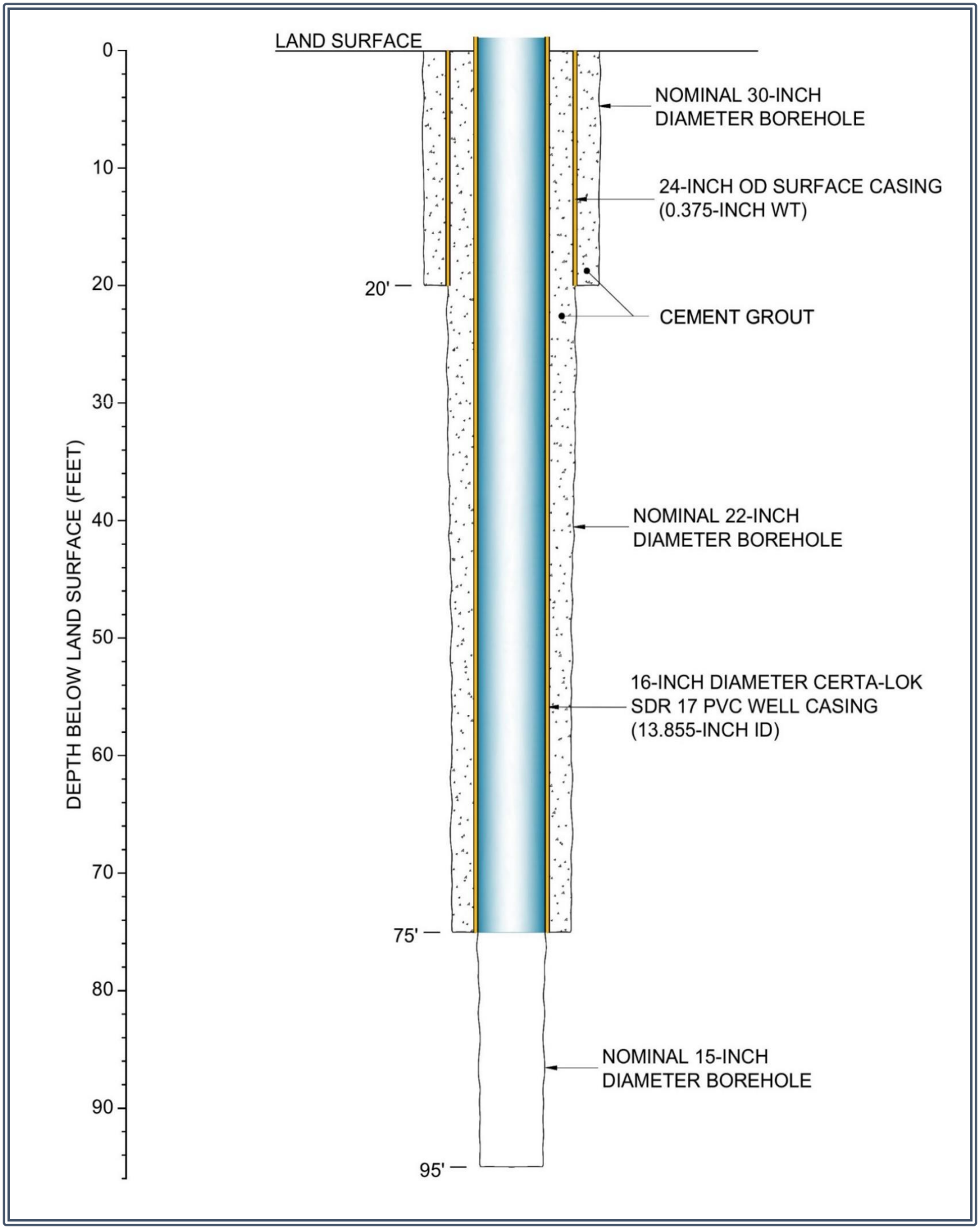

Figure 2. Construction Details of New Supply Wells 426 and 408R

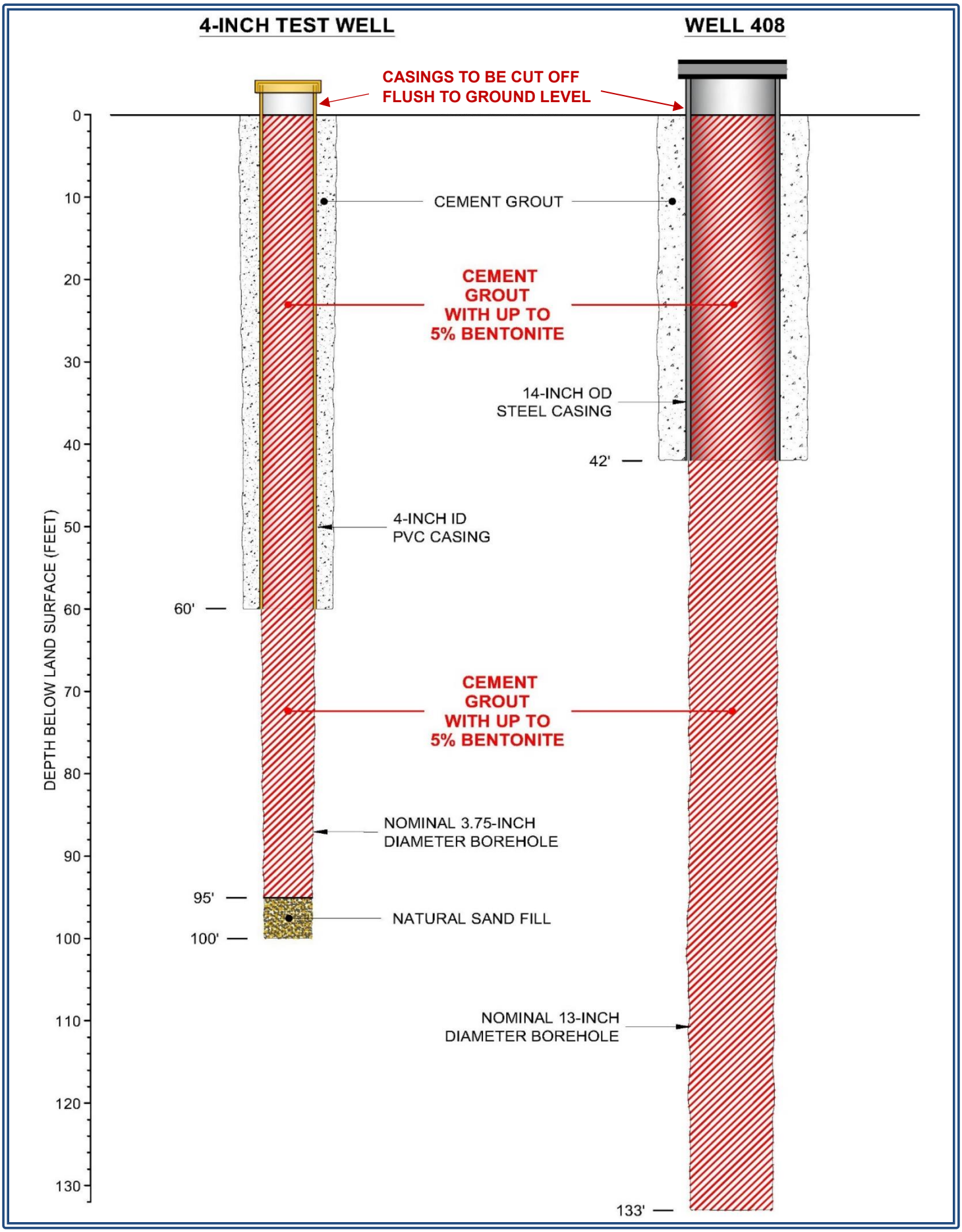

Figure 3. Plugging and Abandonment Details of 4-Inch Test Well and Well 408