I-5877 Utility Construction Criteria -

Sanitary Sewer Pump Station

A Design Build Project

I-95 widening from south of SR 1811 (Bud Hawkins Road - Exit 70) to north of SR 1002 (Long Branch Road – Exit 71)

Harnett County

July11, 2019

PROJECT SPECIAL PROVISIONS
Utility Construction

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100% UC Plans Special Provisions Last Updated 6/29/2019

Revise the 2018 Standard Specifications as follows:

Page 10-62, Sub-article 1036-1 General, paragraph 1:
replace sentence 1 with the following:

All materials when used to convey potable drinking water shall meet National Sanitation Foundation (NSF)/ANSI 61 and NSF/ANSI 372.

Page 10-62, Sub-article 1036-3 Plastic Pipe:
add the following sentence:

All plastic pipe system components and related materials shall be in conformance with NSF/ANSI 14.

Page 15-1, Sub-article 1500-2 Cooperation with the Utility Owner, paragraph 2:
add the following sentences:

The utility owners are the City of Dunn (Dunn) and Harnett Regional Water (HRW). For work involving Dunn's facilities, the Design-Build Team shall contact Heather Adams, Utilities Director at (910) 892-2948. For work involving HRW facilities, the Design-Build Team shall contact Shane Cummings, Senior Utility Engineer at (910) 893-7575, ext 3275 or (910) 984-4059(C).

Representatives from Dunn and HRW shall be given the opportunity to witness all tests performed on their water and sewer facilities. Test results shall be provided to each Utility Owner for any tests involving their facilities.

The Design-Build Team shall notify Dunn and HRW in writing, at least two weeks prior to beginning any work. If the work does not commence on the date specified in the written notice, then a new notice will be required with sufficient lead time to allow the rescheduling of inspection forces.

The Design-Build Team must schedule a pre-construction conference with Mr. Alan Moss, HRW Utility Construction Inspector, and Dunn staff at least two weeks before construction begins and

the Design-Build Team must coordinate with HRW and Dunn for regular inspection visitations and acceptance of the water system. Construction work shall be performed during the normal working hours of HRW from 8:00 am to 6:00 pm Monday through Friday. Holiday, nights and weekend work shall only be done with prior approval. There are several areas where the roadway fill must be placed before proposed water mains can be installed, in order to maintain approximately 3' of cover from proposed finished grade.

Page 15-1, Sub-article 1500-3 Utility Locations and Design-Build Team's Responsibility:
add the following paragraph:

The Design-Build Team will be responsible for any and all repairs due to leakage damage from poor workmanship during the one (1) year warranty period once the water system improvements have been accepted by HRW. HRW will provide maintenance and repairs when requested and bill the Design-Build Team if necessary due to lack of response within 48 hours of notification of warranty work. The Contractor will be responsible for any and all repairs due to damages resulting from failure to locate the new water lines and associated appurtenances for other utilities and their Design-Build Team until the water lines have been approved by NCDEQ and accepted by HRW. The final inspection of water system improvements cannot be scheduled with HRW until the roads have been paved; the rights of way and utility easements have been seeded and stabilized with an adequate stand of grass in place to prevent erosion issues on site.

Page 15-2, Sub-article 1500-7 Submittals and Records, paragraph 3:
replace sentence 3 with the following:

Provide HRW with four copies of as-builts, Dunn with two copies, and Dunn's Engineer, Davis Martin Powell with two copies. These drawings shall be sealed by the Registered Professional Engineer and marked "Record Drawings". Any and all field changes made during construction shall be properly documented in the "As-Built Record" Drawings. The "Record Drawings" shall also include lot numbers. "As-Built Record" Drawings shall also be submitted to HRW and Dunn electronically in Autocad format.

Page 15-2, Sub-article 1500-9 Placing Pipelines into Service, paragraph 2:
replace sentence 4 with the following:

Please note that in accordance with 15A NCAC 18C .0309(a), no construction, alteration, or expansion of a water system shall be placed into service or made available for human consumption until the Public Water Supply Section has issued Final Approval. Final Approval will be issued and mailed to the applicant upon receipt of both an Engineer's Certification and an Applicant's Certification submitted in accordance with 15A NCAC 18C .0303(a) and (c). A copy of the Final Approval shall also be forwarded to Mr. Alan Moss of HRW and Dunn staff for a final inspection. Prior to acceptance, all HRW and Dunn services will be inspected to ensure that they are installed at the proper depth. All meter boxes must be flush with proposed final grade and the meters are to be a minimum of 8" below the box lid.

Page 15-3, Sub-article 1505-2 Materials:
Add the following paragraphs for pipe protection in contaminated conditions:

In the event that contaminated areas are discovered in the field, notify the Engineer and HRW of the contaminants encountered so that corrective measures and removal/remediation can be provided prior to installation of the water mains.

Where shown on the Drawings or where contaminant petroleum (Diesel,Gasoline) is encountered, use contaminant gasket material. Contaminant gasket material shall be nitrile rubber in accordance with ASTM 1418. Gaskets shall be consistent with pipe manufacturer and Engineer's recommendation for any other contaminants encountered.

Page 15-3, Sub-article 1505-2 Materials:
Add the following paragraphs for pipe protection in contaminated and corrosive conditions:

Where shown on the Drawings or where contaminant petroleum (Diesel,Gasoline) and or corrosive and highly organic soils are encountered, provide polyethylene encasement in underground installations of ductile iron piping for water and sewer. Polyethylene wrap in tube or sheet form for piping encasement shall be manufactured of virgin polyethylene material conforming to the requirements of ANSI/ASTM Standard Specification D1248. The specified nominal thickness for low-density polyethylene film is 0.008 in. (8 mils). The specified nominal thickness for high-density cross-laminated polyethylene film is 0.004 in. (4 mils). The minus thickness tolerance shall not exceed 10 percent of the nominal thickness on both material types.

Page 15-4, Sub-article 1505-3(E) Thrust Restraint, second paragraph:
add the following sentences:

HRW requires pressurized pipelines and appurtenances to be restrained by concrete thrust restraint and restrained retainer glands or restrained joint DI pipe along the pipelines as shown on the plans and in the concrete thrust blocking details.

Page 15-4, Sub-article 1505-3, Add Polyethylene Encasement:
Add requirements for Installation of Polyethylene Encasement:

The polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material but is not intended to be a completely air and watertight enclosure. Overlaps shall be secured by the use of polyethylene adhesive tape, plastic string or other nondegradable material approved by the Engineer and capable of holding the encasement in place until backfilling operations are completed. Pipe and fittings shall be wrapped with polyethylene prior to pouring concrete thrust blocks.

<u>Method A - For use with Polyethylene Tubes:</u>
1. Cut polyethylene tube to a length approximately two feet (2') longer than the pipe section.
2. Slip the tube around the pipe, centering it to provide a one foot (1') overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears the pipe ends.
3. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.
4. After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched

polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width at the top of the pipe to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.
5. Any cuts, tears, punctures, or other damage to the polyethylene shall be repaired in accordance with Repairs.

Method B - For use with Polyethylene Tubes:
1. Cut polyethylene tube to a length approximately one foot (1') shorter than that of the pipe section. Slip the tube around the pipe, centering it to provide six inches (6") of bare pipe at each end. Take up the slack at the top of the pipe to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points; secure the ends as described herein under Method A.
2. Before making a joint, slip a three-foot (3') length of polyethylene tube over the end of the preceding pipe section, bunching it accordion-fashion lengthwise. After completing the joint, pull the three-foot length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least one foot (1').
3. Any cuts, tears, punctures, or other damage to the polyethylene shall be repaired in accordance with Repairs.

Method C - For use with Polyethylene Sheets:
1. Cut polyethylene sheet to a length approximately two feet (2') longer than that of the pipe section. Center the cut length to provide a one foot (1') overlap on each adjacent pipe section, bunching it until it clears the pipe ends. Wrap the polyethylene around the pipe so that it circumferentially overlaps the top quadrant of the pipe. Secure the cut edge of polyethylene sheet at intervals of approximately three feet (3').
2. Lower the wrapped pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene. After completing the joint, make the overlap and secure the ends as described herein under Method A.
3. Any cuts, tears, punctures, or other damage to the polyethylene shall be repaired in accordance with Repairs.

Appurtenances:
Pipe-Shaped Appurtenances:
1. Cover bends, reducers, offsets, and other pipe-shaped appurtenances with polyethylene in the same manner as the pipe.
Odd-Shaped Appurtenances:
1. When it is not practical to wrap valves, tees, crosses and other odd-shaped pieces in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edges together, folding over twice, and taping down.
2. Tape polyethylene securely in place at valve stem and other penetrations.

Repairs:
Repair any cuts, tears, punctures, or damage to polyethylene with polyethylene adhesive tape or

with a short length of polyethylene sheet or a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

Openings:
Openings in the encasement shall provide for branches, blowoffs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut with tape. Service taps and other taps without tapping sleeves should be made directly through the polyethylene after wrapping the pipe with 2-3 layers of polyethylene tape, with any resulting damaged areas being repaired as described herein.

Terminations:
Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least three feet (3'). Secure the end with circumferential turns of tape. Service lines and other attached lines of dissimilar metals shall be wrapped with polyethylene or a suitable dielectric tape for a minimum clear distance of three feet (3') away from the ductile-iron pipe.

Backfilling for Polyethylene-Wrapped Pipe:
1. Use the same backfill material as specified for pipe without polyethylene wrap, exercising care to prevent damage to the polyethylene wrapping when placing backfill material.
2. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage the polyethylene. Backfill shall be as specified for the pipe without polyethylene encasement.

Page 15-5, Sub-article 1510-2 Materials, last paragraph:
add the following sentences:

Utility locator wires shall be terminated at the top of valve boxes on HRW water mains and Dunn water mains and force mains. No spliced wire connections shall be made underground on locator wires. Locator wires may be secured with duct tape to top of pipe before backfilling.

Page 15-6, Sub-article 1510-3(A) General, fifth paragraph:
add the following sentence to the beginning of the paragraph:

Protect all pipes during loading, transport, unloading, staging, and installation.

Page 15-6, Sub-article 1510-3(B) Testing and Sterilization, first paragraph:
add the following sentences:

The hydrostatic pressure tests on HRW mains must be witnessed by Mr. Alan Moss. The Design-Build Team must notify HRW when they are ready to begin filling in lines and coordinate with HRW to witness all pressure testing.

Page 15-7, Sub-article 1510-3(B) Testing and Sterilization, ninth paragraph:
add the following sentence to the beginning of the paragraph:

All water samples for bacteria testing on HRW's or Dunn's mains will be collected by the Design-Build Team and witnessed by a representative of HRW and or Dunn.

Page 15-8, Sub-article 1515-3(A) Valves, first paragraph:
add the following sentences:

Install a 4"x4" concrete valve marker at the edge of the right of way to identify the location of each gate valve installed in the relocated HRW water system with the exception of the fire hydrant isolation valves. Measure the distance from the center of the concrete marker to the center of the valve box. This distance (in linear feet) shall be stamped on the brass plate located on the top of the concrete valve marker.

Page 15-8, Sub-article 1515-3(A) Valves, second paragraph:
add the following to the beginning of the paragraph:

Conduct a pneumatic pressure test using compressed air or other inert gas on the stainless steel tapping sleeves prior to making the tap on the existing HRW or Dunn water mains. This pneumatic pressure test must be witnessed by Mr. Alan Moss of HRW or Dunn staff. Use Romac brand stainless steel tapping sleeves or approved equal for HRW.

Page 15-8, Sub-article 1515-3(B) Meters:
add the following paragraphs:

Install new or relocated water service lines crossing state maintained roads inside a Schedule 40 PVC encasement per detail W-12 on sheet UC-3B.

New water meters shall be all brass. Use ABB, Kent, Dewey Brothers (C3000) or approved equal for ¾" or 1" services.

Page 15-8, Sub-article 1515-3(C) Backflow Prevention Assembly, second paragraph:
replace sentence 1 with the following:

Licensed installers shall test in accordance with the HRW Water and Sewer Use Ordinance and certify RPZDA backflow prevention installations.

Page 15-9, Sub-article 1515-3(D) Fire Hydrants:
add the following paragraph:

All fire hydrant installations for HRW must meet all requirements established by the Harnett County Fire Marshall's office. All fire hydrant installations must be inspected by the Harnett County Deputy Fire Marshall. The Design-Build Team shall notify the Fire Marshall at (910) 893-7580 once the construction is complete to request a site inspection of all fire hydrant installations.

Page 15-9, Section 1515-3(F) Air Release Valves:
add the following paragraph:

See Plan Sheets UC-9B and 9D for plan locations, UC-30 for profile locations, and UC-3F for details of sewer Combination Air Release Valves**.** The Design-Build Team's attention is directed to the details on the plans related to the proposed sewer Combination Air Release Valves. Combination air release valves for Dunn's system shall be manufactured by A.R.I.

Page 15-17, Sub-article 1530-3(C) Remove Water Meter:
add the following sentence to the end of the paragraph:

Provide a list of abandoned services to HRW Customer Service.

Plan Sheet UC-9D; Remove Existing Sewer Pump Station. The Design-Build Team's attention is directed to the plans and information below related to removal of an existing sewer pump station. The existing duplex submersible sewer pump station to be removed shall have all equipment and interior piping, and the entire concrete structure removed and properly disposed of, and connecting gravity sewer service pipe and connecting sewer force main plugged. The excavated area for removal of the pump station structure shall be backfilled with properly compacted select backfill material.

The existing pump station and its force main shall not be demolished until after the new pump station is placed in operation and runs properly for approximately 30 days.

The quantity of remove existing sewer pump station, equipment, piping, plugging gravity sewer service pipe, plugging sewer force main pipe, removing entire concrete structure, and backfilling the excavated area with properly compacted select backfill material is part of the "Remove Existing Sewer Pump Station" work.

Plan Sheets UC-9D, and UC-32 through UC-36; Sanitary Sewer Pump Station. The Design-Build Team's attention is directed to the details on the plans related to the proposed Sanitary Sewer Pump Station. Detailed specifications for the sanitary sewer pump station are outlined on the following pages entitled "Factory Built 8'x12' Above Ground Pump Station with Duplex Self-Priming Pumps", "Electrical", "Engine-Generator Systems", and "SCADA System Requirements".

Sanitary Sewer Pump Station, installed in accordance with the plans and provisions herein and accepted, shall include all labor, materials, excavation, backfilling, equipment, 8" piping, manhole, valves, concrete structures, pumps, generator, controls, mechanical work, electrical work, fencing, gravel access drive to Long Branch Road, and incidentals necessary to complete the work as required, and to provide a complete operational sewer pump system.

FACTORY-BUILT 8'X12' ABOVE GROUND PUMP STATION WITH DUPLEX SELF-PRIMING PUMPS

PART 1 – GENERAL

1.01 Section Includes

A. Work under this section includes, but is not limited to, furnishing and installing a factory built duplex pump station as indicated on the project plans, herein specified, as necessary for proper and complete performance. The pumping system pumps, enclosure, and controls shall be manufactured by Gorman Rupp. No other manufacturer's will be considered,

1.02 References

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
   a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
   b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
   c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
   d. ANSI B40.1 Gages, Pressure and Vacuum.
   e. AWWA C508 Single Swing Check Valves.

2. American Society for Testing and Materials (ASTM)
   a. ASTM A48 Gray Iron Castings.
   b. ASTM A126 Valves, Flanges, and Pipe Fittings.
   c. ASTM A307 Carbon Steel Bolts and Studs.
   d. ASTM A36 Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)
   a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
   b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction
   c. IEEE Std 242 Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
   a. NEC National Electric Code.
   b. NEC 701 National Electric Code article 701.
   c. NEMA Std MG1 Motors and Generators.

5. Miscellaneous References
   a. Ten-State Standards Recommended Standards for Sewage Works.
   b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
   c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards

d. ISO 9001 International Organization for Standardization.

1.03 System Description

A. Design-Build Team shall furnish and install one factory built above ground, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled in an 8'X12' fiberglass reinforced polyester resin enclosure.

B. In addition to the station enclosure, principle items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, internal piping, valves, motor control panel, automatic liquid level control system, and internal wiring.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.

1.04 Performance Criteria

A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 4" suction connection, and 4" discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Capacity (GPM)	180 GPM
2. Total Dynamic Head (FT)	40' (see paragraph below)
3. Total Dynamic Suction Lift(FT)	18

The high point in the force main is in the pump station enclosure, and if force main is completely filled during a running cycle the system can experience some siphon effects and TDH can drop to 20' to 25' so **pump motor must be sized to not overload at any conditions from 40' to 20' TDH.**

B. Site power furnished to pump station shall be 3 phase, 60 hertz, 460 volts, 3 wire, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 Submittals

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit eight (8) copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of

equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

B. Operations And Maintenance Manuals

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

   a. Functional description of each major component, complete with operating instructions.

   b. Instructions for operating pumps and pump controls in all modes of operation.

   c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

   d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

   e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system

schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.06 Quality Assurance

A. The pumps and pump station manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. The pumps and pump station manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long-term customer service and product support.

D. In order to unify responsibility for proper operation, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source) and that source shall be the pump manufacturer. The pumps must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer’s representative or distributor be accepted.

E. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. “Reverse-engineered” products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

F. The term “pump manufacturer” or “pump station manufacturer” shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a “pump

manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

G. Pump Performance Certifications

1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

2. Reprime Performance

   a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

   b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

   c. Pump must be capable of repriming 16 vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

      1) A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

      2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

      3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal

run, a 90^{o} elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

4) Impeller clearances shall be set as recommended in the pump service manual.

5) Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

6) Liquid to be used for reprime test shall be water.

3. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

H. Certified Pump Performance Test

1. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.

2. For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed and horsepower. 10 HP minimum drive motors shall be included for this pumping system

I. Factory System Test

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.

J. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.07 Manufacturer's Warranty

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer’s representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCT

2.01 In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting

of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.02 Manufacturer

A. The pump station system integrator must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company. The pumping system pumps, enclosure, and controls shall be manufactured by Gorman Rupp. No other manufacturer's will be considered.

B. The Design-Build Team shall prepare his bid based on the specified equipment. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

2.03 Station Enclosure

A. The station enclosure shall provide sufficient inside area for maintenance personnel to perform normal operation and maintenance inside, sheltered, and free from foul weather. The enclosure shall consist of a base to support the pumps and a cover. Minimum dimensions of the enclosure shall be eight feet by twelve feet and nine feet in height.

B. The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Glass fibers shall have a minimum average length of 1¼ inches. Resin fillers or extenders shall not be used. Major design considerations shall be given to structural stability, corrosion resistance, and water-tight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long maintenance free life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well. Wood core type enclosures shall not be considered acceptable and shall be basis for equipment rejection. See manufacturer's requirements for enclosure warranty in these specifications.

C. All interior surfaces of the housing shall be gel coated with a polyester resin. It shall be of suitable thickness and formulated to provide:

1. Maintenance-free service
2. Abrasion resistance
3. Protection from sewage, greases, oils, gasoline, and other common chemicals.
4. Color fastness
5. Gloss retention

D. Interior surfaces of the enclosure cover shall be white for maximum light reflectivity. The base shall be of a darker color to de-emphasize the presence of dirt, grease, etc. Colors used for both portions shall result in a pleasing looking structure.

E. The pump station shall be furnished with 1" thick foam insulation which shall be applied to the walls, door, and roof to achieve an R-6 insulation factor. A gasketed seal around the door shall also be included.

F. The outside of the enclosure shall be coated with a suitable pigmented resin compound to insure long, maintenance-free life. The fiberglass enclosure shall be a regular product of the pump station manufacturer.

G. Station base shall be constructed of pre-cast, reinforced concrete encapsulated in a fiberglass mold. The design shall resist deformation of the structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and an opening sized to permit installation of piping and service connections to the wet well. After installation, the opening shall serve as a grout dam to be utilized by the Design-Build Team. The base shall incorporate anchor bolt recesses for securing the complete station to a concrete pad (supplied by the Design-Build Team) in accordance with the project plans.

H. Holes through the base shall be provided for suction and discharge lines, air release lines, and level control line. Holes for the suction and discharge lines shall be provided with a grout dam incorporated in a grout retention cavity which the Design-Build Team shall fill at installation with suitable grout to seal each pipe-to-base joint against the entrance of hazardous gases from the wet well.

I. Station base shall incorporate a suitable flange designed for securing the pump station to the concrete pad in accordance with the station plans.

J. The enclosure cover shall be provided with a hinged fiberglass reinforced access door. Minimum dimensions of the door shall be 36 inches wide by 78 inches high for access by maintenance personnel to station interior. Door shall be a minimum 1 7/8 inch thick and shall be hinged with a minimum of two heavy-duty stainless steel hinges to the enclosure cover. Door shall be furnished with a padlockable handle connected to a latching mechanism. Latch shall engage door casing or maximum security against vandalism. All mounting hardware for door casing and door must be concealed or of such type as to prevent vandalism with ordinary tools.

K. Removable panels shall be supplied on two sides of the enclosure for additional access to equipment. Location and size shall permit access for routine maintenance functions such as pump and motor inspection, drive belt adjustment, and pump clean-out. Non-hinged panels shall be secured with stainless steel tamper-proof hardware

L. A duplex ground fault indicating utility receptacle providing 115 volts, single phase, 60 hertz shall be mounted inside the pump station. Receptacle shall be NEMA 5-15r

configuration, heavy duty, specification grade and fitted with a weatherproof cover. The receptacle shall be protected by normal duty circuit breaker.

M. A shuttered exhaust fan with a minimum capacity of 500 CFM to change the air in the enclosure once every minute, shall be mounted in the end wall approximately opposite the hinged door opening. An air intake vent shall be mounted in the hinged door assembly. Both intake and exhaust opening shall be equipped with a screen and cowl suitably designed to prevent the entrance of rain, snow, rocks, and other foreign material. The thermostatically controlled exhaust fan shall energize automatically at approximately 70 degrees F, and turned off at 55 degrees F. Fan circuit shall be protected by a normal duty circuit breaker.

N. Two enclosed and gasketed 80 watt fluorescent light fixtures shall be provided. The fixtures shall be NEMA 4, suitable for wet location. The fixtures shall be located to provide adequate light to all parts of the station and shall not constitute a physical hazard to inspection or service personnel. Light circuit shall be protected by a normal duty circuit breaker and shall be provided with a disconnect switch.

O. Station Heater:

1. A 4 KW three-phase wall mounted forced air heater shall be provided for protection of the pump station equipment. The heater shall maintain an inside/outside temperature differential of 60 degrees F while operating on the primary electrical power available to the station. The heater shall be controlled by a thermostat and contactor and protected by a heavy-duty circuit breaker.

P. Door Open Notification

1. The station enclosure shall include limit switches with defeater switch alarm circuit and time delay, mounted and wired in the station enclosure to indicate that there has been a door left open or unauthorized entry to the station. There shall be an adjustable time period for the operator to disable alarm with an unmarked pushbutton located inside the station. The notification shall be activated when a station door or access panel is opened. Includes dry contacts pre-wired to a terminal strip for remote monitoring.

2.04 Pump Design

A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.

B. The manufacturer of the pumps must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

C. Materials and Construction Features

1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

   a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

   b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

   c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

   d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

2. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:

   a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

   b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

   c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.

   d. Two O-rings of Buna-N material shall seal coverplate to pump casing.

   e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.

   f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

a. Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

   1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

   2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

   3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.

f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

    a. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

    b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above

    c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the pump.

E. Drain Kit:

1. Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

F. Spare Parts Kit:

1. The following minimum spare parts shall be furnished with the pump station:

   a. One spare pump mechanical seal (complete with shaft sleeve)
   b. One cover plate O-Ring
   c. One rotating assembly O-Ring
   d. One set of rotating assembly spacers

G. Volute Casing Heater:

1. Pumps shall be provided with a thermostat mounted to the exterior of the volute casing, and a 115 volt electric heater inserted into the interior of the volute by means of a dedicated port. The heater shall be energized at 43+/-3 degrees F to provide heat to the casing and eliminate the possibility of freezing. Heater probes that must be installed through a pump drain port shall not be acceptable.

2.05 Valves and Piping:

A. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded Buna seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Plug valves shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connection drilled to ANSI 125 lb. Standard. Valves shall have ports designed to pass spherical solids equal to the pumps capability. Valves shall be furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.

C. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.

2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.

3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

6. An additional 2" CARV manufactured by ARI shall also be included in the pump station discharge piping as indicated on the plans.

D. Gauge Kit

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.

2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

E. Station Enclosure Low Temperature Alarm

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

F. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2^{o} between flanges. Flanges shall be faced with a gasket finish.

G. Design-Build Team must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.06 Drive Unit

A. Motors (Note: Maximum motor frame size is 405T open drip-proof.)

1. **Pump motors shall be 10 HP,** 3 phase, 60 hertz, 460 VAC, horizontal ODP, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with Class F insulation and 1.15 service factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.

2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

2.07 Drive Transmission

A. Power to pumps shall be transmitted through V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

B. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.

C. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.

D. The pump manufacturer shall submit power transmission calculations which document the following:

1. Ratio of pump/motor speed.

2. Pitch diameter of driver and driven sheaves.

3. Number of belts required per drive.

4. Theoretical horsepower transmitted per belt, based on vendor's data.

5. Center distance between pump and motor shafts.

6. Arc-length correction factor applied to theoretical horsepower transmitted.

7. Service factor applied to established design horsepower.

8. Safety factor ratio of power transmitted/brake horsepower required.

E. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.

1. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.

2. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.

3. The guard shall be finished in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.08 Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.09 Electrical Control Components

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

B. Panel Enclosure

1. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.

2. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount any component. All control devices shall be clearly labeled to indicate function.

C. UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the subpanel or control cover shall conform to UL descriptions and procedures.

D. UL Label Requirement:

1. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for “Packaged Pumping System”. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

E. Branch Components

1. All Motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electric Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

2. Circuit Breakers and Operating Mechanisms

a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.

b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

3. Motor Starters

a. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

b. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.

c. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

4. Starter: A reduced voltage, solid state motor starter shall be furnished for each pump motor. The starter construction shall be modular with separately replaceable power and control sections. The power section shall consist of six back-to-back SCR's rated 208 to 480 volts, 50/60 hertz. The SCR's shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. The enclosed operating temperature range shall be 0 to 40 degrees C at altitudes up to 2000 meters without derating.

a. Starting Modes: Starting modes shall be selectable soft start, current limit, or full voltage. Soft starting the pump shall include an adjustable initial torque value of 0 to 90 %. The acceleration ramp shall be adjustable from 0 to 30 seconds. The starter shall include a selectable kick start providing a current pulse at start. Kick start level shall be adjustable from 0 to 90% of locked rotor torque. Kick start

time shall be adjustable from 0 to 2 seconds. Current limit mode shall provide means for limiting the starting current to a programmable value between 50 and 600% of full load current. Full voltage start shall provide across the line starting with a ramp time of less than 0.25 seconds.

b. Pump Control Mode: Ramp time will be dependent on pump torque requirements. The starter shall provide smooth acceleration and deceleration, which approximates the flow rate of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds. Pump control provides reduced hydraulic shock.

c. Bypass: When the start ramp time is complete, the starter shall energize an integral bypass contactor. When in the bypass mode, the bypass contactor shall carry the motor load to minimize internal heating in the electrical enclosure.

d. Protection: The starter shall include protective features: Communication fault, control temperature, excess starts/hour, stall, jam, line fault, open gate, overload, overvoltage, phase reversal, power loss, underload, undervoltage, shorted SCR, open bypass and voltage unbalance.

    1) An integral electronic overload relay equipped with thermal memory shall be included and shall utilize three phase current sensing. Adjustments shall include trip current, service factor and 10, 15, 20 or 30 trip class.

    2) Jam trip shall be adjustable 0-1,000% of the nominal motor current with a delay time adjustment of 0-99 seconds.

    3) Stall protection senses that the motor is not up-to-speed at end of ramp and will shut down after a user-selected delay time has elapsed. Stall delay shall be adjustable from 0-10 seconds.

    4) Fault diagnostics shall be displayed on the starter and shall include temperature fault, line fault, open gate and power loss.

e. Display: The starter shall include a keypad and display on the front of the control module. The display is equipped with a built-in four line, 16 character backlit LCD. The LCD displays metering, faults and parameter settings in English. Faults will display in English and fault code. A fault buffer will store the last five faults. Metering capabilities shall include: Three phase current, three phase voltage, power factor, motor thermal usage, wattmeter, kilowatt hours, and elapsed time meter. Digital parameter adjustments shall be made using the keypad.

f. Door Mounted Display: Each starter shall be furnished with a display and keypad mounted to the door of the control panel. The door mounted display will duplicate

the functions of the starter display and allow the operator to monitor or change parameters without opening the control panel door.

5. Phase Monitor

   a. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

6. Phase Monitor

   a. The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by voltage less than 83% of nominal. The motor(s) shall automatically restart when power conditions return to normal.

F. Transient Voltage Surge Suppressor

   a. The control panel shall be equipped with a modular surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating [I_{max}] of 40,000 Amperes. Nominal discharge current [I_n] is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition,Type 2 component assembly.

G. Voltage Alert Indication

1. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

H. Control Circuit

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.

3. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.

4. Six digit elapsed time meter shall be shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.

5. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.

6. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

7. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

8. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer shall be protected by a thermal magnetic circuit breakers, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until primary circuit breaker is in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

    a. Pump Start Delay:

1) The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

b. Panel Heater

1) The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.

9. Wiring

a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the main entrance terminal blocks and final connections to remote alarm devices.

b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).

c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

1) Line and Load Circuits, AC or DC power.....Black
2) AC Control Circuit Less Than Line Voltage.....Red
3) DC Control Circuit.....Blue
4) Interlock Control Circuit, from External Source.....Yellow
5) Equipment Grounding Conductor.....Green
6) Current Carrying Ground.....White
7) Hot With Circuit Breaker Open.....Orange

d. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

e. Motor branch and other power conductors shall not be loaded above the temperature of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

f. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

10. Factory installed conduit shall conform to following requirements:

    a. All conduit and fittings to be UL listed.

    b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.

    c. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.

    d. Conduit shall be sized according to the National Electric Code.

11. Grounding

    a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

    b. The Design-Build Team shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

12. Equipment Marking

    a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

        1) Equipment serial number
        2) Control panel short circuit rating
        3) Supply voltage, phase and frequency
        4) Current rating of the minimum main conductor
        5) Electrical wiring diagram number
        6) Motor horsepower and full load current
        7) Motor overload heater element
        8) Motor circuit breaker trip current rating
        9) Name and location of equipment manufacturer

    b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

    c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.10 Liquid Level Control (Integrinex™ Standard Level Controller)

A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or “standby pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

1. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.

2. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.

3. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc

and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.

a. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

b. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

c. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.

d. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.

e. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.

4. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.

5. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.

6. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.

7. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

8. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

9. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.

10. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.

11. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.

12. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.

13. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.

14. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

15. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a low liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable both pump motors. When the wet well rises above

the low level point, both pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.

16. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.

F. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.

G. Air Bubbler System

1. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

2. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

3. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.

4. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

H. Liquid Level Control (Backup Float Switch Type)

1. The level control system shall include backup floats to start and stop pump motors in response to changes in wet well level. It shall be a mercury free float switch type with floats to be secured to a vertical pipe in the wet well. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.

2. The level control system shall start and stop the pumps in accordance to the wet well level. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the "lead pump start level". When the water is lowered to the "lead pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the water continue to rise, an additional float switch will start the second pump after reaching the "lag pump start level" so that both pumps operate together. Both pumps shall stop at the same "all pumps off level". Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

3. The level control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as "Lead" pump. Alternation will occur at the end of each pumping cycle.

4. Float switches shall be supplied for installation by the Design-Build Team. Each float shall contain a mercury free switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. The float switches shall be secured to a weighted PVC chain.

5. A junction box shall be supplied for installation in the wet well by the Design-Build Team. Junction box shall be NEMA 4X, non-corrosive type incorporating terminal blocks match-marked to terminals in the control panel.

6. A separate float switch shall be used to alert maintenance personnel to a high water level in the wet well (a low water level float switch is optional). Should the water level rise to the "high water alarm" level, the float switch shall energize a 115-volt AC circuit for an external alarm device. An indicator, visible from front of control panel, shall indicate high level condition exists. The alarm signal shall maintain until wet well level is lowered and alarm circuit manually reset.

7. An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the alarm signal shall provide automatic reset of the alarm silence relay.

2.11 Alarm Light (External):

A. Station manufacturer will supply one 115 VAC NEMA 4X alarm light fixture with red globe, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the Design-Build Team.

2.12 Alarm Horn (External):

A. Station manufacturer will supply one 115 VAC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the Design-Build Team.

2.13 SCADA System Requirements

A. See separate SP section "SCADA System Requirements" and Electrical plans for SCADA details.

PART 3 - EXECUTION

3.01 Examination

A. Design-Build Team shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, Design-Build Team shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 Installation

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.03 Field Quality Control

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted by the pump station provider to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics. City and their Engineer's staff shall be present for all testing.

2. After construction debris and foreign material has been removed from the wet well, Design-Build Team shall supply water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gauge readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.

3. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. The technician will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. City and their Engineer's staff shall be present for all testing. Training for City staff shall include 4 hours minimum after the station is proven operational ready by the manufacturer's representative.

B. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

C. The pump station should be placed into service immediately. If operation is delayed, station is to be stored and maintained per manufacturer's written instructions.

END OF SECTION

ELECTRICAL

PART 1 - GENERAL

1.01 SCOPE

A. This section of the specifications includes the furnishing and installation of all labor, materials, tools, equipment, operations necessary for the proper execution and completion of all electrical work indicated on the drawings and specified herein.

B. The Design-Build Team's Electrical Sub Contractor shall furnish and install all conduit, cable, systems for power, and shall furnish and install raceways for special systems as specified herein and as indicated on the electrical drawings, complete and ready to operate in every respect, including connection of Owner furnished equipment, if applicable.

1.02 CODES AND ORDINANCES

A. All electrical work and materials shall comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), American Society for Testing and Material (ASTM), Insulated Cable Engineers Association (ICEA), National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), Underwriters' Laboratories (UL) and applicable local codes and regulations.

B. All electrical equipment shall be UL listed.

C. If discrepancies occur between laws, codes, ordinances, rules and regulations, and the specifications or drawings, each discrepancy shall be called to the attention of the Engineer in writing before the bids are submitted. That work which is shown or specified in violation of these rules and regulations shall be done in compliance with the regulations, and no claim for additional cost required to make implied systems complete will be accepted.

1.03 UTILITY COORDINATION, PERMITS AND FEES

A. The Design-Build Team's Electrical Sub Contractor shall coordinate any required power service modifications with the local power utility and provide equipment in full conformance with their requirements.

B. The Design-Build Team's Electrical Sub Contractor shall obtain all permits and inspections required for the completion of this contract.

1.04 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved. Work shall be performed by experienced and skilled electricians and mechanics under the supervision of a competent foreman. Substandard workmanship will be cause for rejection of work and replacement by Design-Build Team.

1.05 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of conduits, ducts, and equipment, together with details of connections of certain principal items. The layout shown shall be followed as closely as circumstances will permit, but the Design-Build Team shall lay out his work so as to avoid conflict with other contractors and trades, and to avoid

any unnecessary cutting or damage to walls, floors, and supporting structural members. The Design-Build Team's Electrical Sub Contractor shall install at the proper time all necessary sleeves, hangers and inserts which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of the above items.

B. The Design-Build Team's Electrical Sub Contractor shall refer to the general drawings and cooperate fully with other contractors and trades while installing electrical equipment because of close space limits. In case of conflict, the Engineer shall be notified before proceeding with installation.

C. The drawings and specifications complement each other and together are intended to give a complete description of the work. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown on plans, shall be furnished the same as if mentioned or shown in both places. If conflicts exist, then the most stringent method shown or described should apply.

D. Any discrepancy, omission, or conflict found in plans or specifications shall be called to the immediate attention of the Engineer, prior to receipt of bids.

E. The drawings are not intended to show complete details. It is the Design-Build Team's Electrical Sub Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. The Design-Build Team's Electrical Sub Contractor shall take all field measurements and be responsible therefore. Exact locations are to be defined in the field and shall be satisfactory to the Engineer.

1.06 CUTTING AND PATCHING

A. Any cutting of walls or structures required for the installation of work under this section shall be done by the Design-Build Team's Electrical Sub Contractor. Holes through walls for passage of conduits shall be properly and neatly sleeved and grouted. Sleeves through exterior walls shall be effectively sealed against passage of water. All disturbed areas shall be refinished and left in a finished and matching condition and shall meet the approval of the Engineer.

1.07 ALLOWANCE FOR ADDITIONAL WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall be submitted and approved in writing. No claim for addition to the contract will be valid unless so ordered and approved by the Owner and Engineer.

1.08 AS INSTALLED PRINTS

A. This Design-Build Team's Electrical Sub Contractor shall maintain a set of prints, showing exact location of all relocated equipment, concealed equipment, service accesses, hand holes, underground duct banks, and all other changes to the plans. This set of prints shall be kept current and turned over to the Engineer upon completion of the job. Dimensions shall be shown to locate all underground conduit duct banks from permanent reference points.

1.09 INCIDENTAL CONSTRUCTION WORK

A. All openings as required for the electrical work shall be provided by the Design-Build Team's Electrical Sub Contractor. The Design-Build Team's Electrical Sub Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other subcontractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other subcontractors have finished as the Engineer may direct. All excavating required for the installation of the system shall be done by the Design-Build Team's Electrical Sub Contractor. Backfill shall be accomplished as specified in the appropriate section of the specifications.

1.10 CLEANING AND PAINTING

A. The Design-Build Team's Electrical Sub Contractor shall at all times keep the Owner's premises, adjoining driveways and streets clean of rubbish caused by the Design-Build Teamr's operations and at the completion of the work shall remove all the rubbish from and about the premises, all his tools, equipment, temporary work, surplus material and shall leave the work clean and ready for use.

B. The Design-Build Team's Electrical Sub Contractor shall be required to perform touch-up painting on factory finished equipment installed under this contract where necessary to repair damaged areas. All metal exposed to weather shall be properly painted. Any equipment installed exposed to weather shall have all damaged areas cleaned, primed, and be painted by the Design-Build Team's Electrical Sub Contractor.

1.11 GUARANTEE

A. The Design-Build Team shall guarantee all materials, equipment, and workmanship in this contract against defects and failures of any nature for a period of one year from date on which the system is accepted. Apparatus furnished by the Design-Build Team shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications. Upon notice from the Engineer or Owner, he shall immediately check the system, make necessary repairs or adjustments as required due to faulty workmanship, materials, faults, operation, or equipment, without cost to the Owner, and instruct the Owner in proper operation, adjustment, and care of the systems.

1.12 IDENTIFICATION

A. All equipment shall be identified and properly marked. All marking must meet the Engineer's approval. All markers shall be of appropriate size. Each motor Control Panel, transformer, panel, contactor, starter, and other piece of electrical equipment shall be identified as to their service.

B. All disconnect switches, junction boxes, motor controllers, and other equipment requiring electrical power connection shall be marked with voltage present, as appropriate to designate 120, 208, 240, 277, or 480 volts and single or three phase, as applicable.

1.13 MAINTENANCE AND OPERATING INSTRUCTIONS

A. The Design-Build Team shall furnish to the Engineer five (5) complete sets of applicable drawings, instructions and parts lists on all equipment furnished, providing names and addresses of manufacturers or subcontractors and suppliers. Two (2) copies of manufacturer's warranties on all equipment shall be provided to the Owner and one (1) copy to the Engineer.

B. Upon acceptance and approval of this project the one-year warranty period on all equipment and systems by this Design-Build Team shall start, from that date.

1.14 SHOP DRAWINGS

A. Upon award of the contract, the Design-Build Team shall submit to the Engineer for approval, a list of all proposed subcontractors and materials he proposes to utilize and five (5) sets of shop drawings consisting of detailed drawings or manufacturer's cuts of all manufactured equipment he proposes to use on the job. The drawings or cuts shall show details of construction and arrangement of all pertinent data pertaining to equipment proposed to be furnished. The approval of the Engineer shall be obtained before equipment is ordered for delivery. It will be the duty of the Design-Build Team to verify quantities, dimensions, and details, and determine suitability of equipment for installation in space provided. Approval of shop drawings by the Engineer does not relieve the Design-Build Team of the responsibility for coordination, dimensions, quantities or conformance with contract documents.

B. The Design-Build Team shall check and initial shop drawings making such notations and corrections as may be appropriate or necessary to comply with contract documents before submission to the Engineer.

1.15 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. The Design-Build Team shall be responsible for furnishing suitable shelter and protection for all materials and equipment stored on the job. Equipment shall be protected from damage from any source both during storage and after installation until completion of the job. No damaged equipment will be accepted.

PART 2 - MATERIALS

2.01 ELECTRICAL MATERIALS AND METHODS

A. Materials and workmanship on all work installed under this contract shall be new and of the best quality and shall conform to the best practice for such work and be installed in accordance with manufacturer's recommendations and instructions, including all hardware and accessories recommended or appropriate. Any work or materials not specifically mentioned in these plans and specifications, but required to make this job a complete and workable system shall be furnished and installed by the Design-BuildTeam’s Electrical Sub Contractor.

B. Substitution for equipment specified must be equal in every respect and the Design-Build Team shall be of the quality of materials and equipment covered in these specifications and shown on the drawings and approved by the Engineer.

C. All manufactured and fabricated assemblies of electrically operated equipment furnished under this contract shall have Underwriter's Laboratories approval or U. L. Re-examination listing in every case where such approval has been established for the particular type of materials or devices in question.

2.02 CONDUITS AND RACEWAYS

A. All wiring shall be in conduit or other approved raceways except as shown on the drawings or otherwise specified, and shall be concealed unless otherwise noted. Conduit shall be one of the types listed below.

B. CONDUIT TYPES:

1. Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, and shall conform to Fed Spec WW-C-581 and ANSI C80.1, and UL 6.
2. Intermediate Metal Conduit (IMC). IMC shall be hot-dip galvanized and shall conform to Fed Spec WW-C-581 and UL 1242.
3. Liquid tight Flexible Metal Conduit. Liquid tight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moisture proof polyvinyl chloride jacket, and shall be UL labeled.
4. PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel, hot-dip galvanized with a 40 mils thick PVC coating and a 2 mil thick interior coating. PVC coated rigid steel conduit shall be as manufactured by Ocal, Perma-Cote, or Robroy Industries or equal.

C. CONDUIT INSTALLATION:

1. Rigid steel conduit shall be installed in masonry walls, concrete slabs, and cast-in-place walls.
2. PVC-coated rigid steel conduit shall be installed in all exposed outdoor locations. Conduit shall be rigidly supported by PVC-coated mounting hardware and framing materials. Nuts and bolts shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer. Threading tools used for steel conduit shall not be used to thread PVC-coated rigid steel conduit.
3. Liquid tight flexible metal conduit with watertight connectors shall be installed for final connections to dry type transformers, motors, equipment with moving parts, and where indicated on the drawings. Conduit shall be installed without sharp bends and in minimum lengths required for the application but not longer than 4'-0", unless acceptable to the Engineer.
4. All direct buried underground conduit shall be rigid steel conduit coated with thixotropic coal tar paint or PVC coated rigid steel conduit.
5. Underground conduits shall be concrete encased under roadways and where indicated on the drawings.
6. Conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside. Conduits shall be installed between the reinforcing steel in walls or slabs which have reinforcement in both faces. In slabs which have only a single

layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduit shall be neatly grouted into any openings cut into concrete and masonry structures. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.

7. All conduits that enter enclosures shall be terminated by fittings which ensure that the NEMA rating of the enclosure is not affected or changed. A corrosion-resistant coating shall be applied to all conduits that turn out of concrete, masonry, or earth indoors. The coating shall consist of a heavy coat of coal tar paint extending one inch on each side of the point of turn-out.
8. Concrete encased conduit shall have minimum concrete thickness of 2 inches between conduits, six inches above and below conduits. Underground conduit bend radius shall be not less than 2 feet at vertical risers nor less than 3 feet elsewhere. Underground conduits and conduit banks shall have 2 foot minimum earth cover except where indicated otherwise. Underground conduits shall be sloped to drain from buildings to the handholes. Instrument and telephone cables shall be separated from all power wiring in conduits raceways, boxes, and handholes. These cables shall be routed through manholes and handholes in Liquid tight flexible metal conduit.
9. After cable has been installed and connected, conduit ends shall be sealed by nonhardening duct sealing compound forced into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits at handholes and building entrance junction boxes, and for one inch and larger conduit connections to equipment.
10. All exposed conduit runs shall be so located that pull or junction boxes will not be made inaccessible due to inadequate clearance with piping or equipment.
11. All conduits used for service entrance feeders from supply point to first overcurrent device shall be bonded with suitable bonding locknuts and/or bonding insulating bushings, or by separate copper bonding conductor.

2.03 CONDUCTORS

A. GENERAL:

1. The Design-Build Team's Electrical Sub Contractor shall furnish and install all wire and cable necessary to complete the work herein outlined and as shown on drawings, except such items as are specifically noted as being furnished by others. All wiring in the entire system must be color coded and all conductors shall have their size, voltage, manufacturer, and type clearly marked on the outer covering. All wire and cable shall be as herein specified or as shown on the drawings. Wire and cable shall be as manufactured by Okonite, Belden, Anaconda, Rome, General Cable, or equal.

B. CONDUCTORS:

1. Conductors shall consist of annealed copper wire of size indicated on drawings or as may be specified herein. No conductors smaller than #12 AWG copper shall be used unless otherwise indicated on the drawings. All conductors up to and including #10 AWG shall be solid copper and all conductors of #8 AWG and larger shall be copper of size indicated on drawings or, as may be specified herein, Class B concentric stranded construction, unless specified otherwise herein or on drawings.

C. WIRE INSULATION:

1. All wire and cable unless otherwise specified shall be single conductor type THWN or THHN 600 volt insulation. Service entrance conductors shall be RHH/RHW-USE type insulation. Conductors, shall be color coded - black, red, orange, white, on 240/120 volt systems.

D. INSTALLATION:

1. The Engineer reserves the right to inspect any and all joints in wiring. If the joint is already taped, the Design-Build Team's Electrical Sub Contractor shall properly retape after inspection. Conductors shall be continuous without joints or splices in runs between outlet boxes. All splices shall be made at boxes only.

E. SPLICES AND TERMINATIONS:

1. Splices shall be made by use of mechanical connectors of the following manufacturers' types, T & B, "Sta-Kon", Burndy, "Crimpit"; Minnesota Mining and Manufacturing Company, "Scotchlock" Ideal, "Wing-Nuts". Conductors size #8 AWG and larger shall be spliced and connected with suitable solderless, mechanical lugs and connectors. All splices, taps, and connections shall be insulated with Scotch electrical tape as made by Minnesota Mining & Manufacturing Company as applicable to installation.

2.04 SUPPORTING DEVICES

A. GENERAL:

1. All secondary electrical devices such as outlet boxes, poles, bases, switches, and receptacles shall be located generally as shown on the drawings. No device utilized by the handicapped shall be more than 4'-0" AFF. to top.

B. OUTLET AND SWITCH BOXES:

1. Boxes exposed, in masonry walls and cast-in-place walls shall be cast metal with conduit hubs, Crouse Hinds Type FS or equal. Intermediate oversize type plates shall be used where standard plate; will not cover opening. All adjacent plates shall match and be intermediate type also.
2. All exterior mounted boxes shall have approved weather-proof plates and/or covers and all surface installed boxes shall have stamped steel device plates.

C. OUTLET LOCATIONS:

1. All outlets for receptacles or switches shall be installed in the location shown on the drawings. The Design-Build Team shall study the general building plans in relation to the spaces surrounding each outlet in order that his work may fit the other work required by these specifications and plans as well as the work of other trades. When necessary, the Design-Build Team shall relocate outlets so that when fixtures or other fittings are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment.
2. Unless otherwise indicated on the drawings, the top of outlet boxes shall be placed at the following distances from finished floors:
3. Power Panelboards - top of cabinet 6'-6" above floor. Safety switches and/or circuit breakers - handle not over 6'-6" above floor.

4. The Design-Build Team's Electrical Sub Contractor is cautioned to review general drawings to confirm location of equipment and to adjust the exact installed location of receptacles and devices accordingly to avoid interference between electrical devices and equipment. Responsibility for locating in the field is the Design-Build Team's Electrical Sub Contractor's and the Engineer should be contacted for clarification before installation.

D. STRUCTURAL STEEL:

1. The Design-Build Team's Electrical Sub Contractor shall provide miscellaneous structural steel necessary to mount electrical equipment to walls, beams and joists. All structural steel furnished shall be standard shapes and sizes and shall be free from rust and/or scale. All interior steel shall be firmly and rigidly welded or bolted in place. All structural steel shall be structural quality conforming with ASTM A7-497. All exterior steel shall be painted by the Design-Build Team's Electrical Sub Contractor as approved by the Engineer.

E. TAP AND PULL BOXES:

1. Boxes shall be of code gauge galvanized sheet steel but not less than 14 gauge metal. Holes for raceways shall be drilled on the job. Where necessary for boxes to be supported away from the ceiling or beams, strap iron or threaded rod shall be used for supports.
2. Boxes shall have covers fastened on with screws. Sizes of boxes shall be determined by NEC requirements. In concealed wiring areas, boxes shall be installed flush with the finished surfaces and provided with oversized covers.

F. SECONDARY SYSTEMS:

1. The Design-Build Team's Electrical Sub Contractor shall furnish and install all conduit, junction boxes, outlet boxes, and plates for conduit systems as indicated on the drawings.

2.05 GROUNDING

A. All electrical systems and equipment connected under this contract shall be grounded in strict accordance with the National Electrical Code and state and local regulations. Provide a green TW insulated equipment grounding conductor in all conduits. It is intended that equipment grounding is not dependent on conduit terminations.

B. Metal raceways, metal enclosures or electrical devices, switchgear enclosures, transformer frames, and other equipment shall be completely grounded in an approved manner prescribed by the NEC. All necessary conduit, conductors, clamps and connectors for the grounding system shall be furnished, installed and connected by the Electrical Contractor. The ground connection shall be to a driven ground rod and pumping station piping. The pipe connection shall consist of a ground fitting that bonds both conduit and conductor to the pipe.

C. All ground conductors shall be bare or green insulated in accordance with the National Electrical Code, soft drawn copper cable or bar, not smaller than 12 AWG. Ground cable splices and joints which will be inaccessible upon completion of construction shall meet the requirements of IEEE Standard 837, and shall be Cadweld "Exothermic"

or Burndy "Hyground" type. Ground cable near the base of a structure shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches.

D. Ground connections to equipment and ground buses shall be by copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures or by grounding locknuts or bushings.

E. Ground rods not described elsewhere shall be 5/8 inch diameter by 8 feet long, with a copper jacket bonded to a steel core.

2.06 CIRCUIT BREAKER TYPE DISCONNECT SWITCHES

A. Unless otherwise specified, each circuit breaker type disconnect switch shall be 3 phase, heavy-duty, with a voltage and continuous current rating as indicated on the drawings.

B. Each disconnect switch shall have an enclosure rating as indicated on the drawings.

C. The disconnect switch for the primary service shall be service entrance rated.

D. The disconnect switch for the generator shall be provided with insulated neutral terminals.

E. Circuit breakers shall be 3 phase, 480 volt, molded-case circuit breakers of not less than 22,000 amperes interrupting rating at 480 volts ac, complete with thermal and instantaneous trip elements. Breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Circuit breakers shall have "On", "Off", and "Tripped" indication and padlockable handles.

F. Disconnect switches shall have nameplates identifying related equipment, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the enclosure.

2.07 MINI POWER CENTER (MPC)

A. The Mini-Power Center shall be rated as indicated on the drawings. MPC shall be two winding type, self cooled and shall include a main primary breaker with interrupting rating of 22,000 AIC at 480 VAC. The secondary shall include a main breaker with an interrupting capacity of 10,000 AIC at 240 VAC and a panelboard with circuit breakers as indicated on the drawings. All interconnecting wiring shall be factory installed. Main primary, and secondary breakers shall be enclosed with a pad-lockable hinged door.

B. The transformer shall be dry type with encapsulated winding. Transformer shall be insulated with a 185 deg C insulation system and provide the required performance without exceeding the temperature rise in a 40 deg C ambient. Enclosure shall be heavy gauge steel and NEMA 3R SS.

C. Panelboard shall utilize 1” bolt-on circuit breakers. Double pole breakers shall have a common trip. A typewritten directory shall be provided.

D. Mini-power center shall be manufactured by Square D, Cutler-Hammer, General Electric, or equal.

2.08 SWITCHES AND RECEPTACLES

A. The Design-Build Team's Electrical Sub Contractor shall furnish and install all switches and receptacles as called for on the drawings or as herein specified. All wiring devices shall be new.

B. Light switches shall be Industrial Specification Grade Switches rated 20 amperes at 120/277 volts and shall be mounted 45" AFF unless otherwise indicated on the drawings.

C. Receptacles shall be Industrial Specification Grade Duplex Straight Blade Receptacles, NEMA 5-20R, two pole, three-wire, grounding rated 20 amperes at 125 volts and shall be mounted 18" AFF unless otherwise indicated on the drawings.

D. Ground fault receptacles shall be Commercial Specification Grade Ground Fault Circuit Interrupters, NEMA 5-20R, two pole, three-wire, grounding, 20 amperes, 125 volts and shall be mounted 18" AFF unless otherwise indicated on the drawings.

END OF SECTION

ENGINE-GENERATOR SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

A. This section covers the furnishing and installation of engine-generator systems as indicated on the drawings and as specified herein.

B. Each engine-generator system shall include engine, generator, controls, sub-base, double wall fuel tank, weatherproof enclosure, battery charger, accessories power panel, jacket water heater, and accessories as indicated on the drawings and specified herein. Each system shall be skid mounted.

1.02 GENERAL

A. Each engine-generator system shall be prototype tested, factory built, production tested, site tested, and of the latest industrial design. Each system shall be provided complete with accessories for a complete, and furnished system in conformance with system manufacturer specifications and contract drawings and specifications.

B. All equipment and accessories shall be designed, constructed and installed in accordance with the latest versions of EGA, CSA, NEC, IEEE, NFPA, ANSI, NEMA, ASTM, UL and state and local codes and ordinances.

C. Each system shall be factory assembled, wired and tested and set into operation by a single supplier.

D. Engine-generator systems shall meet the requirements of the North Carolina Department of Insurance.

E. Each engine-generator system shall be as manufacturer by Kohler, Onan, Olympian, Generac, Ingersoll-Rand, Caterpiller, or equal.

1.03 DESIGN CONDITIONS

A. Each engine-generator shall be standby rated and classified “Type 10” by the NFPA. Each system shall be suitable for a “black start” condition and shall automatically start and connect to the selected electrical loads when initiated from the automatic transfer switch. Voltage drop shall not exceed 25 percent.

B. The unit shall operate the following loads when sequenced in the following order:

1. 10 KVA of miscellaneous lighting, heating, and motor loads.
2. 10 hp motor started from a full voltage starter.
3. 10 hp motor started from a full voltage starter.

C. The engine-generator system shall be designed and installed for the following conditions:

1. High Ambient Temperature 104° F
2. Low Ambient Temperature -10° F
3. Elevation 1000 feet
4. Wind Velocity 130 mph

D. Minimum design requirements for the engine-generator systems are indicated below:

1.	Fuel Supply	No. 2 Diesel
2.	Radiator Type	Unit-Mounted
3.	Voltage	As Indicated
4.	Power Rating (Min	50 kW
5.	Allow Voltage Dip	0.25
6.	Power Factor	0.8 lagging

PART 2 - PRODUCTS

2.01 ENGINE

The engine furnished shall deliver the horsepower to drive the generator load required.

Number of Cylinders	4 or 6
Cylinder Arrangement	Vee or In-Line
Displacement (min)	4 Liter
Intake Air	Turbocharged or Naturally Aspirated
Cycle	4
Rated Speed	1800 rpm
Power (min)	40KW
Cooling	Unit-Mounted Radiator

A. The engine shall meet the following minimum requirements:

1. Engine driven fuel pump, fuel filter/separator, manual fire safe shutoff valves, fuel filters, electric shut-off valves, flexible fuel lines rated at 300 °F and 100 psi with braided stainless steel covering and brass fittings.
2. Electronic governors capable of regulating the no load to full load frequency to a 1% maximum and steady state regulation of ± 0.5 percent.
3. Battery charging alternator, negative ground polarity, solid-state regulation, and minimum rating of 35 ampere at 12 volts or 20 ampere at 24 volts.
4. Starter motor, 12 or 24 volt.
5. Positive displacement, full pressure lubrication oil pump with full flow cartridge oil filters, dipstick, and oil drain.
6. Dry-type replaceable air cleaner elements.
7. Pressurized, closed recovery cooling system with unit-mounted radiator, belt driven fan, water pump, thermostat, high water temperature cutout.
8. Exhaust system, seamless, gas proof with flexible stainless steel connectors and expansion joints, critical grade exhaust silencer, and counter balancing rain cap.
9. Battery pack, 12 or 24 volt, with rack and cables. Battery pack shall be sized to

deliver the minimum cold-cranking amperes required at 0°F per SAE standard J-537.

2.02 GENERATOR

A. The engine-generator shall be provided with a four pole, 12 lead, revolving field alternator with self-ventilated, drip-proof construction. Insulation shall meet NEMA MG-1-22.4 and NEMA MG1-1.65 standards. Alternator insulation shall be Class F. Rotor and stator insulation shall be Class H and be vacuum impregnated with epoxy varnish.

B. The excitation system shall be brushless and controlled by a solid-state voltage regulator with adjustable volts per hertz operation capable of maintaining voltage within ±2% at any constant load from 0 to 100% of rating.

C. The instantaneous voltage dip shall not exceed 25% and recover to ±2% in one second for any load up to rated load. The generator shall be capable of sustaining at least 250% rated current for at least 10 seconds under fault conditions.

D. The alternator shall be directly connected to the flywheel housing, and the rotor shall be driven through a semi flexible driving flange to ensure permanent alignment.

2.03 CONTROLS

A. The engine-generator system shall be provided with a microprocessor-based control panel mounted inside the enclosure. The control panel shall be vibration isolated as required and powered from system batteries.

B. The control panel shall include the following as a minimum:

1. Engine coolant temperature gauge.
2. Engine oil pressure gauge.
3. Battery voltage meter.
4. Engine run time meter.
5. Voltmeter for all line-to-line and line-to-neutral voltages.
6. Ammeter for all phase currents.
7. Frequency meter.
8. Voltage adjusting rheostat.
9. Indicating lights and contacts for remote monitoring for the following:

- Overcrank
- Low water temperature
- High engine temperature pre-alarm
- High engine temperature
- Low lubricating oil pressure pre-alarm
- Low lubricating oil pressure
- Over-speed
- Low fuel level (main tank)

- Low coolant level
- Control switch not in “AUTO” position
- Emergency Stop
- High battery voltage
- Low battery voltage
- Battery charger fault
- System Ready

10. Test switch for indicating lights.
11. Auto-Off-On selector switch. In Auto, the engine-generator system will operate from the automatic transfer switch.
12. Alarm horn with silence switch.
13. Emergency stop push button.
14. Automatic engine shutdown logic for the following conditions:
    - Overcrank
    - Over-speed
    - Low lubricating oil pressure
    - High engine temperature
    - Operation of remote manual stop station
15. Overvoltage protection that will shut down the unit after one second of 115% or higher voltage.
16. Solid state cranking system controls with individually adjustable “On” and “Off” cranking periods, 2 to 30 seconds with cranking reset button, and over-crank protection.
17. Engine cool down timer factory set at 5 minutes.
18. Provisions for a remote emergency stop switch.
19. Governor speed control.
20. Two spare contacts that will close when engine is running.
21. Two spare contacts that will open when engine-generator is in alarm.
22. Speed switch to ensure the engine cannot restart until the engine has come to a complete stop.
23. Option for the addition of a serial communication interface.

2.04 ENCLOSURE

A. The engine-generator and accessories shall be housed in a lev weather protective enclosure, sound attenuated. The enclosure shall have lockable doors for access and maintenance. The enclosure shall contain intake and exhaust louvers with suitable insect screens. Maximum sound level shall be 75dBa or less at 20 feet.

2.05 FUEL TANK

A. The fuel tank shall be a UL approved, double walled, stub up, base mounted fuel tank. The fuel tank shall be of welded construction and have the structural integrity to support the engine-generator set.

B. The fuel tank shall include as a minimum: a lockable fuel filler cap, fuel gauge, low fuel level alarm, tank rupture alarm, fuel line check valves & fittings for fuel supply, return, fill and vent.

C. The complete fuel tank shall be supplied and warranted by the engine-generator set manufacturer.

D. The fuel tank shall be sized for 24 hours of operation of the full rated load.

2.06 MOUNTING

A. The engine-generator with base mounted fuel tank shall be skid mounted. The skid shall be suitable for anchoring to a concrete pad. Vibration isolation shall be provided.

2.07 ACCESSORIES

A. The engine-generator shall be provided with a UL Listed main line circuit breaker as recommended by the system manufacturer. The circuit breaker shall have load-side lugs suitable for termination of the cables indicated on the drawings.

B. The engine-generator shall be provided with a battery charger with the following features:

- 10 ampere, dual rate, automatic float & equalize operation
- Constant voltage regulation of ±1% from no load to full load over ±10% AC input line variation
- Temperature compensated for ambient from -10 to 104 degrees Fahrenheit
- Current limited to protect the charger during engine cranking and short circuit conditions
- Reverse polarity and transient voltage protected
- Voltmeter
- Ammeter
- Low battery voltage alarm contact
- High battery voltage alarm contact
- Charger malfunction alarm contact
- NEMA 5-15P plug and flexible power cord.

C. The engine-generator shall be provided with a unit mounted, thermostatically controlled, water jacket heater properly sized to maintain the coolant at 90°F in the ambient specified. The Design-Build Team shall provide a junction box for connection of power.

D. The engine-generator shall be provided with a red weatherproof alarm light located on top of the engine-generator enclosure for alarm indication. The alarm light shall indicate common generator alarms including the items listed in the controls section.

E. The engine-generator shall be provided with vibration isolation pads for installation between the skid and the concrete mounting pad.

2.08 AUTOMATIC TRANSFER SWITCH (ATS)

A. The generator manufacturer shall provide an automatic transfer switch as indicated on the drawings and as specified herein. The ATS shall contain lugs suitable for connection of all conductors indicated on the drawings.

B. The transfer switch shall be 100% equipment rated for continuous duty and shall conform to the applicable requirements of UL1008 for emergency total system load. Transfer switch shall bear the UL label and shall have withstand and close ratings of at least 22,000 amperes at 480 VAC. All power contacts shall be rated for multiple fault interruptions per UL 1087.

C. The automatic transfer switch shall consist of enclosed contact assemblies and solid-state control logic. Control power shall be derived from the line side of the source to which the load is transferred. The ATS shall be capable of being operated manually and automatically under full load conditions. A permanently affixed manual operator shall accomplish manual operation. The manual operator shall provide the same contact-to-contact transfer time as provided under automatic operation. The ATS shall be positively interlocked electrically and mechanically to prevent simultaneous closing of both sources under automatic or manual operation. The ATS shall have a manual neutral position for load circuit maintenance. The ATS shall have a delay in neutral capability. An ATS position indicator shall be visible from the front of the switch.

D. In addition, the automatic transfer switch (ATS) shall include the following minimum features.

a. Engine starting contacts.

b. Switch position contacts and indicating lights.

c. Source status contacts and indicating lights.

d. Time delay normal to emergency, adjustable 1 second to 20 minutes.

e. Time delay engine start adjustable 1 second to 20 minutes.

f. Time delay emergency to normal, adjustable 1 second to 20 minutes.

g. Time delay engine cool down, adjustable 10 seconds to 20 minutes.

h. Undervoltage sensing, adjustable.

i. Overvoltage sensing, adjustable.

j. Phase reversal protection.

k. Test-Auto-Engine Start-Off selector switch.

l. Engine-generator exerciser.

m. Dual output lugs for connection of loads indicated on the drawings.

n. NEMA rated enclosure as indicated on the drawings.

o. Contacts for remote monitoring of engine-generator running, engine-generator in alarm, system on Utility, and system on generator.

PART 3 - EXECUTION

3.01 SUPERVISION AND TESTING

A. The engine-generator system shall be factory and field-tested. Factory tests shall include control panel testing, repeated starts and stops, operation at capacity for a minimum of four continuous hours and confirmation of each safety shutdown. Testing shall conform to the requirements of NFPA 110.

B. Field supervision and testing shall be provided by a manufacturer's technical representative and shall include the following as a minimum:

1. Check installation and make necessary adjustments prior to field tests.
2. Verification of safety shutdowns.
3. Repeated starts and stops under load.
4. 4-hour load test under full load conditions. Generator supplier shall provide load bank. Design-Build Team shall provide fuel.
5. Testing as recommended by manufacturer.

3.02 TRAINING

A. The manufacturer's technical representative shall provide four hours of training for the Owner's employees. The training shall include operation and maintenance of the engine-generator system.

3.03 SERVICE

A. The System Supplier shall make an annual service contract available to the Owner.

END OF SECTION

SCADA SYSTEM REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This section covers the new SCADA RTU to communicate pump station parameters to the City of Dunn WTP. The following shall be provided:

1. New RTU pump station
2. SCADA Workstation programming at the WTP
3. Programming at elevated tank repeater site

1.02 CODES AND PERMITS

A. All work performed and all materials used shall be in accordance with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. Underwriters' Laboratories or other testing organization as required by the State of North Carolina shall list all electrical materials and equipment. The Design-Build Team and System Supplier shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

1.03 SUPPLIER'S QUALIFICATIONS

A. The entire system shall be designed, coordinated, and supplied by a qualified system supplier who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Design-Build Team's intended instrumentation supplier shall meet the following qualifications:

1. The Supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
2. The Supplier shall have the physical plant and fabricating personnel to complete the work specified. Fabrication capabilities or subcontractor fabrication arrangements shall be acceptable to the Engineer (100 Mile Radius).
3. The Supplier shall have and shall maintain competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
4. The Supplier shall have successfully provided similar work for at least 5 years.
5. System supplier shall visit the site prior to providing a bid.

1.04 COORDINATION

A. System Supplier shall coordinate system programming with Owner. Descriptions in the specification are general and subject to modification by Owner and Engineer prior to final programming. Prior to system programming, Supplier shall meet with Owner and Engineer to discuss additional programming requirements.

B. After the Supplier has placed the SCADA system in problem free operation, one 8 hour day of training shall be provided for City of Dunn staff.

C. All equipment shall be fully compatible with existing SCADA equipment.

PART 2 – PRODUCTS

2.01 RTU REQUIREMENTS

A. Wiring: The manufacturer shall as normally furnish all internal instrument and component device wiring. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C.

B. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than 5 nanoseconds.

C. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Electronic analog circuits shall be 16 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on the system supplier's panel wiring diagrams.

D. Terminal blocks for external connections shall be suitable for 14 AWG wire. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

E. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and bound by nylon cable ties or shall be routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

F. Painting: Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils. Color samples shall be submitted to the Engineer for color selection. One quart of paint shall be furnished with the panels for future touchup painting.

G. RTU shall be Nema 4X, stainless steel, sized as required for equipment provided.

H. Communications shall be compatible with existing equipment which is a Microwave Data Systems radio system. The following components are currently being and have been used on prior projects:

- RJ11 TO DB9 PROGRAMMING CBL ASSY, Part No. 03-3246A01
- Conversion Kit Analog x710 to SDx, Part No. 03-4758A02
- Radio SD4 400
- MDS SD4 400MHZ managed serial radio, 450-512mhz, COM2 port programmable RS232/485 - Include authorization for remote management access - serial port programmable, RS232/485

I. Battery Backup: RTU shall be provided with a 24 AH Battery Backup

J. Factory Test: Panels shall be factory tested by the panel fabricator before shipment.

K. Panel shall be built to UL 508A standard or equivalent.

L. RTU shall include Control Microsystem Scadapack LP PLC or equivalent.

M. Digital inputs for the following:

- Pump No. 1 Status
- Pump No. 2 Status
- Pump No. 1 Alarm
- Pump No. 2 Alarm
- ATS on Utility
- ATS on Generator
- Generator Running
- Generator Alarm
- Wetwell High Level Alarm
- Wetwell Low Level Alarm
- Spare
- Spare
- Spare
- Spare

N. Circuit breakers, wiring, fuses, relays, and power supplies for a completely functioning system shall be provided.

O. PLC shall be programmed as required to provide communications to central system.

P. Supplier will be required to re-program the existing repeater located at elevated Tank Site. All programming shall be performed without degradation of the data transfer from all existing sites. The Supplier shall monitor the system for a period not less than 2 hours following the program change to verify the integrity of all data (existing sites and new sites).

Q. Provide hard and soft copy of PLC program. Program shall be fully documented. Soft copy shall be on CD.

R. System supplier shall coordinate and FCC license modifications with FCC.

2.02 SCADA WORKSTATION SOFTWARE MODIFICATIONS

A. The existing SCADA Workstation software is 10,000 tag version of Trihedral VTScada.

B. System Supplier shall provide software tag and graphic development to incorporate new RTU. Software shall be similar to existing screens and configured as specified herein and as required meeting the functional requirements of the project. Modifications shall be fully installed, debugged and placed in operation by the System Supplier. All points shall be indicated on the screen.

C. System Supplier shall integrate data with the existing repeater site. Programming will be required at this repeater location.

D. Graphical displays, control faceplate, trending, and alarming will be provided similar to existing workstations.

E. Discrete inputs (DI) and outputs (DO) shall be identified with appropriate tag number and functional name. DI and DO also shall have enable/disable status flags, change of state alarm capability, alarm priority, event logging to printer capability, adjustable alarm setpoints, active time accumulation, and transition accumulation.

F. All analog points shall be provided with adjustable high and low level alarms.

G. All alarms and setpoints shall be adjustable from the screen.

H. RTU data shall be added to existing Microsoft Excel reports. The reports use the same general format as normal state reports and allow plant personnel to enter data onto a state report. These reports archive to removable media for storage.

I. The PLC at the WTP is an Allen-Bradley PLC that passes signals through to the SCADA system. Modifications to the PLC program shall be provided. The PLC software package to be modified is RSLogix 500.

2.03 ACCESSORIES

A. The System Supplier shall provide the following in addition to items indicated above:

1. Antenna
2. Antenna cable and connectors
3. System Start-up and commissioning
4. RTU wire terminations
5. FCC license modification without additional cost to Owner.
6. Physical path study to confirm antenna pole height

PART 3 – EXECUTION

3.01 TRAINING

A. The manufacturer’s technical representative shall provide four hours of training for the Owner’s employees. The training shall include operation and maintenance of the **SCADA** system.

3.02 DATA AND DRAWINGS

A. A complete set of "as-built" wiring, fabrication, and interconnection drawings shall be included with the manuals. Final information shall include as-built SCADA and PLC software in hard and digital form.

END OF SECTION