

Prepared by:

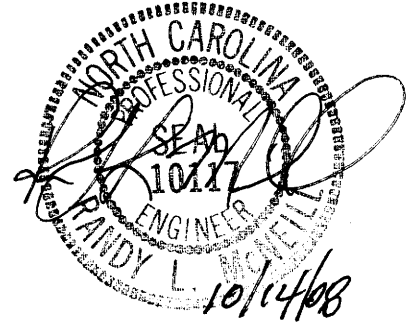
**DAVIS-MARTIN-POWELL & ASSOCIATES, INC.**  
ENGINEERING - LAND PLANNING - SURVEYING  
6415 Old Plank Road  
High Point, NC 27265  
Phone: (336) 886-4821 Fax: (336) 886-4458

69

Project: R-2201  
County: Forsyth/Stokes

October 10, 2008

PROJECT SPECIAL PROVISIONS  
Utility Construction



I. GENERAL CONSTRUCTION REQUIREMENTS

Specifications:

The proposed utility construction shall meet the applicable requirements of the North Carolina Department of Transportation's "Standard Specifications for Roads and Structures" dated July 2006, and the following provisions.

Owner and Owner's Requirements:

The existing water and sewer facilities belong to the City of King. The Contractor shall provide access for the owner's representatives during all phases of construction. The owners shall be notified two weeks prior to commencement of any work and one week prior to service interruption.

For work involving the City of King's facilities, the Contractor shall contact the City of King's Public Utilities Department at (336) 983-4832.

It shall be the Contractor's responsibility to notify customers affected by necessary shut downs of the existing water or sewer system at least 24 hours in advance.

Existing water meters, fire hydrants, and related appurtenances which are removed from service shall become property of the Contractor, and the Contractor shall properly dispose of these items.

Test results shall be provided to the City of King for any tests involving their water and sewer facilities.

The Engineer and owners shall be notified in advance of any interruption of water service with ample time to make arrangements. Interruption of water service on main lines shall be limited to a maximum of four (4) hours or as approved by the Engineer.

II. COMPENSATION:

No direct payment will be made for utility construction work required by the preceding provisions, which are general requirements applying to utility construction, and all of the requirements stated will be considered incidental work, paid for at the contract unit prices of the various utility items included in the contract.

## 1. ABANDON EXISTING SEWER PUMP STATION

The existing sewer pump station in the construction area that will be abandoned shall have all equipment and interior piping inside concrete structures removed and properly disposed of, connecting sewer pipe plugged, the top of the any concrete structures (wetwell, valve vault, manholes) removed to an elevation of 2 feet below subgrade or below the spring line, and the abandoned structures filled with properly tamped select earth material.

The quantity of abandoned sewer pump stations broken down, filled in and accepted will be measured and paid for at the contract unit price per each for "Abandon Existing Sewer Pump Station". Such prices and payments will be full compensation for removal and disposal of equipment and interior piping, all materials, plugging pipe openings, breaking down concrete structures, excavation, backfilling, and incidentals necessary to complete the work as required.

## 2. SANITARY SEWER PUMP STATION

Sanitary Sewer Pump Station, installed in accordance with the plans and provisions herein and accepted, will be measured and paid for at the contract unit price per lump sum for "SANITARY SEWER PUMP STATION". Such price and payment shall be full compensation for all labor, materials, excavation, backfilling, equipment, piping, valves, concrete structures, pumps, generator, controls, mechanical work, electrical work, fencing, and incidentals necessary to complete the work as required, and to provide a complete operational sanitary sewer pump station.

Detailed specifications for the sanitary sewer pump station are outlined on the following pages.

## SECTION 11318 SUBMERSIBLE GRINDER PUMP

---

### PART 1 - GENERAL

#### 1.01 DESCRIPTION:

- A. Work under this section consists of furnishing and installing a pumps and equipment for a wastewater lift station, including accessories as specified herein and as shown on the plans.

#### 1.02 MANUFACTURER'S RESPONSIBILITIES:

- A. The pumps, motors, and controls shall be given an operational test in accordance with the standards of the Hydraulic Institute. Recordings of the test shall substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as herein specified.
- B. The manufacturer of the pump station shall provide the following submittals:
  - 1. Equipment submittals clearly marked to indicate what equipment and options are provided.
  - 2. Written instructions for installation of the pumps, controls and appurtenances.
  - 3. Operation and maintenance instructions specific to the equipment supplied. Instruction manuals applicable to different configurations and models, which require the operator to selectively read portions of the instructions, shall not be acceptable.
- C. Upon request from the Engineer, the pump station manufacturer shall provide proof or evidence of facilities, equipment, and skills required to produce the equipment specified herein.

#### 1.03 MANUFACTURER'S WARRANTY:

- A. The manufacturer of the pump shall warrant it to be of quality construction, free from defects in material and workmanship. This warranty shall include specific details described below.
- B. The equipment, apparatus, and parts furnished shall be warranted for a period of one (1) year, excepting those items that are normally consumed in service, such as light bulbs, oil grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for the warranty of all components.
- C. Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the Owner.
- D. It is not intended that the manufacturer assume liability for consequential damages or contingent liabilities arising out of the failure of any product or parts thereof to operate properly, however, caused by or resulting from or arising out of defects in design or manufacture, delays in delivery, replacement, or otherwise.
- E. The warranty shall become effective upon start-up and acceptance by the Owner.

**PART 2 - PRODUCTS**

**2.01 GENERAL:**

- A. The pumping equipment, as specified and shown on the accompanying plans, shall be furnished and installed by the General Contractor. Control equipment for pumping units shall conform to the requirements of the accompanying plans and other sections of these Specifications.
- B. The Contractor shall furnish all labor, materials, equipment, and incidentals required to provide submersible centrifugal sewage grinder pumps as specified herein. Pumps shall be as manufactured by ABS or approved equal.
- C. Each pump shall be rated for the conditions shown below. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.15. The performance curve submitted for approval shall state in addition to head and capacity performance, the pump efficiency, solid handling capacity, and reflect motor service factor.
  - 1. Capacity: 55 GPM at 88 feet TDH
  - 2. Maximum rotating speed: 3600 RPM
  - 3. Maximum horsepower: 5 HP

**2.02 SUBMERSIBLE PUMP:**

- A. Each wastewater pump shall be of the submersible, centrifugal grinder type. The pump volute, motor, and seal housing shall be high quality gray cast iron, ASTM A-48, Class 30. The pump discharge shall be NPT. All external mating parts shall be machined and Buna N rubber O-ring sealed on a beveled edge, gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 300 series stainless steel.
- B. Electrical power and control cord(s) shall be STW-A, water resistant 600V, 60°C, UL and CSA approved and applied dependent on amp draw for size.
  - 1. The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire at staggered intervals, and each strand shall be individually separated. This area of the cord cap shall then be filled with an epoxy compound potting which will prevent water from gaining entry even in case of wicking or capillary attraction.
  - 2. The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire to wire connection.
  - 3. The cord cap assembly where bolted to the connection box assembly and the connection box assembly where bolted to the motor housing shall each be sealed with a Buna N Rubber O-ring on a beveled edge to assure proper sealing.
  - 4. Power cord shall be of sufficient length to reach control panel or junction box, as shown on the plans.
- C. The motor shall be a dielectric oil-filled submersible motor, NEMA B design. The stator, rotor, and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation. Motor shall be 460 volt, 3 phase, 60 Hz.
  - 1. The pump and motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped. The pump shall not require cooling water jackets.

2. Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field without the use of heat or a press. Stators must be capable of being repaired or rewound by local motor service station. Units that require service only by the factory shall not be acceptable. No special tools shall be required for pump and motor disassembly.
  3. Motor shall be equipped with moisture and heat sensors. Moisture sensor shall be a mechanically activated moisture sensing micro-switch. The heat sensor shall be a low resistance; bi-metal disc that is temperature sensitive. It shall be mounted directly on the stator windings and sized to open at 120°C and automatically reset at 30-35°C differential. The sensors shall be connected in series with motor starter coil so that the starter shall be equipped with 3 leg overload heaters so all normal overloads are protected by the starter.
- D. An upper radial bearing and a lower thrust bearing shall be required. These bearings shall be heavy-duty, single-row ball bearings that are permanently lubricated by the dielectric oil that fills the motor housing.
  - E. The pump shaft shall be machined from solid 416 stainless steel stock and designed with a large diameter and minimum overhang to reduce deflection and prolong bearing life.
  - F. The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. The lower seal shall have tungsten or silicon carbide faces, and the upper seal shall have carbon, ceramic, or stainless steel faces. The lower seal shall be replaceable without disassembly of the seal chamber and without the use of special tools. Units which require the use of foreign manufactured seals shall not be acceptable. Seals shall be locally available.
  - G. The pump unit shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency. There shall be an electric probe or seal failure sensor installed in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants that enter the seal chamber shall be detected by the sensor and indicated in the control panel.
  - H. The impeller shall be multi-vane, semi-open, non-overloading design. It may be either factory or field trimmed to meet specific performance conditions. Impellers shall be hydraulically and statically balanced at the factory, and machined for threading on to the pump shaft. Wear or field trimming shall not deter the factory balance. Pump-out vanes shall be present on the back of the impeller to keep contaminants out of the seal area.
  - I. The combination centrifugal pump impeller and grinder unit shall be attached to the common motor and pump shaft. The grinder unit shall be on the suction side of the pump impeller and discharge directly into the impeller inlet leaving no exposed shaft to permit packing of ground solids.
    1. The grinder shall consist of two stages. The cutting action of the second stage shall be perpendicular to the plane of the first cut for better control of the particle size. The grinder shall be capable of grinding all materials found in normal domestic sewage, including plastics, rubber, sanitary napkins, disposable diapers, and wooden articles into a finely ground slurry with particle dimensions no greater than ¼ inch. Both stationary and rotating cutters shall be made of 440C stainless steel hardened to Rockwell 60C and ground to close tolerance.
    2. The upper (axial) cutter and stationary cutter ring shall be reversible to provide new cutting edges to double life. The stationary cutter ring shall be a slip fit into the suction opening of the volute and held in place by three (3) 300 series stainless steel screws and a retaining

ring. The lower (radial) cutter shall macerate the solids against the I.D. of the cutter ring and extrude them through the slots of the cutter ring. The upper (axial) cutter shall cut off the extrusions, as they emerge from the slots of the cutter ring to eliminate any roping effect that may occur in single stage cutting action. The upper (axial) cutter shall fit over the hub of the impeller and the lower (radial) cutter shall be slip fit and secured by means of peg and hole and rotate simultaneously with the rotation of the shaft and impeller.

3. The grinding mechanism shall be locked to the shaft by a 300 series stainless steel countersunk washer in conjunction with a 300 series stainless steel flat head cap screw threaded into the end of the shaft.
- J. The pump shall be painted after assembly, but before testing, with the manufacturer's standard lead free enamel or high solids epoxy. The paint shall be applied in one coat with minimum mil thickness of 3.0 mils. The paint shall be air dried prior to testing.

### **2.03 GUIDE RAIL MOUNTING SYSTEM:**

- A. The guide rail system shall include base elbow, sealing flange with rail guide, upper guide bracket, lifting chain or cable, float mounting bracket and stainless steel guide rails.
- B. A sealing flange/rail guide bracket shall be mounted on each pump discharge. It shall have a machined mating flange that matches the base elbow discharge connection. Sealing of this discharge connection shall be accomplished by a simple linear downward motion of the pump culminating with the entire weight of the pumping unit supported entirely by the base elbow.
- C. The upper guide bracket shall align and support the two guide rails at the top of the sump. It shall bolt directly to the hatch frame and incorporate an expandable rubber grommet for secure rail installation.
- D. Each pumping unit shall be provided with a stainless steel lifting chain or cable of sufficient length to extend from the pump to the top of the wet-well. The access frame shall provide a hook to attach the chain or cable when not in use. The lifting chain or cable shall be sized according to the pump weight.
- E. The dual rail guide design keeps the pump in proper alignment with the stationary discharge piping. These rails shall be galvanized steel pipes that bolt directly to the base elbow and to the access frame at the top of the wet-well by an upper guide rail bracket.

### **2.04 WIRING CHANNEL:**

- A. A wiring channel shall be provided in the wet well for pump circuit and level control wiring. Wiring channel shall provide cord grip holders for the pump cords and the control cords. The channel box shall have a removable cover for easy adjustment of cords to pumping levels required. All cords shall extend from one end of the box and through conduit in sump cover to a junction box located outside the wet well. No splices shall be made in the wiring channel or conduit. Continuous cords must be used from control panel or junction box to pumps and controls. Wiring channel shall mount on supports fastened to access frame.

### **2.05 CONTROL PANEL:**

- A. The pump station shall be equipped with a control panel supplied by the pump manufacturer. The control panel shall be mounted within a NEMA 4X, dead front type control enclosure. The enclosure door shall be hinged and sealed with a neoprene gasket. It shall include a removable steel back panel on which control components shall be mounted. Back panel shall

be secured to enclosure with collar studs. Operator controls shall be mounted on a steel inner swing panel. All conduits between the sump area and control panel shall be sealed to prevent gasses from entering the enclosure.

- B. A properly sized thermal magnetic circuit breaker shall be furnished for each pump motor. They shall be sealed by the manufacturer after calibration to prevent tampering. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the outer door, with interlocks that permit the inner door to be opened only when circuit breakers are in the "off" position.
- C. An open frame, across the line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmospheres. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and over-voltage protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.
- D. Overload relays shall be of block-type; utilizing melting alloy type spindles, and shall have visual trip indication with trip free operation. Pressing the overload reset lever shall not actuate the control contact until the overload spindle has reset. Resetting of the overload shall cause a snap-action control contact to reset, thus re-establishing a control circuit. Overloads shall provide NEMA Class 10 trip times and shall be selected in accordance with the actual motor nameplate data. An overload reset pushbutton shall be mounted through the door of the control panel in such a manner as to permit resetting the overloads without opening the control panel door.
- E. The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or the presence of moisture in the motor housing. If either event should occur, the motor starter will drop out and an indicator, visible on the inner door, shall indicate the pump motor has been shut down. The pump motor shall remain locked out until the condition has been corrected and the circuit manually reset. Automatic reset shall not be acceptable.
- F. The control circuit shall be protected by a thermal-magnetic circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.
  - 1. H-O-A switches shall be provided to select manual start, manual stop, and automatic operation for each individual pump. Manual operation shall override all shutdown systems, but not the motor overload relays. Automatic operation shall be controlled by the level control system. Selector switches shall be toggle type meeting Military Standards (MS) quality. Switch contacts shall be rated 15 amperes minimum at 120 volts non-inductive.
  - 2. Pump alternator relay shall be of electromechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive. A switch shall be provided to permit the station operator to select automatic alteration of the pumps or to select either pump to be the lead pump for each pumping cycle.
  - 3. Control panel shall be equipped with one pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running. A separate pilot light shall be provided for each pump to indicate lower seal failure.

4. Six digit elapsed time indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".
- G. One 115-volt AC alarm light in a vapor-tight fixture with red globe, guard, conduit box, and mounting fixtures shall be provided. Alarm light and mounting fixtures shall be designed to permit mounting in such a manner that rainwater cannot stand or collect in the gasketed area of the fixture, between the base and globe.
- H. One 115-volt AC weatherproof alarm horn with protector, conduit box, and mounting fixtures shall be provided. Alarm horn and mounting fixtures shall be designed to permit mounting in such a manner that rainwater cannot stand or collect in the projector.
- I. Provide common alarm horn silencing switch with automatic reset.

## 2.06 LEVEL CONTROL SYSTEM:

- A. Sealed float type mercury switches shall be supplied to monitor sump level. The mercury tube switches shall be sealed in a solid polyurethane float for corrosion and shock resistance. The support wire shall have heavy Neoprene jacket and a weight shall be attached to the cord to hold switch in place in sump. The weight shall be above the float to prevent sharp bends in the cord when the float operates under water. The float switches shall hang in the sump supported only by the cord that is held to the wiring channel. All float switches shall be adjustable without personnel entering the wetwell.
- B. The following floats shall be provided:
  1. Low Water Alarm
  2. Pump Off (both)
  3. Lead Pump On
  4. Lag Pump On
  5. High Water Alarm

## 2.07 SYSTEM OPERATION:

- A. The pump control system shall include all relays and components to operate the pumps in accordance with the following functional description.
  1. On sump level rise, the "Lead Pump Start" switch shall energize and start lead pump. The lead pump shall operate until sump level drops to the "Pump Off" level and then stop.
  2. If sump level continues to rise while the lead pump is operating, the "Lag Pump Start" switch shall energize and start lag pump. Both lead and lag pumps shall operate together until the sump level drops to the "Pump Off" level and both pumps are stopped.
  3. If the pump(s) fail to deactivate and the sump level continues to drop below the "Pump Off" level, the "Low Water Alarm" switch shall energize and signal an alarm condition.
  4. If sump level continues to rise when both pumps are operating, the "High Water Alarm" switch shall energize and signal an alarm condition.
  5. When in automatic alternating mode, alternator shall switch lead and lag pumps at the end of each pumping cycle. Alternation shall occur on pump failure.
  6. Operation of the Lead and Lag pumps shall be independent.
  7. System operation shall be limited to one pump when powered from a standby generator. The system shall accept a 120VAC signal to indicate power is being supplied from the standby generator.



## 2.08 ACCESS HATCH:



- A. An access frame assembly shall be supplied as shown on the plans. The frame assembly and access door shall be aluminum with 300 series stainless steel hinges and hardware. The aluminum door shall be raised tread plate to provide a skid-proof surface. The doors shall open to 90 degrees and lock automatically in that position. Doors shall have a minimum live load capacity of 300 lbs. per square foot. A lockable, recessed handle shall be provided with each door, as well as a safety latch to hold the door in an open position.
- B. Hatches shall be as manufactured by Bilco, Halliday, TFCO, or equal.

## 2.09 AUTO-DIALING ALARM MONITOR:

- A. Furnish one (1) automatic dialing alarm monitor. The monitor shall be a microprocessor based system that shall sense four alarm conditions at the site. Power failure shall be sensed internally without using one of the fault channels.
- B. Upon detection of any of the fault conditions or power failure, the unit shall commence dialing the first of eight (8) user selected telephone numbers and deliver a message describing the alarm condition. This message (identifying the site and describing the alarm(s)) shall be delivered in an electronic synthesized voice, using vocabulary selected by the user from a list of no less than 230 words permanently stored in the unit. The unit will continue to call the phone numbers in succession until acknowledged by calling the unit back or by depressing a touch tone key. Once acknowledged, the unit shall enter a programmable inter-call delay to allow the alarm condition to be attended to before beginning notification again.
- C. Upon receipt of a call, the system shall report the station status to the caller. All communications shall utilize standard telephone lines; no leased or dedicated lines shall be required.
- D. The system shall be a Model CB-4 Chatterbox as manufactured by Raco Manufacturing and Engineering Company, Emeryville Corp, or approved equal.
- E. The alarm monitor unit shall possess the following physical and functional characteristics:
  - 1. NEMA 4X enclosure with gasketed cover and lockable stainless steel clasps.
  - 2. Built-in maintenance free 6 hour battery backup.
  - 3. Sealed mylar keyboard.
  - 4. Modular construction with plug-in circuit boards.
  - 5. Terminal connections for fault leads for up to 12 AWG wire.
  - 6. Optically isolated fault input protection.
  - 7. Tone or loop-disconnect dialing capability.
- F. Indications of the following conditions shall be visible even when the cover is closed:
  - 1. All Fault Channels
  - 2. Power On
  - 3. Call in Progress
  - 4. Battery Condition
  - 5. Inter-call Delay in Progress
  - 6. Successful Acknowledgement
- G. The unit shall utilize non-volatile ROM circuitry such that the unit's operating system, vocabulary selections, programmed phone numbers, and all other functions and values stored in memory

shall be retained without any power requirement. Memory retention schemes using batteries in any form are not acceptable.

- H. Additionally, each unit shall include the following standard features:
1. Individually selectable fault delay, per channel, from the keyboard.
  2. Individually selectable open and closed contacts for alarm sensing from the keyboard.
  3. Green light/no alarm and red light/alarm function.
  4. Individually programmable alarm or status only, per channel, from the keyboard.
  5. UL listed power source.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. All equipment shall be installed in strict compliance with the requirements of the manufacturer. All requirements of the respective approved shop drawings shall be met.

### **3.02 INITIAL START-UP AND FIELD TEST:**

- A. The services of a factory-trained representative shall be provided for a minimum of one day to verify proper installation, place pumps in initial operation, and witness the field test as herein specified. The representative shall instruct the owners in the operation and maintenance of the equipment.
- B. The authorized representatives of the pump manufacturer shall perform the initial start-up. The Contractor will coordinate date for the initial start-up and field test. Upon completion of the initial start-up, the field test will commence. Contractor shall have an electrician available at the job site during start-up and field test.
- C. Field testing shall include the following:
1. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase, and hertz.
  2. The motor seal and housing chambers shall be meggered for infinity to test for moisture content or insulation defects.
  3. Pump shall be allowed to run dry to check for proper rotation.
  4. Discharge piping shall be attached, the pump submerged in water, and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
  5. The pump shall be removed from the water, meggered again, and dried.
- D. Prior to acceptance of the submersible pumping equipment by the Owner, a field performance test shall be conducted by factory trained representative of the pump manufacturer, in the presence of the Contractor, Engineer and the Owner, or their respective representatives.
- E. Each pump shall be tested to assure proper sealing between the submersible pump and discharge piping. This test shall be conducted as follows:
1. Fill/Lower wet well with clean water to centerline of pump volute.
  2. Close pump station discharge valves.
  3. Energize pump and operate for a period of not less than one minute and not more than two minutes.

- F. The pump(s) shall be testing with clean water (provided by the Contractor) to verify that the pumps are capable of meeting the operating conditions specified herein. This testing shall be conducted with a full forcemain and all air valves in operation. Each pumping unit will be testing for at least two pumping cycles.
- G. Pumps showing leakage or failure to meet the operating conditions will be rejected. The Contractor shall have seven (7) days to correct any deficiencies prior to a retest. Should equipment fail to perform as specified during the retest, the Engineer shall direct the equipment be removed from the job site and equipment that will perform as specified shall be provided, at no cost to the Owner. The decision of the Engineer to remove equipment failing to perform as specified shall be final.
- H. The Contractor shall supply the Engineer with copies of startup reports and test results.

**3.03 INITIAL OPERATION:**

- A. After all equipment has been completed to the satisfaction of the Engineer and all equipment has been inspected and certified to be operational by the equipment manufacturer, the Contractor shall place the completed system in operation. This procedure shall be accomplished in the presence of the Engineer, operating personnel employed by the Owner and, where required or necessary, representatives of the major equipment manufacturers. This period shall be used as the specified instruction period for operating personnel in the proper operation and maintenance of the respective equipment.

**3.04 FINAL CLEAN-UP:**

- A. Upon completion of the entire project, or any portion thereof, the Contractor shall perform all clean-up operations necessary to place the project in first class condition. This shall include, but not be limited to, cleaning of all vaults, slabs, equipment and grounds, removing and disposing of all excess materials, trash debris, etc.
- B. It shall be the Contractor's responsibility to maintain the project in first class condition until final acceptance by the Owner. The Owner shall then assume operation and maintenance of the facility.

**3.05 OPERATION AND MAINTENANCE MANUALS:**

- A. The Contractor shall furnish the Engineer with operation and maintenance instructions and complete parts list for all equipment installed under this Contract, as specified in Division 1.

**END OF SECTION**

80  
**SECTION 16000**  
**ELECTRICAL**

---

**PART 1 - GENERAL**

**1.01 SCOPE:**

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.

The 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:**

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.

All electrical equipment shall be UL listed.

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:**

The Contractor shall coordinate any required power service modifications with the local power utility and provide equipment in full conformance with their requirements.

The Contractor shall obtain all permits and inspections required for the completion of this contract.

**1.04 WORKMANSHIP:**

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 Contractor.

**1.05 DRAWINGS AND SPECIFICATIONS:**

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 Contractor 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 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.

The 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.

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.

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.

The drawings are not intended to show complete details. It is the Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. The 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:**

Any cutting of walls or structures required for the installation of work under this section shall be done by the 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:**

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:**

This 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:**

All openings as required for the electrical work shall be provided by the Contractor. The 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 Contractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other contractors have finished as the Engineer may direct. All excavating required for the installation of the system shall be done by the Contractor. Backfill shall be accomplished as specified in the appropriate section of the specifications.

**1.10 CLEANING AND PAINTING:**

The Contractor shall at all times keep the Owner's premises, adjoining driveways and streets clean of rubbish caused by the Contractor'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.

The 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 Contractor.

**1.11 GUARANTEE:**

The Contractor 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 Contractor 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:**

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.

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:**

The Contractor 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.

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

**1.14 SHOP DRAWINGS:**

Upon award of the contract, the Contractor 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 Contractor 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 Contractor of the responsibility for coordination, dimensions, quantities or conformance with contract documents.

The Contractor 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:**

The Contractor 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:**

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 Contractor.

Substitution for equipment specified must be equal in every respect and the Contractor shall base his proposal on the quality of materials and equipment covered in these specifications and shown on the drawings.

Where substitutions alter the design or space requirements indicated on the plans, the Contractor shall include all items of cost for the revised design and construction, including the cost of any changes or modifications in structural or mechanical details and electric service resulting from substitution of electrical equipment, and the cost of all allied trades involved.

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:**

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.

**A. CONDUIT TYPES:**

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.

Intermediate Metal Conduit (IMC). IMC shall be hot-dip galvanized and shall conform to Fed Spec WW-C-581 and UL 1242.

Liquid tight Flexible Metal Conduit. Liquid tight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moistureproof polyvinyl chloride jacket, and shall be UL labeled.

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.

B. CONDUIT INSTALLATION:

Intermediate metal conduit shall be installed in exposed applications in the Control/Generator Building and Pumping Station.

Rigid steel conduit shall be installed in masonry walls, concrete slabs, and cast-in-place walls.

Intermediate and rigid steel conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts. Terminations and connections shall be taper threaded. Conduits shall be reamed, free of burrs, and terminated with conduit bushings.

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.

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.

All direct buried underground conduit shall be rigid steel conduit coated with thixotropic coal tar paint or PVC coated rigid steel conduit.

Underground conduits shall be concrete encased under roadways and where indicated on the drawings.

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.

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.

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.

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.

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.

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:

The 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:

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:

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:

The Engineer reserves the right to inspect any and all joints in wiring. If the joint is already taped, the 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:

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 **DISCONNECT SWITCHES:**

Unless otherwise specified, each disconnect switch shall be 3 phase, nonfusible, heavy-duty, 600 volts, with a continuous current rating as indicated on the drawings.

Switches located indoors shall have a NEMA type enclosure indicated on the drawings.

Switches shall have high conductivity, copper, visible blades; nontearable, positive, quick-make, quick-break mechanisms; and switch assembly plus operating handle as an integral part of the enclosure base. Each switch shall have a handle whose position is easily recognizable and capable of being padlocked in the "Off" position with three padlocks. The "On" and "Off" positions shall be clearly marked.

All switches shall be UL listed, horsepower rated, and meet NEMA Specification KS1-1990. Switches shall have defeatable door interlocks that prevent the door from being opened while the operating handle is in the "On" position.

All switches shall have front cover-mounted nameplates that contain a permanent record on switch type, manufacturer and catalog number, and horsepower rating. An additional nameplate shall be provided to identify the related equipment. The additional nameplate shall be engraved or etched, laminated black-over-white plastic, with 1/8 inch letters. Both nameplates shall be securely fastened to the enclosure.

#### 2.05 **SUPPORTING DEVICES:**

##### A. **GENERAL:**

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:**

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.

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:**

All outlets for receptacles or switches shall be installed in the location shown on the drawings. The Contractor 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 Contractor 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.

Unless otherwise indicated on the drawings, the top of outlet boxes shall be placed at the following distances from finished floors:

Power Panelboards - top of cabinet 6'-6" above floor. Safety switches and/or circuit breakers - handle not over 6'-6" above floor.

The Electrical 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 Contractor's and the Engineer should be contacted for clarification before installation.

**D. STRUCTURAL STEEL:**

The 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 Contractor as approved by the Engineer.

**E. TAP AND PULL BOXES:**

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.

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:**

The Contractor shall furnish and install all conduit, junction boxes, outlet boxes, and plates for conduit systems as indicated on the drawings.

**2.06 GROUNDING:**

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.

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.

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.

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

**2.07 MINI POWER CENTER (MPC):**

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 14,000 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.

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 rated as indicated on the drawings.

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

MPC shall be provided with 20KA surge protection per phase: Intermatic model IG1240RC or equal.

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

· **END OF SECTION** ·

## SECTION 16300

### ENGINE-GENERATOR SYSTEMS

---

#### PART 1 – GENERAL

##### 1.01 SCOPE:

- A. This section covers the furnishing and installation of an engine-generator system as indicated on the drawings and as specified herein.
- B. The engine-generator system shall include engine, generator, controls, enclosure, fuel tank, mounting, accessories, and automatic transfer switch as indicated on the drawings and specified herein.

##### 1.02 GENERAL:

- A. The engine-generator system shall be prototype tested, factory built, production tested, site tested, and be 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. The engine-generator system shall be UL2200 Listed.
- D. The system shall be factory assembled, wired and tested and set into operation by a single supplier.
- E. The engine-generator system shall be as manufacturer by Onan, Generac, Kohler, Detroit Diesel, Caterpillar, or equal.

##### 1.03 DESIGN CONDITIONS:

- A. The 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.
- B. System shall operate the following loads when sequenced in the following order:
  - 1. 7 KVA of miscellaneous lighting and heating loads.
  - 2. 5 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 0° F
  - 3. Elevation 1000 feet
  - 4. Wind Velocity 110 mph

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

Fuel Type	No. 2 Diesel
Fuel Quantity	24 hours at 100% of calculated load
Radiator Type	Unit-Mounted
Voltage	480V, 3 Phase, 60 Hz
Power Rating (Min)	20 kW
Voltage Drop (Max)	25%
Power Factor	0.8 lagging
Engine Speed	1800 rpm

**1.04 SUBMITTAL:**

- A. Submittals shall be provided to Engineer for review. Submittal shall include dimensioned drawings, specification sheets showing all standard and optional accessories to be supplied, schematic wiring drawings, and interconnection diagrams identifying connection between the engine-generator set and the automatic transfer switch.
- B. Submittal shall include layout, fuel system details, operating instructions, engine control panel layout and load calculations for starting and voltage dip.

**PART 2 – PRODUCT**

**2.01 ENGINE:**

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

Number of Cylinders	3 or 4
Cylinder Arrangement	Vee or In-Line
Displacement (min)	2.45 Liter (150 in <sup>3</sup> )
Intake Air	Turbocharged or Naturally Aspirated
Cycle	4
Rated Speed	1800 rpm
Power (min)	25 hp
Cooling	Unit-Mounted Radiator

- B. 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  $\pm 2\%$  at any constant load from 0 to 100% of rating.
- C. The instantaneous voltage dip shall not exceed 25% and recover to  $\pm 2\%$  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:
    - a. Overcrank
    - b. Low water temperature
    - c. High engine temperature pre-alarm
    - d. High engine temperature
    - e. Low lubricating oil pressure pre-alarm
    - f. Low lubricating oil pressure
    - g. Overspeed
    - h. Low fuel level (main tank)
    - i. Low coolant level

- j. Control switch not in "AUTO" position
  - k. Emergency Stop
  - l. High battery voltage
  - m. Low battery voltage
  - n. Battery charger fault
  - o. 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:
    - a. Overcrank
    - b. Overspeed
    - c. Low lubricating oil pressure
    - d. High engine temperature
    - e. 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 overcrank 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 weather protective enclosure. 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 85dBa or less at five 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 load specified in paragraph 1.03.



**2.06 MOUNTING:**

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 batter charger with the following features:
  - 1. 10 ampere, dual rate, automatic float & equalize operation
  - 2. Constant voltage regulation of  $\pm 1\%$  from no load to full load over  $\pm 10\%$  AC input line variation
  - 3. Temperature compensated for ambient from -10 to 104 degrees Fahrenheit
  - 4. Current limited to protect the charger during engine cranking and short circuit conditions
  - 5. Reverse polarity and transient voltage protected
  - 6. Voltmeter
  - 7. Ammeter
  - 8. Low battery voltage alarm contact
  - 9. High battery voltage alarm contact
  - 10. Charger malfunction alarm contact
  - 11. 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. A junction box shall be provided for connection of power by the contractor.
- 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 14,000 amperes at 250 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. 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.
1. Engine starting contacts.
  2. Switch position contacts and indicating lights.
  3. Source status contacts and indicating lights.
  4. Time delay normal to emergency, adjustable 1 second to 20 minutes.
  5. Time delay engine start adjustable 1 second to 20 minutes.
  6. Time delay emergency to normal, adjustable 1 second to 20 minutes.
  7. Time delay engine cool down, adjustable 10 seconds to 20 minutes.
  8. Undervoltage sensing, adjustable.
  9. Overvoltage sensing, adjustable.
  10. Phase reversal protection.
  11. Test-Auto-Engine Start-Off selector switch.
  12. Engine-generator exerciser.
  13. Dual output lugs for connection of loads indicated on the drawings.
  14. NEMA rated enclosure as indicated on the drawings.

## **2.09 SPARE PARTS:**

- A. The following spare parts shall be provided:
1. Two (2) air filters
  2. Four (4) oil filters
  3. One (1) set of gaskets for complete overhaul
  4. Twelve (12) lamps for indicating lights
  5. Two (2) fuses for each type
  6. One (1) matched set of V-belts
  7. One (1) set of non-commercial tools required for maintenance
- B. Spare parts shall be suitable packaged, labeled, and delivered to the Owner.

## **2.10 MANUALS:**

- A. Three sets of manuals shall be provided. Each set shall include installation, operation, maintenance, and parts manuals. Each set of manuals shall be bound and labeled. Manuals shall be delivered to the Owner upon delivery of the engine-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.
  5. Testing as recommended by manufacturer.

**3.02 TRAINING:**

The manufacturer's technical representative shall provide four (4) hours of training for the Owner's employees. The training shall include operation and maintenance of the engine-generator system.

**3.03 SERVICE:**

The system supplier shall make an annual service contract available to the Owner.

**END OF SECTION**

PROJECT SPECIAL PROVISIONS

## Utility

UTILITIES BY OTHERS

## General:

The following utility companies have facilities that will be in conflict with the construction of this project.

- A) Duke Energy – Power (Distribution)
- B) Windstream Communications - Telephone
- C) Piedmont Natural Gas
- D) Time Warner Cable - CATV

The conflicting facilities of these concerns will be adjusted prior to the date of availability, unless otherwise noted and are therefore listed in these special provisions for the benefit of the Contractor. All utility work listed herein will be done by the utility owner. All utilities are shown on the plans from the best available information.

The Contractor's attention is directed to Article 105-8 of the Standard Specifications.

## Utilities Requiring Adjustment:

## A) Duke Energy - Power (Distribution)

- 1) See Utilities by Others Plans.
- 2) Duke Energy will be complete with all relocations of their power distribution facilities by May 1, 2009.

## B) Windstream Communications - Telephone

- 1) See Utilities by Others Plans.
- 2) All aerial telephone lines will be in joint use with Duke Energy. The contractor shall allow Windstream Communications three months after Duke Energy has completed their power line relocations to install their proposed aerial telephone lines.

## C) Piedmont Natural Gas

- 1) See Utilities by Others Plans.
- 2) All gas lines throughout project will remain in place to be adjusted as necessary.

D) Time Warner Cable - CATV

- 1) See Utilities by Others Plans.
- 2) All aerial CATV lines will be in joint use with Duke Energy. The contractor shall allow Time Warner Cable two months after Duke Energy has completed their power line relocations to install their proposed aerial CATV lines

NOTE: All other utilities will remain in place and will be adjusted as necessary.