WAUFORD
J. R. Wauford & Company, Consulting Engineers, Inc.

ADDENDUM NO. 1
SEWER SYSTEM IMPROVEMENTS
CONTRACT 18-02
SEWAGE PUMPING STATION REPLACEMENTS
SHELBYVILLE POWER, WATER & SEWERAGE SYSTEM
SHELBYVILLE, TENNESSEE
WAUFORD PROJECT NO. 2085

Date of Addendum: Tuesday, May 22, 2018
Bid Opening: Thursday, May 24, 2018, 2:00 P.M. Central Time

1. Detailed Specifications, Sub-Section 5A, Shoffner-Bomar Sewage Pumping Station and Appurtenances:

   Replace this Sub-Section with the attached Sub-Section 5A*.

2. Detailed Specifications, Sub-Section 5B, U.S. Pencil Sewage Pumping Station and Appurtenances, Paragraph 3. Pump Performance Requirements, Page DS 5B-2:

   Modify the fifth bullet point as follows:

   "• Maximum Allowable Horsepower : ***20*** HP"

J. R. WAUFORD & COMPANY,
CONSULTING ENGINEERS, INC.

J. Gregory Davenport, P.E.
Tennessee License No. 104881

SUB-SECTION 5A

SHOFFNER-BOMAR SEWAGE PUMPING STATION AND APPURTENANCES

1. Scope

The work under this Sub-Section of these Detailed Specifications consists of furnishing all labor, equipment and materials necessary to construct a new suction lift Shoffner-Bomar Sewage Pumping Station together with all appurtenances as shown on the Plans or specified.

Electrical work associated with equipment described at this Sub-section, including all connecting signal and power wiring, is depicted at the accompanying Drawings and should be reviewed and taken into account by the Vendor of equipment described at this Sub-Section.

THE VENDOR OF EQUIPMENT DESCRIBED AT THIS SUB-SECTION IS DIRECTED TO READ ALL OF SECTION 5 – MECHANICAL AND CONTROL EQUIPMENT – GENERAL BEFORE PROCEEDING WITH READING THIS SUB-SECTION.

2. Pumps, Pumping Station Construction and Controls

a. General

The new Shoffner-Bomar Sewage Pumping Station shall be equipped with complete dual pumping units including two (2) pumps, each having the design capacity as set forth in this section.

The 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.

Each single pump unit shall have a fiberglass reinforced plastic enclosure cover which shall house the pumps, valves, ventilating fan, control system and electrical panel(s).

b. Fiberglass Reinforced Plastic Enclosures and Ventilation

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.

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. See manufacturer's requirements for enclosure warranty in these specifications.

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

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.

The pump station shall be furnished with 1 1/2-inch thick foam insulation which shall be applied to the walls, door, and roof to achieve an R-10 insulation factor. A gasketed seal around the door shall also be included.

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.

The enclosure cover shall be provided with hinged fiberglass reinforced access doors. Minimum dimensions of the door shall be 72 inches wide by 80 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.

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.

Four 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.

The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with minimum of 30 percent fiberglass and a maximum of 70 percent resin. Glass fibers shall have a minimum average length of 1 1/4 inches. The enclosure shall be resistant to corrosion, impervious to mold, mildew, fungus and sewer gases and shall be raintight. The enclosure shall have a K-factor of 1.5 so that the heating and ventilating provided will protect the equipment and allow it to operate between temperatures of minus 25ºF and plus 105ºF. The temperature in this area often remains in the plus 20ºF to minus 15ºF range for several days.

A shuttered exhaust fan with a minimum capacity to change the air in the enclosure once every minute, shall be mounted in open end wall. In the wall approximately opposite to this shall be mounted an air intake. Both intake and exhaust openings shall be equipped with a bronze bird screen and cowl suitably designed to prevent the entrance of rain, snow, rocks, and foreign material. The fan circuit shall be fused and shall be provided with a disconnect switch. The fans shall operate on thermostats.

c. <u>General Pump Requirements</u>

Pump shall be horizontal, self-priming centrifugal type, designed specifically for handling raw unscreened domestic sanitary sewage or industrial waste.

The discharge port of the upper casing shall be capable of being rotated to allow for multiple pipe connection orientations.

The pumps shall be horizontal, belt driven, self-priming sewage pumps, specifically designed for pumping raw, unscreened, domestic sanitary

sewage. The pump shall retain sufficient liquid in its casing to accomplish unattended automatic re-priming.

Openings and passages of the pump shall be large enough to permit passage of a sphere 3 inches in diameter and similar grease, trash, or stringy material. Each pump shall be equipped with a removable inspection cover plate allowing complete access to pump interior to permit removal of stoppages and to provide simple access for service and repairs without disturbing suction or discharge piping.

d. Pump Materials and Construction

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

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

(2) Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a positive lock clamp bar assembly. In consideration for safety, capscrew threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A non-metallic gasket shall prevent adhesion of the fill port cover to the casing while assuring a reliable seal.

(3) Lower casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

(4) Liquid volume and recirculation port design shall be consistent with performance criteria listed hereinafter at Paragraph 2.e. Pump Characteristics and Requirements.

e. Coverplate Assembly

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

(1) A lightweight inspection cover plate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete cover plate assembly for access to the impeller will not be accepted.

(2) Retained by acorn nuts for complete access to pump interior. Back coverplate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back coverplate shall incorporate an obstruction free flow path by

combining four support posts into a two-point “webbed” plate design for increased durability, reduced clogging, and increased operational efficiency.

(3) Aggressive Self-Cleaning Wear Plate

- A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.

- The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.

- The aggressive self-cleaning wear plate shall have integral laser cut notches and grooves in combination with a “tooth” designed to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Wear plate is designed to constantly and effectively clear the eye of the impeller without the use of blades or cutters.

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

(5) One O-ring of Buna-N material shall seal inspection coverplate to back coverplate.

(6) Two O-rings of Buna-N material shall seal back coverplate to pump casing.

(7) Pusher bolt capability to assist in removal of inspection coverplate or back coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

(8) Easy-grip handle shall be mounted to face of inspection coverplate.

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

(1) Seal plates and bearing housings shall be cast iron Class 30. Anti-rotation ribs shall be cast into the seal plates to reduce internal wear and maximize component life. 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.

(a) Each 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.

(b) Each 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.

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

(2) Impellers shall be ductile iron, two vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impellers shall be statically or dynamically balanced. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

(3) Shafts shall be AISI 4140 alloy steel unless otherwise specified by the Engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

(4) 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.

(5) Each shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon 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 seal plate, 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. Seals shall be warranted in accordance with requirements listed under Paragraph 22. Guarantee of this section.

(6) Pusher bolt capability to assist in removal of rotating assemblies. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assemblies.

Adjustment of the impeller face clearances (distance between impeller and wear plate) shall be accomplished by external means.

(1) 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. Cover plates shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

(2) There shall be provisions for additional clearance adjustments in the event that adjustment tolerances have been depleted from the cover plate side of the pump. The removal of stainless steel tabbed spacers from the rotating assembly side of the pump shall allow for further adjustment as described above.

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

Removal or installation of the check valve must be accomplished through the cover plate opening without disturbing the suction piping or completely draining the casing. A blow-out center shall protect pump casings from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of the lower pump casing without disturbing the suction piping or completely draining both casings. 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.

Pump shall include flange kit consisting of two ASA spool flanges that shall be one piece cast iron class 30 suitable for attachment to suction and 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.

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. Pump Characteristics and Requirements

The Shoffner-Bomar Sewage Pumping Station shall be furnished with two (2) suction lift sewage pumps meeting the following criteria:

Maximum Speed Condition	
Maximum Allowable Speed	1,400 RPM
Minimum Shutoff Head	115 Feet
Design Capacity	1,400 GPM
Design Total Dynamic Head	92 Feet
Minimum Speed Condition	
Minimum Allowable Speed	700 RPM
Design Capacity	700 GPM
Design Total Dynamic Head	42 Feet
Other Requirements	
Maximum Motor Horsepower	75 HP
Minimum Solids Size Passing	3-inch Sphere
Minimum Efficiency – Max. Speed	58 percent
Minimum Efficiency – Min. Speed	50 percent
Maximum Net Positive Suction Head Required @ Max. Speed	15 Feet

A Gorman Rupp Model T8A-B-3 with a 14¾ Ø" impeller at 1,350 rpm appears to meet the above design requirements.

g. Variable Frequency Drives (Two Required)

The two variable frequency drive units shall be Allen-Bradley – PowerFlex 755. The drives shall be suitable for continuous operation of the inverter duty electric drive motors furnished with each submersible pump and shall infinitely vary output speed between the limits of maximum speed and minimum speed to produce the pump performance described at Paragraph 2.e. of this Section of these Detailed Specifications. Speed adjustments between the limits of maximum and minimum speed shall be controlled in response to the 4 to 20 milliamp signal proportional to the wastewater level in the wetwell to be transmitted by the control system. The drives shall come with a Human Interface Module (HIM) rated NEMA/UL Type 1 with an integral LCD display and operating and programming keys. The HIM shall have a backlit LCD display with graphics capability, and indicate drive operating conditions, adjustments, and fault indications.

h. Air Release Valves

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.

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.

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

Valves shall be field adjustable for varying discharge heads.

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

i. Pressure Gauges

Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerine-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Compound gauges shall be graduated -34 to 34 feet water column minimum. Discharge

pressure gauges shall be graduated 0 to 250 feet water column and shall be equipped with red lag hands.

Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each gauge line at the point of connection to suction and discharge pipes. All gauge piping to be SST.

j. Spare Parts Kit

There shall be furnished with the pump station the following minimum spare parts:

(1) One spare pump mechanical seal (complete with shaft sleeve)
(2) One cover plate O-Ring
(3) One rotating assembly O-Ring
(4) One set of rotating assembly spacers
(5) One set of impeller clearance adjustment shims
(6) One quart of seal lubricant

k. Electrical Control Components

(1) General

The pump station control panel shall 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.

(2) Panel Enclosure

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.

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.

(3) Branch Components

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.

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.

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. Phase Monitor

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.

4. Transient Voltage Surge Suppressor

The control panel shall be equipped with a transient voltage surge suppressor to minimize damage to the pump motor and control from transient voltage surges. The suppressor shall utilize thermally protected silicon-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 surge current rating of 100,000 Amps per phase and a 100 kA interrupting rating.

5. Control Circuit

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

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.

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.

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". Separate pilot lights shall be provided to indicate which motor is energized and should be running.

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. If casing temperature rises to a level sufficient to cause pump damage, the high pump temperature protection circuit shall interrupt power to the pump motor. A visible indicator, mounted through the control panel door shall indicate 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.

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.

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.

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

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

6. Wiring

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.

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

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

a.	Line and Load Circuits, AC or DC power	Black
b.	AC Control Circuit Less Than Line Voltage	Red
c.	DC Control Circuit	Blue
d.	Interlock Control Circuit, from External Source	Yellow
e.	Equipment Grounding Conductor	Green
f.	Current Carrying Ground	White
g.	Hot With Circuit Breaker Open	Orange

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.

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.

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.

7. Factory Installed Conduit

All conduit and fittings to be UL listed.

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

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

Conduit shall be sized according to the National Electric Code.

8. Grounding

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.

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

9. Equipment Marking

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

a. Equipment serial number
b. Control panel short circuit rating
c. Supply voltage, phase and frequency
d. Current rating of the minimum main conductor
e. Electrical wiring diagram number
f. Motor horsepower and full load current
g. Motor overload heater element
h. Motor circuit breaker trip current rating
i. Name and location of equipment manufacturer

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.

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.

10. Pump Automatic Control System

Hardware and software components shall be integrated into a system to automatically monitor and control the operation of the variable frequency drives

and their driven pumps and monitor certain other conditions. The integrated system shall automatically control and monitor the following performance:

a. The wastewater level in the wetwell shall be continuously sensed via a submersible pressure transducer generating a 4 to 20 milliamp output signal proportional to wetwell level over a range of 3 feet (two feet above the submersible pressure transducer) to 11 feet (10 feet above the submersible pressure transducer). The transducer shall be a an LTA standard submersible level transmitter with pressure reading capabilities from 0 to 15 psi.

   The pump operation protocols in response to wetwell levels and elevations are as shown on the Plans.

b. The normal pump operational protocol shall consist of the following operation in response to the 4 to 20 milliamp signal generated by the submersible level transducer installed in the wetwell when the pump operation selector switches for both pumps are in the “Automatic” position:

   - Start one pump motor, designated by the control system software as the “Next Pump Motor to Operate”, at the Hertz value coinciding with the minimum motor speed setting when the vertical level transducer reaches the “Start Pump Minimum Speed” level. Maintain a 20 second “ramp-up” time from zero to the minimum motor speed setting.
   - Continually increase the motor speed of the single pump if the wetwell level continues to rise until the pump is running at maximum speed at the “Pump Maximum Speed” setpoint.
   - Decrease single pump motor speed in reverse order if the wetwell level decreases.
   - Stop all pump motor(s) if the wetwell level decreases to the “Stop All Pumps” level.
   - Designate the pump motors with the least total runtime as the “Next Pump Motors to Operate”.
   - Repeat this normal pump operational protocol until one or more of the pump operation selector switches are moved from the “Automatic” position.

c. In the event that a pump operation selector switch is in the “Off” position, the control system software shall automatically designate the operating pump motor as the “next pump motor to operate” after that pump motor is started.

d. No pump motor shall start and operation of all pumps shall be ceased at any time the 4 to 20 milliamp signal generated by the submersible pressure transducer installed in the wetwell indicates the wastewater level is at or below the level designated as the “Low Wetwell Level” or when the float switch indicates “Low Wetwell Level”, regardless of the position of the three-position pump operation selector switch for any pump.

e. No pump or motor shall start and operation of pump shall stop on check valve open/close failure alarm. The pump control system shall automatically call for the next available pump.

f. No pump motor shall be started automatically when the three-position operation selector switch for that pump is placed in the “Off” position.

11. Mechanical Tilt Float Switch (Back-up Level Control System)

A back-up level control system shall start and stop pump motors in response to changes in wetwell level. It shall be a mercury free float switch type with floats to be secured to a vertical pipe in the wetwell. Rising and falling liquid level in the wetwell causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system. The back-up level control system shall start and stop the pumps in accordance to the wetwell level. The floats will operate the two pumps based off the wetwell levels depicted in Paragraph 10. Pump Automatic Control System hereinbefore.

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

A separate float switch shall be used to alert maintenance personnel to a high water level in the wetwell (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 a high level condition exists . The alarm signal shall maintain until wetwell level is lowered and alarm circuit manually reset. 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.

12. Alarm Light (External)

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 Contractor.

13. Alarm Horn (External)

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 Contractor.

14. Installation

Contractor 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, contractor 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.

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.

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 wetwell.

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.

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.

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

15. Shop Drawings

Shop drawings for the Shoffner-Bomar Sewage Pumping Station and enclosure shall be submitted according to Section 1, Paragraph 16. Shop Drawings.

16. Wrenches and Tools

The Contractor shall furnish one complete set of standard and special wrenches, spanners and other tools required for the disassembly of each pumping unit. In addition to all special tools, the standard tools shall include opened-boxed wrenches of suitable sizes, a ball peen hammer, any necessary feeler gauges, two electricians' screwdrivers (Phillips Head and Plain), a pair of electrician's pliers, and a set of Allen wrenches. These tools shall be forged steel, case hardened and fully finished. They shall be supplied in an appropriately sized steel tool box.

17. Quietness of Operation

The pumps and motors shall operate at the specified capacities in the range of heads specified without undue noise and vibration. Any undue noise in the pumps or motors which is objectionable in the opinion of the Engineer, will be sufficient cause for rejection of the units.

18. Shop Tests

The pumps shall be fully tested at the manufacturer's works before shipment, at their rated speed, capacity and head and at such other conditions of head and capacity to establish properly that they have met all guarantees on the characteristic curves submitted as pre-bid data. Five (5) certified copies of the results of these tests shall be sent to the Engineer. (A witnessed pump test is not required).

19. Acceptance Tests

The pumping units will be accepted upon the basis of the certified copies of the Shop Tests, subject to a four hour field test of each unit. The field test will be for the purpose of determining if the pumping units will operate under installed conditions within a reasonable degree of correlation with the Shop Tests. If, in the opinion of the Engineer, the four hour test does not indicate a close correlation with the Shop Tests, then the Engineer will direct that a complete field test be made under the standards of the Hydraulic Institute. If the pumps are accepted, this test will be paid for by the Owner. It will be witnessed by representatives of the Contractor and the Owner. The results of this complete field test will then be the final basis of acceptance or non-acceptance of the pumping units. If the pumps are not accepted, the test will be paid for by the Contractor. The Contractor shall furnish all necessary tools, materials, equipment, and

superintendence for the tests; however, the Owner will furnish the electrical energy.

Any defects in the equipment or failure to meet the guaranteed requirements of these specifications shall be promptly corrected by the Contractor by replacement or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligation shall be final and binding on all parties.

20. Installation and Operating Instructions

Installation of the pumps and related appurtenances shall be done in accordance with written instructions provided by the manufacturer. These instructions shall be securely attached to and readily visible on the inside of the sewage pumping station control panel.

A conspicuous Maintenance and Operating Instructions Chart and Daily Maintenance and Inspection Records Chart with ample room for recording daily inspections of the pump station shall be securely mounted on the interior of the control panel.

In addition to the Maintenance and Operating Chart, the manufacturer shall further provide five (5) copies of a complete and detailed Operating and Maintenance Manual. This Manual shall cover, in addition to general operating procedures, the operation, maintenance and servicing procedures of the major individual components provided with each sewage pumping station.

21. Final Acceptance Tests

After the sewage pumping station has been completely installed, with all appurtenances and is ready for operation, it shall first be checked by a factory trained representative of the manufacturer. At this time, if found necessary, any adjustments shall be made to insure proper operation in all respects. Final adjustment and testing of the equipment shall be carried out by or under the supervision of the manufacturer's representative.

The Contractor shall furnish all necessary tools, materials, equipment and supervision for the test.

Any defects in the equipment or failure to meet the guaranteed requirements of these Detailed Specifications shall be promptly corrected by the Contractor by replacement or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations shall be final and binding on all parties.

22. Guarantee

The manufacturer of the sewage pumping equipment shall guarantee for one year from date of acceptance that the system and all equipment will be free from defects in design, material and workmanship.

Warranties and guarantees by the suppliers of various components in lieu of a single source responsibility by the manufacturer will not be accepted. The manufacturer shall be solely responsible for the guarantee of all components.

In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall provide replacement parts without cost to the Owner. He shall further provide, without cost, such labor as may be required to replace, repair or modify pumps, motors, controls, *etc*.

The replacement or repair (including cost of parts and labor) of those items normally consumed in service, such as light bulbs, oil, grease, *etc*., shall be considered as part of routine maintenance and station upkeep and will be the responsibility of the Owner.

23. Electric Motors

a. General

All electrical equipment shall conform to the latest regulations and standards of the American Institute of Electrical Engineers, the American Standards Association, and the National Electrical Manufacturers Association and these Specifications.

The Contractor shall not avail himself of any discrepancy or conflict but shall report same to the Engineer immediately for a determination.

All pump motors shall have routine tests and the efficiency and power factor at 100%, 75% and 50% loading shall be reported with the pump shop drawings.

Motor windings shall have a special Class F insulation system with a tough moisture resistant flexible varnish on each conductor, reliable slot insulation and the ends of coils shall be securely braced. Pump motors shall have a 1.15 service factor. Automatic reset thermal overloads shall be provided. Each motor shall have an accurate nameplate firmly attached, which shall give as a minimum: manufacturer, HP, phase, Hz, frame, voltage and amps, rpm, continuous rating, design and S.F. and serial number.

All pump motors shall be designed for continuous operation and shall be of a high efficiency (87% minimum) and high power factor (85% minimum at the normal operating point or furnish capacitors) design.

b. Motors for Suction Lift Pumps

Motors shall be NEMA Standard horizontal solid shaft open, drip-proof, 60ºC rise (by resistance) over 40ºC ambient at 1.15 service factor. All motors shall have ball bearings with sealed-in lubricant or be lubricated by readily accessible fittings provided. The motors shall be capable of bringing the equipment up to speed without exceeding the specified service factor.

24. Painting

All piping, valves, pumps and miscellaneous metals shall be painted as per the following specification. This specification applies to both interior and exterior surfaces. The painting system specified employs the products of the Tnemec Company. Other systems, such as Devoe, Sherwin-Williams or approved equal are also acceptable.

All surfaces shall be thoroughly cleaned. Immediately following surface preparation all surfaces shall be primed with one coat of Chem-Prime 37-77 applied to yield a dry coat thickness of 2.5 - 3.5 mils. The finish paint shall be one (1) coat of Hi-Build Epoxyline Series 66 applied to yield a dry coat thickness of 4.0 - 6.0 mils.

All pumps, valves, piping and miscellaneous metals shall be Desert Sands (AH52).

25. Electrical Work

All electrical work shall be performed in strict accordance with the latest edition of the National Electric Code, any local requirements, and as shown on the Plans. Services shall be grounded in accordance with the N.E.C. Article 250 State of Tennessee code requirements (see Chapter 0786--2-1 Code, latest edition) and the local utility company requirements. Service available at the pumping station is 480 volt, 3 phase, 4 wire.

Color code conductors as follows:

	480 Volt
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Gray
Ground	Green

Use factory color coded conductors where commercially available. If not, use black wire and band with color tape.

Provide heavy-duty, horsepower rated, quick-make, quick-break, circuit breakers with the number of poles as required.

All breakers to be capable of interrupting locked rotor current of motor which it serves.

The Contractor shall notify the Shelbyville Power, Water & Sewerage System a minimum of sixty (60) days before power is required at the pumping station.

26. Miscellaneous Metals for Pumping Stations

a. Fabricated Steel

Generally, all connections in fabricated steel miscellaneous metal work shall be welded. All welding shall be performed in accordance with Code I, Part A, of the "Code for Fusion Welding and Gas Cutting in Building Codes of the American Welding Society". In assembling and during welding, the component parts of built-up members shall be supported and held by sufficient clamps and other adequate means to hold the parts in proper relation for welding. All exposed welds shall be ground smooth. Shop drawings of all items are required.

Angles, plates, frames, lintels, and miscellaneous structural and bar shapes shall conform to the Standard Specifications of the American Institute of Steel Construction and ASTM Designation A 36, latest revision.

b. Stainless Steel

All bolts, nuts, turnbuckles, and fabricated work, as shown on the Plans or specified herein, shall be Alloy 316 stainless steel conforming to the requirements of ASTM Designation A 276, latest revision.

27. Parking Areas and Access Roads

a. General

Access to the pumping station site shall be furnished by the Contractor by constructing an access road according to the route and elevation shown on the Plans. The Contractor shall construct all necessary drainage appurtenances as shown on the Plans. The construction and surfacing of all roadways and parking areas on this project shall be in accordance with TDOT Specifications.

b. Subgrade

Clearing and excavation for the subgrade for the access road shall be in accordance with Paragraph 2 of this Section of these Detailed Specifications. All fill sections shall be placed in layers and compacted by conventional means to at least 95 percent of the fill material's maximum theoretical density as determined by the latest revision of Method A, ASTM Specification D 698.

c. Crushed Stone

Crushed stone for the parking areas and the access road shall meet the requirements of TDOT Class "A", Grading "D" compacted to a depth of six (6) inches in accordance with Section 303 of the Tennessee Department of Transportation Specifications.

****