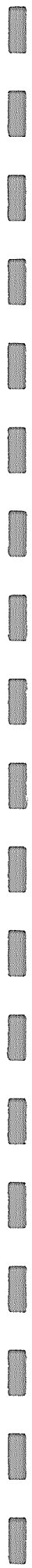


**DIVISION 16**  
**ELECTRICAL**



## SECTION 16001

### GENERAL ELECTRICAL PROVISIONS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. Work Included:

1. The work shall include the furnishing of all labor, material, equipment, and performing all operations indicated, specified, or necessary for a complete electrical system. All electrical work will be done under the general contract by licensed electricians or subcontractors unless separate bids are called for in the Bid Documents.

##### 1.02 CODES AND QUALITY ASSURANCES

- A. Electrical Systems: The Contractor shall provide detailed shop drawings of all electrical devices. These shop drawings will be prepared based on the recommendations of the equipment manufacturers and applicable codes.
- B. Codes and Standards: Work shall be in accordance with the provisions of the following Codes and Standards.
1. Southern Standard Building Code, as amended.
  2. NFPA70 National Electrical Code. Latest Edition.
  3. Applicable Local Codes and Ordinances: Where sizes or capacities are specified which are in excess of the minimum requirements of these Codes, such sizes or capacities shall prevail.
- C. All materials provided shall be new and shall be approved by the Underwriter's Laboratories, Inc. wherever that agency has applicable standards.
- D. Permits and Licenses:
1. The Contractor shall obtain all permits and licenses required for his work and shall pay all fees in connection with such permits and/or licenses.
- E. Workmanship:
1. Poor workmanship shall be rejected and the work reinstalled when, in the judgment of the Engineer, the workmanship is not of the highest quality.
  2. Where outlets are installed in masonry walls, holes shall be cut with a masonry saw under the supervision of the Electrical Contractor.
  3. All work shall be performed at such times as are required by the progress of the job.

F. Completeness:

1. It is the intent of the Contract Documents to provide complete systems.
2. Completeness shall mean not only that all material and equipment has been installed properly, but that all material and equipment has been installed and has been adjusted, and that, in the opinion of the Engineer, all material and equipment is operating as designed.

G. Specification Intent:

1. Where items are specified by catalog number, type, or manufacturer, it is for the purpose of establishing quality, general appearance, and function desired. Items by other manufacturers of equal quality and similar design may be submitted to the Engineer for consideration for use on the job. The Engineer's evaluation of the proposed substitution shall be final. Wherever three or more manufacturer's types or brands are listed herein, the Contractor shall provide one of the items specified.

1.03 EQUIPMENT IDENTIFICATION:

- A. Each of electrical equipment installed shall be identified by an etched laminated plastic nameplate, in addition to the manufacturer's nameplate. The plastic plate shall clearly identify the item of its intended use and shall be securely fastened to the equipment with sheet metal screws.

1.04 PAINTING

A. Factory Finishes:

1. Any equipment shipped with a factory applied finish shall be touched up to repair any damage to the finish so that it is the same as new.

B. Unfinished Items:

1. Exposed conduit systems, boxes, and cabinets in all areas to be painted as specified on the Contract Drawings, shall be painted.
2. All items in finished areas will be painted by Contractor.

1.05 CUTTING AND PATCHING

- A. Cutting and patching necessary for the proper installation of the work under this contract shall be by the Contractor. Patched areas shall be refinished to match adjacent undisturbed areas.

END OF SECTION

## SECTION 16111

### CONDUIT

#### PART 1 – GENERAL

##### 1.01 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install electrical conduit and fittings as specified herein and/or shown on the Drawings.
- B. The Contractor's attention is called to the fact that all conduits and conduit fittings are not necessarily shown completely on the Drawings, which are more or less schematic. However, the Contractor shall furnish and install all conduit and conduit fittings indicated or required for the proper connection and operation of all equipment and services requiring such conduit.

##### 1.02 SHOP DRAWINGS AND ENGINEERING DATA

Shop drawings and engineering data shall be submitted in accordance with the requirements of the section entitled "Submittals" of these Specifications.

##### 1.03 STORAGE AND PROTECTION

Store and protect conduit and fittings in accordance with the manufacturer's recommendations and the requirements of these Specifications. Conduit shall be stored aboveground and adequately supported.

##### 1.04 GUARANTEE

Provide a guarantee against defective equipment and workmanship in accordance with the requirements of these Specifications.

#### PART 2 – PRODUCTS

##### 2.01 GENERAL

- A. Unless otherwise shown or specified, all conduits shall be rigid non-metallic conduit.
- B. All primary power conduits shall be buried with 4' or more of cover. Concrete encasement of the conduits shall not be allowed without prior approval from Santee Cooper.
- C. Damaged, dented, flattened, or kinked conduit shall not be used.

## 2.02 RIGID NONMETALLIC CONDUIT

- A. Rigid nonmetallic conduit shall be SCH 40 heavy wall polyvinyl chloride (PVC) electrical conduit rated for 90EC conductors and conforming to NEMA TC-2, Type EPC-40-PVC. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduits shall be as manufactured by Carlon, Borg-Warner, or equal.

## 2.03 BENDS AND SWEEPS

- A. All abrupt changes in direction of a conduit run shall be made with a sweep of the same diameter as the rest of the conduit run, and having the following minimum radii for each conduit size:

Minimum Sweep radii for Project:

1" Conduit	-	2' Radius
1 ¼" Conduit	-	2' Radius
2" Conduit	-	3' Radius
3" Conduit	-	3' Radius
4" Conduit	-	4' Radius
6" Conduit	-	4' Radius

## 2.04 COUPLINGS

- A. All transitions between PVC and HDPE conduit shall be accomplished using a suitably air and water tight coupler at the joint. The coupling shall be locking to eliminate pull-out of either conduit from the end of the coupling. The locking couplings shall be manufactured for the same size conduit as the joint will be installed upon. The locking couplings shall be Shur-Lock II by A-D Technologies, Push2Connect Couplers by B&C, or other approved equal.

## PART 3 – EXECUTION

### 3.01 GENERAL

- A. Minimum size conduit shall be 1 inch except where noted otherwise, and no conduit shall have more than 40 percent of its internal area occupied by conductors.
- B. During construction, all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and any conduits which may become clogged shall be replaced. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.
- C. Unless otherwise shown or specified, exposed rigid conduit shall be installed parallel or at right angles to structural members, surfaces, and building walls.
- D. Two or more conduits in the same general routing shall be parallel with symmetrical bends.

- E. Where groups of conduits terminate together, provide template to hold conduits in proper relation to each other and to building.
- F. Conduits shall be plugged or capped with plastic caps during construction to protect ends and prevent entrance of dirt and water.

### 3.02 INSTALLATION OF RIGID NONMETALLIC CONDUIT

- A. Field bending of polyvinyl chloride conduit is not allowed. Torches or flame-type devices shall not be used to bend conduit.
- B. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings, and shall be dry. A solvent cement shall be applied to bond the joint. The joint should be watertight.
- C. Polyvinyl chloride conduit shall be installed in accordance with the manufacturer's specifications and recommendations.

### 3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. No conduit shall be concealed or covered until the Engineer has inspected the conduit for proper installation and accurate placement.
- B. The Contractor shall be responsible for all excavating, draining, trench forming of duct assembly, protective concrete envelope, backfilling, and removal of excess earth.
- C. Underground conduit shall be installed with a minimum 3-inch per 100-foot downward slope for drainage. Drains shall be provided at all low points.
- D. Bends and turns shall be made using long sweeps. Ninety-degree bends will be used only where approved by the Engineer.
- E. All underground conduit runs for primary power service shall be at least 48 inches below grade and shall have a minimum conduit separation of 6 inches. Conduit shall not be encased in concrete without prior approval from Santee Cooper.
- F. All underground conduit runs shall be rodded, followed by a swab to clean out any obstructions which may cause cable abrasions.
- G. All underground conduit runs shall be marked by a strip of permanently colored red polyethylene tape, 0.0004 inch thick and 6 inches wide, buried above the conduit and 6 inches below finished grade.
- H. After conduits have been installed to their termination point, the Contractor shall install rope into each conduit run, with a tag on the end indicating the owner and size of each conduit. This rope shall be polypropylene, with a minimum tensile strength of 100 Newtons (240 pounds), which shall remain in place for future use.

- I. Conduit bends, conduit bodies (condulets), sweeps, pulling boxes, miscellaneous fittings, couplings, adapters, bushings, locknuts, and other items shall be incidental to conduit installation and shall not be measured.
- J. All conduit runs shall be marked with a semi-permanent color coding system on each conduit run. The color coding system shall be consistent throughout the execution of the contract. The color coding system will help the contractor install the conduit runs correctly, and will assist the utility companies in determining the proper conduits to use for when performing the conversions. All conduit stub-ups, and vault conduit ends, shall have a visible color identifier on the conduit end at the completion of Phase One and Two of the project. The Engineer shall approve the color code system prior to installation of the conduit bank.

END OF SECTION



## SECTION 16300

### SEWAGE ELECTRICAL VFD CONTROL PANEL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Summary of Work.
- B. Electrical Controls.
- C. Control Equipment.

##### 1.02 RELATED SECTIONS

- A. Section 02650 - Horizontal Self-Priming Centrifugal Pumps.
- B. Section 02770 - Electrical.
- C. Section 16001 - General Electric Provisions.
- D. Section 16100 - Electrical Conduit.

##### 1.03 REGULATORY REQUIREMENT

- A. Conform to applicable code and municipality requirements for materials and installation for the work in this section.

##### 1.04 SUBMITTALS

- A. Submit product data on all equipment included in the control panel.

##### 1.05 WORK BY OWNER

- A. The contractor will be responsible for all equipment, labor, and parts.

##### 1.06 PUMP AND CONTROL PANEL COORDINATION

- A. Control panel shall be packaged with the pump to ensure VFD pumps and VFD controls are compatible with each other.

#### PART 2 PRODUCTS

##### 2.01 CONTROL PANEL

- A. Enclosure:

- 1. Provide a 12 gauge Type 304 stainless steel enclosure complying with NEMA 4X

Cap standards, lockable, dead front type. Enclosure or enclosures fabricated of stainless steel or aluminum (painted steel will not be acceptable)

2. Provide a removable back panel of 12 gauge steel or aluminum, attached to the enclosure on collar studs, and of adequate size to accommodate all basic and optional components.
  - a. Mount all components on the back panel securely utilizing screw and lock washers.
  - b. Tap panel to accept mounting screws.
  - c. Do not use any self tapping screws.
3. Enclosure doors shall be gasketed with neoprene shall be hinged and shall be equipped with captive closure hardware.
4. A duplex ground fault indicating utility receptacle providing 115 Volts AC60 Hertz, single-phase current shall be mounted near the bottom of the control panel. All wiring except 250/480 V-3 phase to and from the electrical control panel shall be thru terminal blocks or terminal strips.
5. Back panel to be painted with 2 coats of white epoxy enamel.
6. For enclosures containing VFD's drives or electronic soft starts, proper ventilation, fans and filters shall be furnished.
7. Control cabinet shall be sized to meet applicable codes.
8. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.
9. Cabinet shall contain a Hoffman Stainless Sheet type 4 x Hoffman air conditioning unit as sized to cool the components within cabinet.
10. 30 AMP 3-phase breaker for Zabco odor control system.

B. Control panel to be sized to meet applicable codes.

1. Spare Parts

Furnish the following spare parts of type used to fabricate control panel.

Two (2) - each type fuse  
Two (2) - each type relay  
One (1) - each type timer  
Two (2) - each type lamps  
One (1) - PLC Programmed  
One (1) - VFD Drive

2. Labels

All components used in the control panel shall have identification labels attached above the component - relays, fuses, and timers.

3. Component Substitution

Bidders wishing to use components other than specified herein shall submit shop drawings and data sheets for review to the Engineer. Submittals shall be received by the City of Myrtle Beach no later than ten (10) days prior to bid opening date.

4. Substitute components submittals received late will not be considered.

5. Written approval of substitute components required.

C. Motor Starters and Drives

1. Provide for each of the specified motors a Variable Frequency Drive (VFD) Square D ATV 61 Type of 150% or more at 1 Hz., 100% continuous operating torque with a 3:1 speed range without motor derating and 1% speed regulation ratio minimum. The drive shall have a DSP [digital signal processor] to improve response speed characteristics [.1 second torque response [approx.] achieved]. The unit should also incorporate an AIR [automatic voltage regulator] function to compensate for voltage drops, allowing high starting torque to be maintained. Automatic tuning will ensure simplified commissioning by matching the inverter and motor constants. Acceleration and deceleration shall be accomplished by means of "FUZZY LOGIC" circuit which will automatically calculate based on motor load and braking requirements. The drive should automatically select parameters enabling the motor to run at minimum current with respect to torque vs. load requirements. Motor noise shall be reduced by means of an I'M [intelligent power module] consisting of a high speed micro computer and a IGBT [insulated gate bipolar transistor].

The unit shall be as manufactured by Square "D".

- a. All motor starters shall be Square "D"

- D. PLC – Programmable Logic Controller. All PLC controlled equipment shall be provided with a local Hand-Off-Automatic (HOA) selector switch. Control by the PLC shall only be enabled when the respective local HOA selector switch is in the automatic position. In addition to the automatic controls described within, all equipment shall have the ability to be controlled in a remote manual mode and in the local manual mode through a hard-wired HOA connection, independent of the PLC control system.

1. OPERATOR INTERFACE TERMINAL CONTROL FUNCTIONS (OIT) - The OIT System will be programmed with control functions and will only be available and functional when the local HOA switch is in the "Automatic" position. The system operator with the appropriate level of password controlled access shall be able to perform the following functions from the OIT:

A. Pumps

- a. Manually On/Off Pump #1

- b. Manually On/Off Pump #2
- c. Manually On/Off Pump #3
- d. Manually On/Off Pump #4
- e. Set Lead Pump On wetwell level set point
- f. Set Lead Pump Off wetwell level set point
- g. Set Lag Pump #1 On wetwell level set point
- h. Set Lag Pump #1 Off wetwell level set point
- i. Set Lag Pump #2 On wetwell level set point
- j. Set Lag Pump #2 Off wetwell level set point
- k. Set Lag Pump #3 On wetwell level set point
- l. Set Lag Pump #3 Off wetwell level set point
- m. Select pump #1 as lead pump
- n. Select pump #2 as lead pump
- o. Select pump #3 as lead pump
- p. Select pump #4 as lead pump
- q. Select automatic alternation of lead/lag pumps based on pump off or by hours
- r. On the Lead Pumps upon request
- s. Enter the wetwell level control set point (VFD mode only)
- t. Enter the High/Low Wet Well Level alarm set points
- u. Acknowledge PLC generated alarms

2. OPERATOR INTERFACE TERMINAL (OIT) DISPLAYS. The Control System Integrator shall create separate display points as required for each similar device at the station. Display points indicated shall be created from a combination of input, output and logical data from control logic within the PLC.

(A) Denotes OIT Alarm will be associated with data point. Provide adjustable High and Low threshold set points for alarms based on analog values as applicable.

3. PLC CONTROL ALGORITHMS

B. Pumps

- a. Summer operations (20" and 24" force main to 36" force main)
- b. Winter operations (20" force main to 20" force main)
- c. 20" force main to 36" force main operation
- d. 24" force main to 36" force main operation
- e. 20" and 24" force main to 36" force main operation
- f. 20" force main to 20" force main operation
- g. 20" and 24" force main to 20" force main operation
- h. 20" and 24" force main to 20" and 36" force main operation

Wet well level set points shall be programmed in the programmable controller for control actions corresponding to the following wet well levels:

- a. Lead Pump On Level
- b. Lead Pump Off Level
- c. Pump #2 Pump On level or if lead pump over 3000 gpm flow
- d. Pump #2 Pump Off Level

- e. Pump #3 Pump On Level
- f. Pump #3 Pump Off Level
- g. Pump #4 Pump On Level
- h. Pump #4 Pump Off Level
- i. One Pump Run to Maximum GPM and Start Another Pump
- j. Select Automatic Alternation of Lead/Lag Pumps Based on Level Pump Off or by Set Number of Hours
- k. Wetwell High Level
- l. Wetwell Low Level
- m. Wetwell Level Control Set Point
- n. Pump Down Mode Varying Wetwell Level and Elevation by a Set Time
  - 1. On (Time)
  - 2. Off (Time)

The programmable controller shall be programmed with level control logic to control the sewage level in the wet well between the operational set points or to maintain a set point level. The programmable controller shall start a delay timer when the sewage level in the wet well rises to the elevation of "Lead RSP start" level set point. When this timer times out, the programmable controller shall start the lead pump. If the "Maintain Level" control scenario is selected, the PLC will control the speed of the RSP through a PID loop to match the influent flow and maintain a constant wet well level. If the "Constant Speed" control scenario is selected, the RSP will operate at the maximum a speed that the VFD is configured to operate.

The lead pump shall run continuously as long as the influent flow rate into the wet well meets or exceeds the pump flow rate and the sewage level in the wet well remains above the pump stop level. When the sewage level in the wet well is drawn down to the "pump stop" level set point, the programmable controller shall stop the lead pump.

If the lead pump maximum flow rate cannot keep up with the influent flow and the sewage level in the wet well continues to rise to the "lag pump start" level set point, another adjustable start delay timer, in the programmable controller shall be started. When this timer times out, the programmable controller shall start the lag pump. As long as the sewage level is above the Lag pump stop level, both pumps shall run continuously. When the sewage level in the well is pumped down to the "lag pump stop" level set point the programmable controller shall shut down the lag pump. If both pumps are running, the PLC shall control the speed of both pumps to match the influent flow rate and a constant wet well level. All pumps shall be operated at the same speed.

When the Pump Alternator function is in the automatically alternate position, the lead/lag status of the pumps shall be automatically alternated at the end of every pump cycle or by a set timeframe.

The Operator shall be provided the ability to start the Lead RSP through a "Lead Pump Test" function programmed into the HMI/OIT. If the wet well level is above the Lead Pump Stop level, this function will

F. Components:

1. Provide the following components with the panel:
  - a. Pilot run light for each motor.
  - b. Lock-able enclosure.
  - c. Condensation heater.
  - d. Phase protection.
  - e. High level alarm indication light.
  - f. Alarm horn silence.
  - g. Reset-motor over temperature.
  - h. GFI 20A duplex receptacle with stainless steel cover.
  - i. Control relays.
  - j. Remote alarm terminals.
  - k. "High temperature" indicator lamp.
  - l. "Power on" indicating lamp.
  - m. Temperature failure test push-button.

G. Pump Motor Alternator:

1. The PLC shall be programmed with Pump Motor Alternator based on time and/or pump off.

H. Control Circuits:

1. The control circuit shall be protected by a thermal magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all other control circuits.
2. The control circuit shall be routed through a set of normally closed contacts on the Phase Monitor. In the event of a power failure, under voltage, over voltage or phase loss the Phase Monitor shall sense this condition, open its normally closed control contact and de-energize the control circuit relay, stopping all pumping actions. Once normal power has been restored all systems shall automatically return to normal operations.

I. Phase Monitor:

1. Phase Monitor shall be three-phase and voltage as specified in the proposal and manufactured by Diversified, Inc. or approved equal.

J. Control Components:

1. Two 15 amp, 120V, 60 Hertz thermal magnetic breakers shall be installed and wired to a terminal strip for customer's circuitry. These breakers shall be wired from an isolated terminal block or approved manner.
2. A signal relay shall be installed and wired to the terminal strip for customer's data communications connections.

3. In the event of power or control power loss, a set of normally open contacts on the control relay shall close and notify maintenance personnel of the failure through customer's data communications system.
4. Manual operations shall override all shut down systems, but not the motor overload relay.
5. Selector switch shall be toggle switches meeting military standards (MS) for quality. Switch contacts shall be rated 10 amps minimum at 120V non-inductive.

K. High Temperature Shutdown:

1. Provide high temperature shutdown for each motor utilizing the temperature switches embedded in the motor winding.
  - a. Under high temperature conditions switch shall open, de-energizing the motor starter and stopping the pump motor.
  - b. High motor temperature shutdown device shall be manual reset type. Automatic reset of such a circuit shall not be acceptable.
  - c. One (1) red indication light for each pump shall be mounted on the inner swing door and shall indicate that a pump has been stopped in the event of a high temperature condition.

L. Provide the following components and mount on the back plate:

1. Provide a 115V control circuit transformer (open core and coil type) with a primary circuit breaker and secondary circuit breaker for:
  - a. Control
  - b. Duplex receptacle
    1. A duplex ground fault indicating utility receptacle providing 115V AC 60 Hertz, single phase current, shall be mounted on the side of the control enclosure.
    2. Receptacle circuit shall be protected by a 15A thermal magnetic circuit breaker.
    3. Provide a manual reset for alarm horn.
    4. Provide lightning arrester.
    5. Provide power terminals and control terminals.

M. Pump Run Indicators:

1. Control panel shall be equipped with one green pilot light for each pump motor. Lights shall be wired in parallel with the related pump motor starter to indicate

that the motor is on or should be running.

2. A six (6) digital non-resettable time meter shall be installed for each pump motor. Each time meter shall be wired in parallel with its related pump motor to indicate total running time in hours and tenths.

N. Wiring:

1. Pump Control Panel:

- a. The unit shall be completely factory wired except for the supply power, motors connections and remote devices.

2. All wiring, workmanship and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by local and the (NEC) National Electrical Code.

3. The control panel shall be completely wired by the manufacturer. Use intermival blocks and terminal strips for supply poser and remote devices. All user serviceable wiring shall be type MTW or THHN, 600 volts and be color codes as follows:

- |    |  |        |
|----|--|--------|
| a. | Line and load circuits, AC or DC power     | Black  |
| b. | Control circuits less than line voltage    | Red    |
| c. | DC control circuit                         | Blue   |
| d. | Interlock control circuit, external source | Yellow |
| e. | Equipment grounding conductor              | Green  |
| f. | Current carrying ground                    | White  |
| g. | Hot with circuit breaker open              | Orange |

4. Control circuits inside the control panel. With the exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW motor branch wiring shall be sized, based on actual motor horsepower. Wiring conduit shall be 16 gauge minimum. Motor branch wiring shall be sized based on horsepower gauge minimums.

5. Control panel wiring shall be clearly numbered at both ends of wire within (1/2") half inch of its termination point. Termination of more than two (2) wires under terminal shall not be accepted.

6. Motor branch conductors and other power conductors, shall not be loaded above 60 degree C temperature rating. Circuits of 100 amps or less, nor above 75 degree C on circuits above 100 amps. Wires shall be clearly numbered at each end in conformance with applicable standards.

7. All wire connections in the control panel shall be of the tongue type with nylon insulated shanks. All wiring on the sub-plate shall be bundled and tied. All wiring extending from components mounted on the door shall be terminated on terminal strips mounted on the back plate.



8. Wire Bundles

- a. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice.
- b. Bundles shall be made flexible at the hinged side of the enclosure.
- c. Adequate length and flex shall be so that the door can swing to its fullest open position with out undue mechanical stress or abrasion on conductors insulation.
- d. Bundles shall be securely clamped and held in place with mechanical fastening devices on each side of the hinge.

9. Grounding

- a. The pump control manufacturer shall ground all electrical equipment to the enclosure back panel.
- b. The mounting surface of all ground connections shall have any paint removed before making final connections.

10. Agency Recognition

- a. The control panel shall be "UL" #590 listed as a complete unit. **NOTE: THE USE OF ALL "UL" LISTED COMPONENTS SHALL NOT BE ACCEPTABLE IN LIEU OF THE "UL" LABEL.**

O. Design control sequence so that panel is functioning automatically again after a power failure and manual reset is not necessary.

- 1. Provide a time relay to prevent four (4) pumps from starting simultaneously after power failure.

P. Provide a terminal board for connection of line, pump leads will go direct to the VHD's.

Q. High water alarm and alarm silence.

1. High water alarm

- a. Include front panel mounted silence switch.
- b. Provide 115 volt AC, 40 watt, weather proof, alarm light and red globe, guard and mounting hardware.
- c. Provide 115 volt AC, single projection, vibrating type horn with weatherproof housing, including mounting lugs and conduit tap.
- d. Horn and light to operate simultaneously under alarm conditions.

- e. Horn and light to be on at high level.
  - f. The electronic pressure switch shall be equipped with an additional electronic comparator and solid state relay to alert maintenance personnel to a high liquid level in the wetwell.
  - g. In the event that wetwell liquid reaches a preset high water alarm level, the high water alarm output shall energize a signal relay.
  - h. An indicator, visible on the front of the control panel, shall indicate that a high wetwell level exists.
  - i. The signal relay shall maintain the alarm signal until the wetwell level has been lowered and the circuit has been manually reset.
  - j. The signal relay shall have one normally open contact wired to a terminal strip for customer data communications connections.
  - k. High water alarm float ball system designed to activate relay for data communications.
2. Alarm Silence Switch
- a. An alarm silence switch and relay shall be installed and wired to permit maintenance personnel to de-energize the external alarm device while corrective actions are underway.
  - b. After silencing the alarm device, manual reset of the signal relay shall provide automatic reset of the alarm silence relay.
  - c. Signal relay shall have one normally open contact wired to a terminal strip for customer data communications connections.
3. Level Control Backup System (Float Switches)
- a. Float Switches:  
(Start)  
(Stop)  
(Alarm)
  - b. Furnish three (3) normally open float switches, one for Start, one for Stop and one for Alarm.
  - c. The backup control system shall be designed to start and stop the lead pump motor and activate an external alarm system in response to high wetwell liquid levels.
4. Sequence of Operations
- a. Rising and falling liquid levels in the wetwell shall cause switches within floats to open and close, providing start, stop and alarm signals for control

components. Intrinsically safe relays for high water alarms and pump motor function.

- b. Should wetwell liquid level rise and activate the high level float switch assembly relay, it shall energize a signal relay. The signal relay shall complete a 120V AC circuit for an external alarm device. A mechanical indicator visible on the front of the control cabinet door shall indicate a high wet well condition. The signal relay shall maintain an alarm signal until wetwell liquid level has been lowered and the circuit manually reset.
- c. Should wetwell liquid rise and activate the start float switch, it shall energize a control relay and start the lead pump motor. The lead pump motor shall operate until wetwell liquid level has been lowered and de-energize its stop relay and stops the lead pump motor.

#### R. Relays

1. Relays shall be Potter @ Blumfield KRPA or approved equal.
2. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise.
3. The ON state of each relay shall be identified by illumination of a light emitting diode. The output of each relay shall be fused providing overload and short circuit protection.
4. Provide general purpose relays shall be plug-in type relay, silver cadmium oxide contacts.
5. Miniature relays are not acceptable.

#### S. Air Level Control System

1. Level Controller
  - a. The level control system shall be the air bubbler consisting of air bubbler piping which extends into the wetwell or (approved equal).
  - b. This shall be of the self-cleaning type with high strength corrosion resistant polymer air bell.
  - c. The air bubbler level control system shall consist of two (2) 0 to 5 PSI WISA or approved equal air compressors with a two (2) year warranty.
  - d. One (1) of the air compressors shall always be operating to produce a continuous positive pressure in the bubbler tube.
  - e. Air compressor system shall be designed to alternate the air compressors and allow only one (1) compressor to operate at any time.
  - f. If either compressor fails the other compressor shall operate the system.

- g. If either compressor fails an indicator visible on the front of the inner swing door shall light alerting maintenance personnel that a failure has occurred and shall close a normally open set of contacts.
  - h. The contacts shall be wired to a terminal strip for the customer data system connection.
  - i. Pressure switches shall sense air pressure in the piping to determine when a high wet well liquid level exists, activate the high level alarm system, and determine when pumps are to be switched on and off.
  - j. Air bubbler piping, fittings and bubbler bell shall be installed complete by contractor.
  - k. The control panel manufacturer shall furnish and install all air bubbler piping and fittings from the control panel into the existing wet well. Bubbler pipe and fitting shall be ¼" Rubber Flex Tubing.
2. Provide a three (3) float ball back-up system for one pump control in the event of a controller failure. One (1) Start - one (1) Stop - one (1) High Level.
  3. Sequence of Operations
    - a. The level control system shall continuously monitor wetwell level.
    - b. The system shall start the motor for one pump when liquid level in the wetwell rises to "lead pump start level."
    - c. When wetwell liquids rise to "lag pump" start level, the system shall start the second pump so that both pumps are operating to pump down wetwell.
    - d. Pumps shall stop at their respective stop levels. Levels shall be adjustable as described below.
  4. Automatic Pump Alternation
    - a. The PLC level control system shall utilize its alternating system to select first one (1) pump, then the second pump, third, forth, etc. to run as lead pump for a pumping cycle.
    - b. Alternation shall occur at the end of the pumping cycle. Lead, second, third, fourth pump based on a programmed time period or pump down shot off cycle.
  5. Electronic Pressure Switch
    - a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120V output. Comparator shall be integrated with other components to perform as described below.

- b. The electronic pressure switches shall be operating on a supply voltage of 108V to 132V AC, 60 Hertz, in an ambient temperature range of - 18 degree C (0 degree F) through +55 degree C (131 degree F).
  - c. Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of  $\pm 0.1$  feet of water.
  - d. The electronic pressure switch shall consist of the following integral components, pressure sensors, display, electronic comparators and output relays.
6. Pressure Sensors
- a. The pressure sensor shall receive an input pressure from the bubbler system.
  - b. The transducer shall convert that input to a proportional electric signal for distribution to the display and electrical comparators.
  - c. The transducers' output shall be filtered to prevent control response to level pulsation's or surges.
  - d. The transducer range shall be 0 to 15 psi, temperature compensated for (-40 degree F) through (85 degree C) (+185 degree F), with a repeat accuracy of  $\pm 0.25\%$  full scale above a fixed temperature.
  - e. Transducer over pressure rating shall be three times full scale.
7. Display
- a. The electronic pressure switch shall incorporate a digital panel meter which shall display liquid levels in the wetwell.
  - b. The meter shall be digital display, calibrated to read out in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indicator of not less than 33 feet.
8. Electronic Comparators
- a. Level adjustments shall be electronic comparator set points to control levels at which the lead and lag pumps start and stop.
  - b. Each of the levels shall be adjustable, and accessible to the operator through screen on the PLC.
  - c. Controls shall be provided to permit the operator to read the selected levels.
  - d. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation introduction of pressure to the electronic pressure switch.

9. Output Relays

- a. Each output relay in the electronic pressure switch shall be solid state.
- b. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise.
- c. The ON state of each relay shall be indicated by illumination of a light emitting diode.
- d. The output of each relay shall be individually fused providing overload and short circuit protection.
- e. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor.
- f. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

10. Quality Assurance

- a. The electronic pressure switch shall be subject to severe environmental test to minimize field failure.
- b. The test shall include but is not limited to vibration test, exposure to elevated temperatures, and burn under load.
- c. Additional testing may be conducted at the manufacturer's discretion.

11. Service Ability

- a. The electronic pressure switch shall be equipped with replaceable output fuses.
- b. The main circuit board assembly shall be provided with keyed plug-in connections to off board components, permitting main board removal without de-soldering.
- c. All printed circuits shall have a conformal coating applied to both sides to protect against moisture or fungus.

12. Independent Lag Pump

- a. Circuits designed in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

T. Schematic and Shop Drawings

1. Furnish a minimum of three (3) sets of as-built drawings and wiring diagrams, and three (3) sets of shop drawings of all components used to fabricate the control cabinet and controls.

END OF SECTION

