

LIFT STATION MONITORING CONTROL SYSTEM

PART 1 GENERAL

1.0 General

1.1 Scope of Work

The contractor shall furnish, install, start up and place into service a factory built pump control system engineered to operate sewage pumps in a sewage lift station as described herein. The control system shall be designed utilizing the latest proven technology in control design for sewage lift stations. The control system shall be easy to maintain and user friendly to ensure easy system set up and minimize down time.

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The pump control system shall be capable of operating the involved pumps at their maximum horsepower ratings and the associated interconnecting controls in a constant speed across the line (ACL) mode in order to efficiently pump sewage to the next lift station without causing a sewage over-flow wherever possible regardless of system demands. The entire control system specified herein shall be built and warranted by the manufacturer of the specified controller. The control system shall be comprised of a standard off the shelf microprocessor. Programmable logic controllers with custom software shall not be acceptable. The controller shall have the following features and meet all the requirements described in section 3.1

2.0 Products

2.1.1 Codes

Electrical equipment, materials and workmanship shall comply with all applicable codes, safety and fire law regulations at the location of the work and shall conform to applicable codes and standards of the organizations listed below:

- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories. (UL-508A or 698A for intrinsically safe)
- American National Standards Institute. (ANSI)
- National Electric Code. (NEC)

2.1.2 Component Standards

All control panels shall be as manufactured by Best Controls. All equipment and materials shall be new and shall bear the manufacturers name and trade name. In cases where the standard has been established for the particular material, the material shall be labeled as such. All equipment being furnished shall be the standard product of a manufacturer that regularly engages in the production of the said equipment. All equipment being supplied shall be the manufacturers latest approved

design. The specified equipment and material shall be suitably delivered and stored and shall be readily accessible for inspection.

## 2.2 Construction

### 2.2.1 Enclosure

The described equipment shall be housed in a Hoffman NEMA 4 X stainless steel enclosure fabricated from 14 gauge Type 304 stainless steel with a white polyester powder coat finish inside and out to reduce absorption of solar radiation so as to appreciatively reduce the internal temperature of the enclosure to extend the longevity of the internal components. The enclosure shall include a Type 316L stainless steel small POWERGLIDE® padlocking handle and internal 3-point latching combine ease of access with security.

The enclosure size shall be approximately 36 inches high, 30 to 36 inches wide and 12 inches deep. Pilot and indicator devices shall be mounted on the hinged inner door.

### 2.2.2 Hinged Inner Door

The hinged inner door shall be fabricated from painted marine alloy aluminum. It shall be held closed by at least (2) hand operated 1/4 turn fasteners.

### 2.2.3 Control Circuit Wiring

Control circuit wiring inside the panel shall be (16) gauge minimum, type MTW or THW, rated for 300 volts. All power wiring shall be rated for 600 volts. Conductors shall be color coded in the same colors throughout the entire panel. All control wiring shall be clearly identified by numerical or alphabetical wire markers. The wire markers shall be permanently affixed to the control wire terminations for ease of wire identification.

## 3.0 Equipment Description

### 3.1 Pump Controller

The Best Controls Model PC-3000 is a general purpose pump controller designed to control up to 3 pumps, in either pump up or pump down applications. It sequences pumps on and off in response to changes in level, pressure, or flow. The primary sensor input is a 4 to 20 Ma. current loop which can be connected to any sensor which has a 4-20 Ma output. When used to control level in a tank or well the input is usually connected to a pressure transducer, or ultrasonic transmitter. A loop power supply is provided in the PC-3000.

The PC-3000 shall be configurable for many applications using its front panel user interface. Wiring terminations shall include removable terminal blocks on the back cover. The controller shall have the following features:

- 32 character alpha-numeric liquid crystal display for level, status, and set point information.
- An alternation selection switch on front panel to turn alternation on and select the lead pump if alternation is off.
- Simple menu structure for easy display and modification of set points and setup configuration.
- Built in elapsed time meters for all pumps. They are nonvolatile and easily examined from the front panel.
- 4 to 20 mA main sensor input with loop power supply for easy connection to most transducers and transmitters.
- Adjustments are provided for both scale and offset.
- Inputs for pump seal leak sensors and pump over temperature sensors with display messages for out of specification conditions.
- Fully scaleable 4-20 mA output transmitter.
- Built in single float backup system for pump down applications.
- Three auxiliary inputs which can be pump disable or pump run confirmation inputs for a fail to start test.
- Built in horn relay with internal and input for external mute button.
- Relay outputs for both high and low level alarms with adjustable set points.
- Individually selectable on and off set points for up to three pumps.
- All inputs are filtered and transient protected.
- Built in software, no programming required.
- All inputs operate on low voltage and current.
- Input power is 115 V AC, internally fused and transient protected.
- All terminal strips unplug without removing the wires for easy field replacement.

### 3.2 OPERATION

#### 3.2.1.1 PUMP DOWN OPERATION

Pump down operational controls shall be applied in these wastewater lift station applications. These control panels are specified so that they will serve to function for both a duplex and a triplex operation. A triplex controller shall be provided regardless of the number of pumps involved. Two electrically driven pumps will be interconnected for the duplex pump stations. Two electrically driven pumps and one diesel driven pump will be interconnected for the triplex pump stations. The controls shall include a duplex/triplex selector switch on the inner swing out door. When applied in the field for the triplex lift station this selector switch shall inhibit the diesel driven pump from operating when it is placed in the duplex position. This shall permit the diesel driven pump to be included in the normal triplex alternation scheme at times so that the diesel engine and related components are exercised. The diesel driven pump shall be independently started upon sensing of a high-high level condition in the wet well. This shall be accomplished through an independent float switch for this purpose. Whenever the diesel driven pump is operating the two electrically driven pumps shall be interlocked out to prevent their operation.

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The level shall be continually monitored by the level transmitter which shall send a 4-20 mA signal to the controller which shall display the level on the first line of the display. If the level is below the low alarm set point then the low alarm light and relay are activated. If the horn is enabled then it too shall be activated. As the level rises above the low alarm set point the low alarm condition will be cleared. When the level rises above the lead pump on set point the lead pump will be called to run. Which pump is the lead pump is determined by the alternator. The current lead pump is displayed on the right side of the top line of the display. When the lead pump starts the liquid level should begin to fall as liquid is pumped out of the well. When the level falls to the lead pump off set point then the lead pump will be stopped and the alternator sequenced if it is on. If the level continues to rise it will reach the lag pump on set point and the lag pump will be called. If the level then falls to the lag pump off set point then the lag pump will be turned off. The lag pump will not be called if the total number of pumps set point is 1. If the lead and lag pump running do not cause the level to fall then the third pump will be called when the level reaches the lag2 on set point and if three pumps are selected for the maximum number of pumps. If the level continues to rise then it will reach the high alarm set point and set a high alarm condition. The high alarm light and relay will be activated. If the horn is enabled then it too will be activated until the alarm condition clears or until the mute button is depressed.

3.2.1.2 FLOAT BACKUP

Two Float Backup System

A float backup system that utilizes a common off float and a signal on float shall be provided that operates independent of the pump controller. During normal operation FS1 would be set slightly below the normal off level set within the pump controller and FS2 higher than the HWA level set within the pump controller. FS1 would be closed during normal operation and in the event that the primary control system fails to bring on pumps and the level in the wet well raises above the normal HWA level FS2 will close, the "Float Backup" light on the on the inner will illuminate, the HWA light will come on, the auto dialer will call out, a pump will come on, the lag pump on timer will be energized. If FS2 does not open prior to the lag pump on time delay timing out a second pump will be called for. The float back up will lock out the pump controller from controlling pumps until the float backup circuit is reset on the front of the inner door.

3.2.1.3 PUMP SEQUENCE TIMERS

In both pump up and pump down modes there are two timers which prevent more than one pump from turning on or off at the same time. These timers prevent excess power loads when pumps are turning on and some hydraulic problems (water hammer) when pumps are being turned off.

3.2.1.4 TIME AT SET POINT

The PC-3000 shall be equipped with a feature which prevents any pumps from being turned on or off until a set point condition has been satisfied for a minimum time. This minimum time is the TIME AT SP set point in the setup menu and can be set from 0 to 31 seconds. As an example, assume this set point is set for 8 seconds, and we have a pump down system (lift station). Then, the water level in the tank must exceed the lead on set point continuously for 8 second before the lead pump will be called. There is not much need for this in most lift stations as the level changes

slowly but this feature can be very useful in water pressure (pump up) systems where the pressure may swing wildly for several seconds after a pump is turned off or on. If this time is set longer than the pressure takes to settle then no further pump calls will happen until the new pressure has stabilized.

#### 3.2.1.5 FAIL TO START TEST

The PC-3000 shall be equipped with an optional fail to start test. This optional test is controlled by the START TEST time in the setup menu. If this time is zero then this test is disabled. If the start test is enabled then the AUX/DIS inputs for each pump must be connected through a dry contact to ground. These contacts must close and short the AUX/DIS input to ground when the pump is running. The auxiliary contact on the starter or a switch on the check valve arm can be used. If the start test is disabled (time = 0) then these inputs are pump disable inputs. For example let's assume that the test is enabled with a START TEST time of 15 seconds. When a pump is called a timer is started for that pump. If the timer reaches 15 seconds and the AUX/DIS input for that pump has not been shorted to ground then a fail to start test failure is set for that pump. The pump is then disabled and the next available pump is called in its place. This failure condition is displayed on the front panel and will remain active until reset by either a reset button or reset input. The high level alarm will also reset this condition. This is to make sure that a broken or misadjusted check valve switch does not cause an overflow.

### 3.2 ALTERNATION

The PC-3000 shall be equipped with an automatic alternation system which can be used to cause a different pump to be used each pump cycle. This is useful to equalize pump wear. When the alternator is off the lead pump can be selected and that pump will always be called first. The alternator on the PC-3000 is controlled by a toggle switch on the front panel. When the switch is in the up position the alternator is on and the lead pump will be changed each cycle. When the switch handle is in the center position the alternator is off and the lead pump is selected by pushing the handle down. The handle has a spring return from the down position. Each time the handle is pushed down the lead pump will be incremented to the next available pump. The current lead pump is displayed on the right side of the first line of the display (LP=2).

For systems with two pumps, alternation (if on) simply swaps lead pump duty between the two pump each pump cycle. If there are three pumps, alternation can be either of two options: In normal alternation, each pump cycle the next available pump is selected as lead so that if all pumps are available then each will be lead every third time. The other option is jockey pump. In this type of system pump 1 is a small pump and pumps 2 and 3 are large. The small pump (pump 1) is always the lead pump and the other two pumps alternate as lag and lag2. When either of the two large pumps is on the small one is turned off. This is useful in systems where demand can be low at some times and large at others.

### 3.4 STARTUP

When the PC-3000 is first powered up it shall execute an internal self-test. During this test many internal functions are checked and the displays are sequenced. The system is controlled by an

internal microcomputer which is monitored by a watchdog timer system which will restart the system in the unlikely event that the program fails to execute properly. After the self-test is complete several timers are started which prevent any relay outputs from activating until all of the system inputs have had a chance to settle and all of the input filtering has resolved to their proper values.

### 3.5 FRONT PANEL INDICATORS AND CONTROLS

The front panel includes eight LED lamps, a 32 character LCD display, 5 push buttons, one toggle switch and one adjustment knob. They have the following functions:

- **PUMP 1 THRU PUMP 3 LAMPS**  
These three green LED lamps indicate which pump is currently being called for.
- **OFF LAMP**  
This green lamp indicates that no pumps are currently called to run.
- **HIGH LAMP**  
This red lamp signals that the level is above the high set point.
- **LOW LAMP**  
This red lamp signals that the level is below the low set point.
- **FLOATS LAMP**  
This red lamp will be on if the system has had a float backup cycle since the last reset or power up.
- **XDUCER LAMP**  
This red lamp signals that the main level sensor input is outside of its normal range of 4 to 20 milliamps. This is useful for detecting transducer failures.
- **ALT SWITCH**  
The alternate switch will turn alternation on when up and off when in the center position. When it is pushed down the lead pump will be sequenced to the next available pump. The current lead pump is indicated on the first line of the display.
- **MENU BUTTON**  
This button is depressed and held for 10 seconds to enter the set point menu.
- **UP / YES BUTTON**  
This button has several functions depending on the mode of the controller. When the controller is in normal mode (not in one of the menus) this button causes the bottom line of the display to sequence between pump status and the three elapsed time meters. After 15 seconds the bottom line of the display always reverts to pump status in normal mode. When the controller is in one of the two menus this button is used to increment the current parameter being adjusted or to tell the system to save the new value.

- **DN / NO BUTTON**  
This button has several functions depending on the mode of the controller. When the controller is in normal mode (not in one of the menus) this button caused the bottom line of the display to sequence between the pump status and the three elapsed time meters. When the controller is in one of the two menus this button is used to decrement the current parameter being adjusted or to tell the system not to save the new value.
- **MUTE / RESET BUTTON**  
This button will reset any current latched up alarms such as temp fail or on floats. It will also silence the horn if an alarm is currently active.
- **TEST / ADJUST BUTTON AND KNOB**  
The function of these two operators depends on the mode of the controller. When the controller is in the normal (not menus) mode these operators are used to test the system. When the TEST button is depressed and held the ADJUST knob will be the level for the system. As you turn the knob up and down the level will go up and down. This will call on pumps and make alarms just as if the level was coming from the transducer. The controller shall switch back to the transducer 8 seconds after the button is released. When the controller is in one of the menus these operators are used to change the value of the set point or parameter. Depressing and holding the ADJUST button will cause the knob value to be placed in the current parameter or set point. This can be used along with the up and down buttons to easily adjust all of the set points.
- **32 CHARACTER DISPLAY**  
This alpha-numeric display shall have two lines of 16 characters each. The first line always displays the current level in feet and the current lead pump. The second line depends on the mode of the controller. In normal mode this line displays pump status or the elapsed time meters. Pressing the up or down buttons will sequence through the three elapsed time meters. After 15 seconds this line will revert to pump status. When pump status is displayed the display will read ALL PUMPS OK if there are no pump faults. If there are pump fault, such as temperature failures or seal failures, they will be displayed one at a time every 2 seconds. In either of the two menus the second line of the display shows the parameter being adjusted and its current value.

### 3.6 SET POINT MENU

The set point menu is used to examine and change the on and off set points for the pumps and the high and low alarm set points. The menu is entered and updated using the following procedure:

- Depress the MENU button and hold it until the first set point appears on the bottom line of the display. This will take about 10 seconds.
- The display should say LEAD ON = XX.X FT. where XX.X is the current value for the lead pump on set point.
- If you wish to change this value then use the UP or DOWN buttons or you can hold the ADJUST button down and turn the ADJUST knob until the value is correct. After the value is correct then depress the MENU/NEXT button to go to the next set point.

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- If you have changed the value then the displays will ask SAVE? (Y/N) If you wish to save the new value then press UP/YES if not then press DOWN/NO. The display should change to the next set point.
- The display should say LEAD OFF = XX.X FT. where XX.X is the current lead off set point. Repeat steps 3 and 4 above to make any changes you need to this set point.
- This process should be repeated until all of the set points have been examined and changed or until no further changes are required. Once all set points have been done the screen will return to normal mode or you can, at any time, hit the MUTE/RESET button and return to normal mode. If the system is setup for 2 pumps then the set points for the lag2 pump will be skipped in the menu. If the system is setup for only 1 pump then the set points for both lag pumps will be skipped. The set points are stored in electrically erasable programmable memory EEPROM which will not lose its contents when powered down. This is done every time the operator answers YES to the SAVE? (Y/N) prompt.

3.7 CONFIGURATION MENU

This menu is used to configure the PC-3000 controller for its application. This is normally only done once (when the panel is built or at startup) and would not be required again unless the configuration changed. This menu is entered using the following procedure:

- Depress the UP and DOWN buttons at the same time and hold them until the first setting is displayed on the bottom line of the display. This will take about 10 seconds.
- The display should say MAX LEVEL XX.X FT where XX.X is the current value. This parameter is the level when the level transmitter is at 20 mA. (full scale). For example if the transducer is a 10 psig submersible pressure transducer then 10psi is 23.1 feet so adjust this value to 23.1.
- If no change to this setting is required then press the MENU/NEXT button. To change this value we use the same procedure that we used on the set point menu. Use the UP or DOWN buttons or depress the ADJUST button while turning the ADJUST knob. After you have the value required depress the MENU/NEXT button to go to the next parameter.
- If the parameter has changed then the display will ask SAVE? (Y/N). If the value is correct then press the UP/YES button to save it, or press the DOWN/NO button to continue without saving the new setting.
- The display should say OFFSET XX.X where XX.X is the current value. This parameter is the level when the level transmitter is at 4 Ma. For example if the transmitter is a submersible pressure transducer mounted 6 inches off of the floor of the wet well then this setting should be 00.5 ft. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say HOW MANY PUMPS X where X is the current max number of pumps. If this is a duplex station set this to 2. If it is a triplex station then use 3. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say START DELAY XXXS where XXX is the current delay between pump starts. This parameter is the minimum time between starting one pump



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and then starting another. It is set in seconds from 0 to 255. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say STOP DELAY XXXS where XXX is the current delay between pump stops. This parameter is the minimum time between stopping one pump and then stopping another. It is set in seconds from 0 to 127. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say TIME AT SP XXXS where XXX is the current set point time. This parameter is the minimum time a set point condition must be continually met for the required action to take place (for example starting a pump). It is set in seconds from 0 to 31. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say PUMP UP/PUMP DN XX where XX is the current setting. This parameter determines the overall pump mode of the controller. If you have a lift station then set it to DN. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say BACKUP TIME XXXS where XXX is the current float backup time. This parameter is the time period after the high float comes out of the water that the pumps will remain on. To disable the float backup system set this to 000. It is set in seconds from 0 to 255. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say START TEST XXXS where XXX is the current start test delay time. This parameter is the maximum time delay between a pump being called and the confirming pump run signal (on the AUX/DIS input). To disable the fail to start test set this to 000. It is set in seconds from 0 to 63. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter
- The display should say SEAL XXX YYY. This parameter is use to setup the mode of the seal fail inputs. Use the UP and DOWN buttons to select between the options available. The options are:
  - a) SEAL NORM AUTO R  
In this mode the seal fail input is set to cause a failure if the resistance to ground is less than 50,000 ohms and the alarm will auto reset if the alarm condition clears.
  - b) SEAL NORM LATCH  
In this mode the seal fail input is set to cause a failure if the resistance to ground is less than 50,000 ohms and the alarm will latch up and must be cleared by the MUTE/RESET button.
  - c) SEAL INVR AUTO R  
In this mode the seal fail input is set to cause a failure if the resistance to ground is greater than 50,000 ohms and the alarm will auto reset if the alarm condition clears.

d) SEAL INVR LATCH

In this mode the seal fail input is set to cause a failure if the resistance to ground is greater than 50,000 ohms and the alarm will latch up and must be cleared by the MUTE/RESET button.

Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.

- The display should say TEMP XXX YYY. This parameter is use to setup the mode of the temperature fail inputs. Use the UP and DOWN buttons to select between the options available. The options are:

a) TEMP NORM AUTO R

In this mode the temp fail input is set to cause a failure if not shorted to ground and the alarm will auto reset if the alarm condition clears.

b) TEMP NORM LATCH

In this mode the temp fail input is set to cause a failure if not shorted to ground and the alarm will latch up and must be cleared by the MUTE/RESET button.

c) TEMP INVR AUTO R

In this mode the temp fail input is set to cause a failure if shorted to ground and the alarm will auto reset if the alarm condition clears.

d) TEMP INVR LATCH

In this mode the temp fail input is set to cause a failure if shorted to ground and the alarm will latch up and must be cleared by the MUTE/RESET button.

Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter

- The display should say AUX R XXX  
This parameter is use to setup the function of the auxiliary relay output. Use the UP and DOWN buttons to select between the options available. The options are:

a) HORN

The aux relay is for an audible alarm (horn).

b) SEAL

The aux relay will close if there is a seal fail condition on any pump.

c) TEMP

The aux relay will close if there is a temperature fail condition on any pump.

d) SEAL / TEMP

The aux relay will close if there is a seal fail or a temperature fail condition on any pump.

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Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter

- The display should say ALTERNATE XX where XX is the current setting. This parameter determines what type of alternation will be used. If the controller is set for 1 or 2 pumps then this parameter is not used. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter. The options are:
  - a) NORMAL  
The controller will use normal sequential alternation (1-2-3, 2-3-1, 3-1-2).
  - b) JOCKY  
The controller will use single jockey pump alternation. Pump 1 is lead, the other two pump alternate and pump 1 is turned off if pump 2 or 3 is on.
- The display should say MAX ON AT ONCE X where X is the current max number of pumps which can be on at the same time. This would normally be set to the number of pumps the station has unless some factor (such as available power) prevents proper operation with all pumps running at the same time. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say A OUT LOW XX.X FT. where XX.X is the level at which the analog output signal is at its minimum or 4 Ma. This parameter and the next one set up the proportional scaling of the analog output of the PC-3000. Use the procedure in steps 3 and 4 above to make any changes and go to the next parameter.
- The display should say A OUT HI XX.X FT. where XX.X is the level at which the analog output signal is at its maximum or 20 Ma. Use the procedure in steps 3 and 4 above to make any changes and depress the MENU/NEXT button which will complete setup and return you to the main display.

4.0 SPECIFICATIONS

- a) General specifications:
- b) SIZE H = 5.9" W = 7.2" D = 3.5'
- c) WEIGHT 1.8 LB
- d) OPERATING TEMPERATURE -20 C TO +70 C
- e) STORAGE TEMPERATURE -30 C TO +80 C
- f) INPUT POWER 120 +/- 10% 50-60 Hz. 0.3 Amp max.

4.1 INPUT SIGNALS

The PC-3000 shall have one analog input (from the level or pressure transmitter) and eleven discrete inputs. They shall be transient protected and use both electronic and software filters to reduce noise and improve reliability.

4.1.1 TRANSDUCER INPUT

This is an analog 4-20 Ma. input which serves as the level sensing input for the controller. A 125 ohm resistor is used to convert the current input to a voltage which is converted to digital information using a 12 bit analog to digital converter. If the input signal is greater than 20 mA. or less than 4 mA. then a transducer error lamp on the front panel will illuminate. The level data is processed through a 16 stage rolling average filter in the microcomputer to reduce sensitivity to wave action and other noise. Figure 4 show how this input is connected to a loop powered transducer.

- a) INPUT IMPEDANCE 125 OHM
- b) MAXIMUM VOLTAGE 0 TO 2.5 VDC
- c) LEVEL ACCURACY +/- 0.5 %

4.1.2 SEAL FAIL INPUTS

The PC-3000 has 3 inputs for the leak sensors commonly found in submersible pumps. These microcomputer measures the resistance from the input to ground to determine if a leak has occurred.

- a) VOLTAGE WHEN OPEN 5.0 VDC
- b) CURRENT WHEN SHORTED 0.5 MA

4.1.3 TEMPERATURE FAIL INPUTS

The PC-3000 has 3 inputs for the over-temperature sensors commonly found in pump motors. These inputs are designed to detect a short to ground.

- a) VOLTAGE WHEN OPEN 5.0 VDC
- b) CURRENT WHEN SHORTED 0.5 MA

4.1.4 AUX / DISABLE INPUTS

The PC-3000 has 3 inputs which can either be run confirming inputs or pump disable inputs. These inputs are designed to detect a short to ground.

- a. VOLTAGE WHEN OPEN 5.0 VDC
- b. CURRENT WHEN SHORTED 0.5 MA

4.1.5 MUTE/RESET and HIGH FLOAT INPUTS

The PC-3000 has 2 inputs which are for the high float and for the MUTE button in the panel. These inputs are designed to detect a short to ground.

- a) VOLTAGE WHEN OPEN 5.0 VDC
- b) CURRENT WHEN SHORTED 0.5 MA

4.2 OUTPUT SIGNALS

The PC-3000 has one analog output, one loop supply output, and six relay outputs.

4.2.1 ANALOG OUTPUT

This is an analog 4-20 Ma. which is proportional to the system level. It is self powered, referenced to ground and not isolated.

- a) MAXIMUM VOLTAGE OUT                      10 VDC

4.2.2 LOOP POWER SUPPLY

This output is a 24 VDC output intended to power a level transmitter. It is not isolated and is referenced to ground.

- a) VOLTAGE OUT                                      22 TO 28 VDC
- b) MAXIMUM CURRENT                              30 mA.

4.2.3 RELAYS

The PC-3000 has 6 form A (SPST) relay contacts which are used to control horns, lights, and motor starters.

- a) MAXIMUM VOLTAGE                              140 VAC
- b) MAXIMUM CURRENT                              3 AMPS

5.0 CONNECTOR PINS

5.1 CONNECTOR J1 (POWER AND COMMUNICATION)

PIN	FUNCTION
1.	MAIN POWER IN HOT TERMINAL ( 120 VAC )
2.	MAIN POWER IN NEUTRAL TERMINAL
3.	MAIN POWER IN GROUND TERMINAL
4.	EMERGENCY +12 VDC POWER INPUT
5.	RS-232 TRANSMIT TERMINAL
6.	RS-232 RECEIVE TERMINAL
7.	GROUND
8.	ANALOG OUT 4-20 mA. OUTPUT
9.	GROUND
10.	+12VDC OUTPUT ( 0.1 AMP MAX )
11.	GROUND
12.	GROUND

5.2 CONNECTOR J2 (RELAYS)

PIN FUNCTION

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- 1. AUX RELAY COMMON TERMINAL
- 2. AUX RELAY NORMALLY OPEN TERMINAL
- 3. HIGH ALARM RELAY COMMON TERMINAL
- 4. HIGH ALARM NORMALLY OPEN TERMINAL
- 5. PUMP 3 RELAY COMMON TERMINAL
- 6. PUMP 3 NORMALLY OPEN TERMINAL
- 7. PUMP 2 RELAY COMMON TERMINAL
- 8. PUMP 2 NORMALLY OPEN TERMINAL
- 9. PUMP 1 RELAY COMMON TERMINAL
- 10. PUMP 1 NORMALLY OPEN TERMINAL
- 11. LOW ALARM RELAY COMMON TERMINAL
- 12. LOW ALARM NORMALLY OPEN TERMINAL

5.3 CONNECTOR J3 (INPUTS)

PIN FUNCTION

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- 1. GROUND
- 2. PUMP 1 AUX / DISABLE INPUT
- 3. PUMP 3 OVER- TEMPERATURE SENSOR INPUT
- 4. PUMP 2 OVER- TEMPERATURE SENSOR INPUT
- 5. PUMP 1 OVER- TEMPERATURE SENSOR INPUT
- 6. PUMP 2 AUX / DISABLE INPUT
- 7. PUMP 3 AUX / DISABLE INPUT
- 8. HIGH FLOAT INPUT
- 9. MUTE / RESET BUTTON INPUT
- 10. PUMP 1 LEAK SENSOR INPUT
- 11. PUMP 2 LEAK SENSOR INPUT
- 12. PUMP 3 LEAK SENSOR INPUT
- 13. ANALOG INPUT SENSE RESISTOR RETURN ( connect to ground )
- 14. GROUND
- 15. ANALOG INPUT ( for loop powered devices connect to – terminal )
- 16. +24 VDC LOOP POWER ( for loop powered devices connect to + terminal)

NOTES:

- a) HEADER AND PLUGS USE COPPER CONDUCTORS ONLY.
- b) TORQUE REQUIREMENT 1.47 FT.LB.
- c) THIS UNIT OPERATES AT “POLLUTION DEGREE 2”.

6.0 Inner Door Devices

The following devices shall be operable or viewed through the inner door to prevent operator exposure to live

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electrical current:

- a) Hand-Off-Auto selector switches to override automatic mode control.
- b) Run lights.
- c) Ground fault protected, 115V convenience receptacles.
- d) Elapsed time meters for each pump.
- e) Elapsed time meter for concurrent pump run time.
- f) Pump circuit breakers for each pump.
- g) Main circuit breaker, if required.
- h) Manual Transfer with sliding bar mechanical interlock (includes main circuit breaker)

7.0 Pump Breakers

All electrical circuits shall be protected by molded case circuit breakers. Each pole of the breaker shall provide inverse time delay overload protection and instantaneous short circuit protection by means of a thermal magnetic element.

The breaker shall be operated by a toggle type handle and shall have a quick make, quick break switching mechanism that is mechanically trip free from the handle. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual “on” and “off” position. Breakers shall be completely enclosed in a molded case and shall bear the UL label. Short circuit interrupting duty (18 KAIC minimum) rating for all motor protection circuit breakers shall be applicable for operating conditions. Substitution of fuses to replace circuit breakers is not acceptable. Circuit breakers shall be operable through the inner door to prevent exposing the operator to live power.

- The acceptable manufacturer is Square D only.

8.0 Motor Starters

All starters shall be full-voltage non-reversing NEMA rated (Size 1 minimum) and bear a UL label. The coil operating voltage shall be 120 volts AC 60 Hz. IEC rated starters will not be accepted due to a reduced life expectancy. All starters shall be complete with ambient compensated overload relays. The overload relays shall be equipped with an electrical isolated normally open contact to annunciate a tripped overload due to a motor overload condition.

- The acceptable manufacturer is Square D only.

9.0 Control Relays

Relays shall be of the square base plug in type Mechanical “relay status” indicator and rated for 5 amps at 250VAC. All relays shall have a transparent polycarbonate dust cover to protect the contact surfaces from airborne dust and other contaminants. Relays shall be rated for continuous duty operation. Relay sockets shall have screw terminals with self-lifting clamps and terminal identification numbers located at each connection on the relay socket.

- The acceptable manufacturer is Square D only.

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10.0 Submersible Transducer

The submersible transducer shall utilize a piezoresistive sensing element encased in a 316 SS cage style housing, 316 SS diaphragm, 270# tinsel strength shielded & vented polyurethane cable, repeatability and hysteresis shall be +/-25% full scale, 4-20 ma DC, 13-30 VDC, internal lightning and surge protection, replaceable vent filter

- Acceptable manufacturers include Mercoid / Dwyer or approved equal.

11.0 Pilot Light Indicators

All pilot lights shall UL listed and incorporate replaceable LED bulbs rated for 120 VAC. The lamps shall be self-insulated and capable of operating for a minimum of 25,000 life hours.

- The acceptable manufacturer is Square D only.

12.0 Phase Monitor Relay

The phase monitor shall protect 3-phase pumps against phase loss, under voltage, and phase reversal conditions. With normal operating voltages applied in the proper ABC sequence, the internal relay will energize (PICK-UP). When incorrect phase sequence or phase loss occurs or the three-phase voltages fall below the drop out voltages, the relay will de-energize (DROP-OUT). On models featuring indicators, the LED glows when all line conditions are normal. Both Delta and Wye systems may be monitored. In Wye systems, connections to neutral are not required. For UL Listed units, with field wiring terminals, copper wire with 60°/75°C rating must be used for control circuitry connections.

- The acceptable manufacturer is Diversified Electronics only.

13.0 Elapsed Time Meters

A elapsed time meter shall have 6 digits measuring hours and tenths of an hour of operation shall be provided for each pump and a concurrent meter to accurately record the amount of time the both pumps ran together to more accurately track the requirements of the system. The time meter shall operate from the control voltage of the motor starter. The meter shall be totally sealed and have a quartz accuracy +/- 2% over the life time of the meter.

- The acceptable manufacturer is Redington only.

14.0 Lighting Arrestor/ Surge Arrestor

A lighting/surge arrester shall be provided at the service entrance to the control panel. The Secondary Surge Arrester (commonly known as a lightning arrester) shall incorporate the latest MOV technology.

The device shall incorporate the following:

- UL Listed as TVSS; UL and C-UL as secondary surge arrester
- Meets ANSI/IEEE C62.11-1987
- Suitable for use in Category B and C locations



- Metal oxide varistor (MOV) design
- LED indicates operational status
- Fast response time
- Maintenance-free, long life

#### Housing

The arrester housing is made of high temperature thermoplastic. The cover is permanently bonded to the housing by an ultrasonic welding process, and the wire exit is sealed using a potting compound. The arrester can be used for both indoor and outdoor applications.

#### MOV Technology

MOVs provide voltage surges with a low resistance path line-to-neutral while providing high resistance to the 50/60 Hz power source. Traditional gas tube arresters suffer from slow response time, high clamping voltages, and crow barring effects (the reduction of voltages during conduction in order to short circuit the load). The MOV responds faster and has a lower clamping voltage because it does not have a gap structure.

#### Fuse Links and Thermal Cut-offs

Individual non-replaceable internal fuse links and thermal cut-offs protect the MOVs and open in the event of a varistor-damaging overload. Silica inside the arrester housing reduces the risk of one fuse damaging another when it opens.

#### LED Indicator

The LED on the face of the device indicates operational status of the arrester. If the light is on the device is fully operational. When the LED indicator goes off, the device should be replaced.

- Square D Model SDSA3650 only.

#### 15.0 Transformers

- a) All transformers shall be the dry type and shall be designed and tested in accordance with the latest applicable standards of ANSI, IEEE and NEMA, and shall be UL listed.
  - b) Large transformers that generate a large amount of heat are to be mounted external to the control panel to minimize component degradation due to excessive heat.
  - e) 480/120 VAC Transformer, 2 KVA, 480/120 VAC, NEMA 4X SS (mounted external to the panel)
  - f) 120/24 VAC Transformer, 50 VA (to power Pump manufacturers moisture relay if required)
  - g) The 120/24 VAC transformers, 50 VA (open style mounted inside the panel to power the pump manufacturer's OT/Moisture relays)
- The acceptable manufacturer is Square D.

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16.0 Convenience Receptacle

A GFI receptacle shall be provided to protect against ground fault leakage and shock. The unit shall have a retractable ground pin and polarized blades for two (2) or three (3) wire receptacles. The unit shall require a reset after any ground fault interruption.

17.0 Alarms

High and Low Level alarms shall be available with a silence push button. On decreasing levels, the alarm condition will automatically reset when the level falls below the high level alarm set point. On increasing level, the low level alarm shall automatically reset when the level rises above the low level alarm set point.

18.0 Hand - Off - Automatic Switch

Standard HOA switches shall be supplied on the inner door for each pump. The switches shall be UL listed and rated for 600 VAC, 10 amp

19.0 Moisture/Seal Failure Relays

- a) An MSR providing thermal protection for each pump shall be supplied by the pump manufacturer to be factory installed and tested by the panel manufacturer to ship as part of a complete package by the panel manufacturer.
- b) The MSR senses moisture in the pump the seal failure relay shall not shut down the pump but shall illuminate a red LED pilot light located on the inner door that shall correspond to the appropriate pump.

21.0 Over Temperature Sensing Relays

- a) An OTR providing thermal protection for each pump shall be supplied by the pump manufacturer to be factory installed and tested by the panel manufacturer to ship as part of a complete package by the panel manufacturer. The OTR senses the status of the pumps internal over temp circuit. In the event that the OT circuit changes status the OTR will shut down and lock out the pump while illuminating a red LED pilot light located on the inner door that shall correspond to the appropriate pump. The pump shall remain locked out until a manual reset button located on the inner door that corresponds to the appropriate pump has been reset.

22.0 Quality Assurance

The control system manufacturer must meet the following requirements.

- a) The manufacturer of the control system shall be certified by Underwriters Laboratories (UL) as being a UL 508A and 698A listed manufacturing facility and certified to install a serialized label for quality control and insurance liability considerations.
- b) The manufacturer of the control system must be able to document ten years of experience in successfully designing and manufacturing similar control systems for wastewater pumping applications.
- c) The manufacturer shall have an authorized stocking distributor with 24 hour service available within a 100 mile radius of the installation.

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- d) The distributor must maintain a minimum of two of the controllers being specified to minimize down time.

23.0 Manufacturer Quality Control

The complete control system shall be functionally tested at the manufacturing facility and certified as a complete system to assure proper operation per specification. All components must be mounted with stainless steel hardware.

24.0 Manufacturer Approval

Manufacturers listed in this specification do not constitute approval. All controls must have the capabilities and functions as outlined in the specifications.

25.0 Submittal Requirements

25.1 Base Bid

The base bid control system shall be the PC-3000 system as manufactured by Best Controls Inc. of Clearwater, Florida. All bidding contractors shall base their bid on the PC-3000 control system. Contract shall be awarded on the base bid control system. Alternative deductive systems will be considered only after contract award and must be specified with any applicable deducts at bid time in order to receive consideration. Bidders submitting alternate quotations shall submit appropriate cut sheets, circuit drawings and a detailed bill of materials with their alternate bid packages. Approval of an alternative system shall be at the sole discretion of the Owner's Representative and the City of Galveston. All equipment and materials shall be new and shall be specifically designed for the function herein.

26.0 Substitutions

The Owner's Representative will consider proposals for substitution of materials, equipment, methods and services only when proposals are accompanied by full and technical data and all other information required by the Owner's Representative for the proposed substitution. Substitution of materials, equipment, methods and/or services is not allowed unless such substitution has been specifically approved by the Owner's Representative.

27.0 Shop Drawing Submittals

27.1 Drawing Requirements

All drawings are to be of the computer generated class.

27.2 Engineering Approval

The Owner's Representative reserves the right to approve or disapprove any and all equipment based upon his evaluation. Approval for fabrication and installation will be made only after submittal and review of all shop contract documents. The information required for approval shall include the following items and be provided in (8) sets as a minimum:

- a) Appropriate cut sheets
- b) Complete electrical schematics detailing the system

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- c) A complete bill of material
- d) Detailed drawings of the enclosure
- e) Exploded detail of every control faceplate, light, switch or meter mounted on the exterior of the enclosure.

28.0 Start up And Testing

- a) Eight (8) sets of as built drawings including any field modifications made by the authorized start-up personnel during installation, start-up or testing.
- b) The equipment is to be started up by the manufacturers authorized representative.

29.0 Warranties

All components in the specified control system shall have a minimum, a comprehensive, parts only, twelve (12) month guarantee against defects in workmanship and material from the date of start up or eighteen (18) months from the date of shipment from the manufacturers facility. The manufacturer of the control system shall warrant all components in the system for unit responsibility purposes.

END OF SECTION