

## PUMP CONTROL CENTER (PCC)

### PART 1 – SUMMARY

- A. In accordance with the plans and specifications, the Contractor shall provide and install a complete pre-fabricated, pre-tested ArcSafe® Pump Control Center including all required equipment, accessories, wiring and adjusting as indicated in the project specifications, on the project plan, and installed in accordance with applicable National, State and Local Codes.

#### 1.1 GENERAL

- A. The PCC shall be a completely prewired automatic ArcSafe® system for pump control and alarming. The entire panel shall have a minimum Short Circuit Current Rating of 35kA. The control system shall be designed to assure operation for wet wells categorized as hazardous - Class 1, Division 1. The control panel shall be UL listed and carry a UL Label indicating suitable for use with intrinsically safe circuits extending to classified hazardous locations. The PCC shall be an ArcSafe® PCC as manufactured by Starnet Technologies, Inc.

### PART 2 – PRODUCTS (PUMP CONTROL CENTER)

#### 2.1 PANEL EQUIPMENT

- A. Primary Pump Controller with Operator Interface (PPC)
  - a. PPC shall utilize a submersible pressure transducer for automatic operation of pumps, as described in specific section.
  - b. PPC shall display Wetwell level as determined by the transducer.
  - c. See – 2.3 CONTROL SYSTEM – PRODUCTS AND PERFORMANCE, C. Primary Pump Controller (PPC).
- B. Redundant Float Backup Pump Controller (BPC)
  - a. BPC shall utilize 4 floats for backup operation of pumps during conditions when the Primary Controller is either failed or forced off.
  - b. See – 2.3 CONTROL SYSTEM – PRODUCTS AND PERFORMANCE, D. Backup Pump Controller (BPC).
- C. Telemetry System
  - a. Telemetry equipment shall be provided as factory installed in the PCC.
  - b. System shall operate as described in the relevant sections of this specification.
- D. Motor Starters mounted in separate compartments
  - a. Starters shall be provided in individual compartments, separated from PPC, BPC, and ATS.
  - b. Starters shall be as described in “Pump Starters” portion of this Specification section.
  - c. Provide type, quantity, and with ratings to accommodate the described pumps of the project as shown on the Project drawings.
  - d. See – 2.4 PUMP STARTERS.
- E. Lighting Transformer to step down line voltage to 120 volts
  - a. 600V rated primary side circuit breaker.
  - b. 5kVA Transformer, open-type, mounted in line voltage compartment.
  - c. 1-Pole and 2-Pole load side 250V rated circuit breakers as required.
  - d. See – 2.5 BREAKER/TRANSFORMER COMPARTMENT.
- F. Transient-Voltage Surge-Suppressor (TVSS)
  - a. 65kA rated TVSS
  - b. Accessory contacts to indicate condition of TVSS if “OK”.
  - c. Press-to-Test, 30mm White Indicating Light, door mounted.

## PUMP CONTROL CENTER (PCC)

- G. Uninterruptible Power Supply
  - a. 24V DC UPS System, in Pump Control Panel
  - b. UPS shall provide temporary power to Primary Controller and Telemetry System when normal and/or generator power fails.
  
- H. Automatic Transfer Switch (ATS)
  - a. ATS shall be ASCO 300 Series, no exceptions.
  - b. The ATS and accessories shall conform to the requirements of:
    - 1) UL 1008 – Standard for Automatic Transfer Switches
    - 2) NFPA 70 – National Electric Code
    - 3) NFPA 110 – Emergency and Standby Power Systems
    - 4) NEMA Standard ICS10-1993 – AC Automatic Transfer Switches
    - 5) NEC – Articles 700, 701, and 702
    - 6) International Standards Organization – ISO 9001:2000
  - c. Rated to carry 100% or rated current continuously.
  - d. Sized as shown on the plans and as indicated in relevant specifications.
  - e. Inherently double-throw, electrically operated and mechanically held in the normal and emergency source positions.
  - f. Mechanically interlocked to ensure only one of two possible positions, normal or emergency.
  - g. Provide with a Programmable Engine Exerciser and door mount display/keypad. Display shall indicate Normal and/or Emergency Source available as well as Normal or Emergency Source connected.
  - h. A controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The controller shall be enclosed with a protective cover.
  - i. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
    - 1) ANSI C37.90A/IEEE 472 (Voltage Surge Test)
    - 2) NEMA ICS – 109.21 (Impulse Withstand Test)
    - 3) IEC801-2 (Electrical Discharge Immunity [ESD])
    - 4) ENV50140 and IEC 801-3 (Radiated Electromagnetic Field Immunity)
    - 5) IEC 801-4 (Electrical Fast Transient Immunity [EFT])
    - 6) ENV50142 (Surge Transient Immunity)
    - 7) ENV50141 – Group 1, Class A (Conducted and Radiated Emissions)
    - 8) EN61000-4-11 (Voltage Dips and Interruptions Immunity)
  - j. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting. Time Delays to include:
    - 1) Override momentary normal source outages and delay all transfer and engine starting signals.
    - 2) Transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
    - 3) Generator stabilization after transfer to emergency.
    - 4) Retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
    - 5) 5-minute cool down on shutdown of engine generator.
    - 6) All adjustable time delays shall be field adjustable without the use of special tools.
  - k. In-phase monitor shall be inherently built into the controls. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
  - l. Terminals shall be provided and utilized to determine actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

## PUMP CONTROL CENTER (PCC)

- m. The ATS shall be provided with dry contacts to be wired to the Generators Start/Call circuit.
  - n. Terminals shall be provided and utilized in conjunction with the pump controls to monitor a pre-transfer, load shed, signal from the ATS. The pump controls shall use this signal to provide orderly shutdown of any pumps in operation prior to ATS source transfer and properly coordinate the reinitiating of pump calls once it is determined that transfer is complete.
  - o. The ATS shall have a minimum Withstand & Closing Rating of 100kA when protected by proper fusing and a minimum rating of 22kA when protected by a thermal-magnetic circuit breaker.
  - p. The ATS shall be factory installed and tested in the PCC prior to shipment and shall arrive at the jobsite wired to field-landing terminals.
- I. Room Heater
- a. The PCC shall be provided with a factory installed Heater with integral thermostat.
  - b. Electric fan forced heater shall be 120V AC, commercially approved.
  - c. Heater shall have a lubricated motor, tangential blower, heavy gauge steel finned heating element and an automatic high temperature shutting system.
  - d. Amps AC: 12.5/6.3
  - e. Watts: 1500/750
  - f. BtuH: 5120/2560
- J. Pre-wired Field Terminals
- b. PCC shall arrive onsite with factory wiring to terminals for the following field connections:
    - 1) Wetwell – Pumps, floats, and transducer.
    - 2) Telemetry equipment.
    - 3) Incoming Power – Normal and Emergency.
- K. *(Optional) ArcSafe® Bypass System*
- c. *PCC shall be provided with a means for temporary bypass power operation.*
  - d. *Bypass shall be achieved with twist lock receptacles and double-throw main disconnect.*
  - e. *Capable of automatic control for operation of one pump while being utilized in bypass.*

### 1. PCC CONSTRUCTION

- A. The ArcSafe® Pump Control Center specified herein shall be designed to be a compartmentalized control center with all included ArcSafe® modular units having interconnects, power, and control wiring factory installed and tested. Modular units shall include the following:
  - a. Pump Control Panel (Housing Primary and Backup Pump Controllers as well as telemetry equipment.
  - b. Individual starter compartments.
  - c. ATS and TVSS compartment.
  - d. 120V AC power distribution compartment.
  - e. Lighting transformer and line-voltage circuit breaker compartment.
  - f. Separate compartment/housing for field connection terminals.
- B. The control panel unit shall be the product of a manufacturer that is authorized by Underwriters Laboratories, Inc. to build products in compliance with UL Standard 698A (Enclosed Industrial Control Panel – Enclosure in Non-Hazardous area with extensions into hazardous area).
- C. Shall be equipped with lifting eyes (if provided as stand-alone unit) and cover plates.
- D. Constructed as a single assembly with modular compartments.
- E. All nameplates shall be engraved type with white text on black field.
- F. All internal wiring shall be provided by manufacturer as specified herein.

## PUMP CONTROL CENTER (PCC)

- a. All wiring shall be alphanumerically labeled in reference to manufacturer's standard wiring schematics with minimum 10pt font.
  - b. Labels shall be high performance matte white polyester type. Labels shall be thermal transfer type and shall be UL recognized, CSA approved, and AGA approved.
  - c. Terminal blocks shall be identified by reference number, which clearly indicates the purpose of each terminal block. Reference number used for identification shall reference rung number and component type as indicated by manufacturer's project specific drawings.
  - d. Conductor color coding and marking shall conform to the following UL508A standards:
    - 1) Line voltage, ungrounded: Black (Appropriately phase marked)
    - 2) Line voltage, grounded: White
    - 3) AC controls, ungrounded: Red
    - 4) AC controls, grounded: White
    - 5) DC controls, ungrounded: Blue
    - 6) DC controls, grounded: White with Blue Stripe
    - 7) Interconnect, ungrounded: Yellow
    - 8) Interconnect, grounded: White with Yellow Stripe
    - 9) Ground Green
- G. Termination compartments shall not contain any exposed current carrying conductors where exposed segment of conductor exceeds 0.125 inches.
- H. Total enclosure shall be adequately sized to incorporate all controls specified herein and to include normal and emergency power connections, indicating lights, selector switches, pump control logic, motor starters, telemetry equipment, etc.
- I. Total enclosure sizing shall not exceed that shown on the Project plans. (5'W x 6'-8"H x 16"D)
- J. All lugs and terminals for line voltage field wiring shall be "finger-safe".
- K. All current carrying conductors shall be fully insulated. The use of bus bars and/or exposed metal lugs is not acceptable.
- L. Modular compartments shall be constructed in accordance with the following criteria:
  - a. 14-gauge steel, powder coat painted manufacturer's standard white. All hardware including the hinges, latches, and padlock provisions shall be steel. Panel shall have been degreased, cleaned, and treated with a phosphatizing process, then primed and painted.
  - b. Continuously welded and ground smooth seams.
  - c. Flanged doors and body flange trough.
  - d. 3-point latching mechanism operated by pad-lockable handle, for control component compartments.
  - e. Oil resistant door gaskets.
  - f. Removable 14-gauge steel panels mounted on collar studs.
  - g. Control wiring to removable plates and doors shall utilize pull-apart terminals, allowing for simple unit replacement and servicing.
  - h. Removable doors.

### 2.2 SAFETY PROVISIONS AND STUDIES

- A. The pump control system shall be connected to the level sensors through intrinsically safe barriers and relays.
- B. The completed assembly shall conform to all applicable federal, state, and local codes & regulations.
- C. Procedures and Hazard Levels
  - a. Manufacturer shall provide written procedures for servicing in compliance with OSHA 1910

## PUMP CONTROL CENTER (PCC)

- and NFPA 70E. Manufacturer shall provide Labels for NFPA 70E hazard levels, for each compartment as well as a written procedure.
- b. Hazard Levels shall be determined using simulation software that is the product of a UL registered firm and meets the requirements set forth by the following:
    - 1) ISO 9001:2009
    - 2) 10 CFR 21
    - 3) ASME NQA-1
    - 4) CAN/CSA-Q396.1.2
    - 5) 10 CFR 50 Appendix B
    - 6) ANSI/ASME N45.2
    - 7) ANSI/IEEE 730.1
    - 8) ANSI N45.22
  - c. Hazard Level determinations and written procedures shall be completed under the direct supervision of and signed by a State Licensed P.E.
- D. The enclosure shall have a separate hinged door with interlocked pad-lockable disconnect handle for each individual motor starter compartment. Disconnects shall include flexible cable mechanisms to operate circuit breakers in separate breaker compartment. Units shall be designed such that ALL power (including that at line-side lugs) is removed from each starter compartment when disconnect is open. All control wiring within the motor starter compartments shall be sourced from the starter control power supply such that all circuits within the compartment are de-energized by the disconnect.
- E. The PCC shall include a separate low voltage Pump Control Panel (PCP) compartment with lockable door. All Voltages within the PCP compartment shall be 24V or lower. Thru-wall pull-apart terminal strips shall be used for interconnects.

### 2.3 CONTROL SYSTEM – PRODUCTS AND PERFORMANCE

- A. The pumps shall be controlled as described herein. The Wetwell shall be monitored by a submersible pressure transducer and 4 floats. The transducer and float switches shall be separated from the control panel by intrinsically safe barriers. The system shall provide fully automated pump control despite failure in an individual pump, or manual selection of an OFF status. Alternation shall continue in the programmed sequence with the next pump in sequence replacing the failed or off pump. After power failure, delay shall precede the sequential start of the pump cycle with no 2 pumps starting within 30 seconds of each other. The control system shall allow for the following set-points:
  - i. High Level Alarm (Redundant Pump Start)
  - j. Start Lag Pump
  - k. Start Lead Pump
  - l. Stop Lag
  - m. Stop Lead
  - n. Low Level Alarm (Redundant All Pump Stop)
- B. The pumps shall alternate after each pumping sequence if the alternation selection switch is in the AUTO position. Each pump shall be disabled until manually reset if its respective protective device or control circuit trips or otherwise inhibits operation. Each pump, at a minimum shall have the following door mounted devices:
  - a. HAND-OFF-AUTO Selector Switch
  - b. RESET Pushbutton
  - c. Elapsed Runtime Meter
  - d. RUN Indicator, Press-to-Test LED
  - e. FAIL Indicator, Press-to-Test LED
  - f. Pump Protection Monitor Status Indicator(s)

## PUMP CONTROL CENTER (PCC)

### C. Primary Pump Controller (PPC)

- a. PPC PLC shall be Allen-Bradley Micrologix 1400, no exceptions. The controller shall have 24 inputs which include 20 digital and 4 analog, 14 outputs which include 12 digital and 2 analog, and capability of up to seven future expansion modules. The overall accuracy of the analog ports shall be greater than or equal to 1% of full scale. The controller shall display status of Power, Run, Fault and Force.
- b. Operator Interface Touchscreen shall be Allen-Bradley Panelview Plus-6 700, no exceptions. The Operator Interface shall be powered by 24V DC, 64MB, color display, and utilize Ethernet communications.
- c. Level alarms shall include of high alarm, low alarm and input signal out of range.
- d. Monitor functions shall include control power and normal system operation.
- e. The control circuits shall be forced OFF by activation of the external inhibit input or upon power loss. Upon power restoration, or removal of the inhibit input, the controller shall enable its outputs in an adjustable time-step sequence as required to meet the demand.
- f. The controller shall continuously indicate the status of the selected alternation sequence, pumping direction, and control modes. The controller shall provide 1st ON - 1st OFF, Fixed, and Auto Rotate alternation sequences.
- g. The controller shall have a configurable security lockout feature.
- h. It is the specific intention of this functional requirement that a standard program shall be provided with features as described herein. Additionally, this controller shall be an integrated assembly with door mounted interface. That is, the furnishing of similar functions using extensive relay/timer logic to accomplish control sequences, etc., is specifically precluded by this specification and is not acceptable.

### D. Backup Pump Controls (BPC)

- a. BPC shall be a separate and independent from PPC PLC to ensure redundancy. The BPC shall be an alternating relay and control relays as required to achieve the described functionality, no exceptions.
- b. Pump control shall automatically switch to backup control in the event of primary control system failure. The BPC can also be forced on by a selector switch. When the BPC has assumed pumping operation it shall cutout the PPC's ability to call pumps via hardwired relays.
- c. The controller shall be hard wired to each Pump Starter Compartment (Via relays as necessary) for automatic pump calls.
- d. The intent of the specification is that a standard controller be provided, with standard documentation.
- e. The system shall allow prevention of simultaneous pump starts and shall allow limiting the maximum number of pumps when operating on standby power.
- f. The BPC shall utilize 4 floats for pump operation. The High Level and Low Level float elevations shall be above and below, respectively, normal transducer operation. The backup controller shall permit locating of all remaining floats within the normal transducer operating range.
- g. A hardware selector switch for controlling backup activation will be provided. This switch will allow the following selections:
  - 1) Force Backup
  - 2) Off
  - 3) Automatic
- h. BPC as well as High and Low level alarms shall be locked in until manually reset. An alarm contact shall also be provided to indicate that the backup system is in operation.

## 2.4 PUMP STARTERS

### A. Full-Voltage Non-reversing Starters (FVNR)

- a. FVNR motor starters shall be provided in the PCC for pump control. Each starter shall be installed in an electrically isolated compartment with door-interlocked disconnect. Circuit

## PUMP CONTROL CENTER (PCC)

- breaker shall be remote mounted and connected via flexible cable mechanism to the Starter Compartment disconnect operator.
- b. Motor starters shall be Allen-Bradley NEMA Type.
  - c. Each FVNR shall include the following door mounted devices:
    - 1) Nameplate showing HP, voltage, and FLA
    - 2) HAND-OFF-AUTO Selector Switch
    - 3) RESET Pushbutton
    - 4) RUN Indicator, Push-to-Test LED
    - 5) POWER OK Indicator, Push-to-Test LED
    - 6) OVERTEMPERATURE Indicator, LED
    - 7) SEAL FAIL Indicator, LED
    - 8) Electronic Overload Remote Display
    - 9) Elapsed Runtime Meter, non-resettable
  - d. Each FVNR shall include the following panel mounted devices:
    - 10) Thermal-Magnetic Circuit Breaker (Remote mounted)
    - 11) Control Power Transformer
    - 12) Starter
    - 13) Electronic Overload
    - 14) Current Transformer
    - 15) Relays and Timers as required for proper operation
    - 16) Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
    - 17) Thru-wall Pull-Apart Connection Terminals for interconnect wiring
- A. Adjustable Frequency Drives (AFD)
- a. AFD motor starters shall be provided in the PCC for pump control. Each starter shall be installed in an electrically isolated compartment with door-interlocked disconnect. Circuit breaker shall be remote mounted and connected via flexible cable mechanism to the Starter Compartment disconnect operator.
  - b. AFD's shall be Allen-Bradley Powerflex 753 or Cutler-Hammer SVX9000.
  - c. AFD's shall be flange-mount type with heat-sinks outside the starter compartment and ventilation provisions to prevent heat buildup. No fans or filter-grilles shall be door-mounted on the starter compartment.
  - d. Each AFD shall be supplied with IEC contactor combination for bypass operation.
  - e. Each AFD shall include the following door mounted devices:
    - 1) Nameplate showing HP, voltage, and FLA
    - 2) HAND-OFF-AUTO Selector Switch
    - 3) AFD-BYPASS Selector Switch
    - 4) AFD Keypad
    - 5) RESET Pushbutton
    - 6) RUN Indicator, Push-to-Test LED
    - 7) AFD TRIP Indicator, Push-to-Test LED
    - 8) POWER OK Indicator, Push-to-Test LED
    - 9) OVERTEMPERATURE Indicator, LED
    - 10) SEAL FAIL Indicator, LED
    - 11) Electronic Overload Remote Display
    - 12) Elapsed Runtime Meter, non-resettable
  - f. Each AFD shall include the following panel mounted devices:
    - 1) Thermal-Magnetic Circuit Breaker (Remote mounted)
    - 2) Control Power Transformer
    - 3) Adjustable Frequency Drive
    - 4) DC Bus Choke (Powerflex 753) or 3% Line Reactor (SVX9000)
    - 5) IEC Output Contactor
    - 6) IEC Bypass Contactor
    - 7) Bypass Electronic Overload

## PUMP CONTROL CENTER (PCC)

- 8) Current Transformer
  - 9) Relays and Timers as required for proper operation
  - 10) Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
  - 11) Thru-wall Pull-Apart Connection Terminals for interconnect wiring
- A. Reduced-Voltage Soft-Starters (RVSS)
- a. RVSS motor starters shall be provided in the PCC for pump control. Each starter shall be installed in an electrically isolated compartment with door-interlocked disconnect. Circuit breaker shall be remote mounted and connected via flexible cable mechanism to the Starter Compartment disconnect operator.
  - b. Motor starters shall be Allen-Bradley SMC-Flex or Cutler-Hammer S811.
  - c. Each RVSS shall include the following door mounted devices:
    - 1) Nameplate showing HP, voltage, and FLA
    - 2) HAND-OFF-AUTO Selector Switch
    - 3) RVSS Keypad
    - 4) RESET Pushbutton
    - 5) RUN Indicator, Push-to-Test LED
    - 6) POWER OK Indicator, Push-to-Test LED
    - 7) OVERTEMPERATURE Indicator, LED
    - 8) SEAL FAIL Indicator, LED
    - 9) Electronic Overload Remote Display
    - 10) Elapsed Runtime Meter, non-resettable
  - d. Each RVSS shall include the following panel mounted devices:
    - 1) Thermal-Magnetic Circuit Breaker (Remote mounted)
    - 2) Control Power Transformer
    - 3) Reduced-Voltage Soft-Starter
      - i. Integral IEC Bypass Contactor
      - ii. Integral Overload
    - 4) Current Transformer
    - 5) Relays and Timers as required for proper operation
    - 6) Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
    - 7) Thru-wall Pull-Apart Connection Terminals for interconnect wiring

### 2.5 BREAKER/ TRANSFORMER COMPARTMENT

- A. Circuit breakers shall be provided in the PCC for each motor starter and for control power transformers. Breakers shall be thermal-magnetic type. Pump and Transformer breakers shall have a short circuit interrupting capacity of 35kA at 480V. Circuit Breakers shall be UL Listed.
- B. Lighting Transformer shall be 5kVA open type iron core. Transformer Breaker shall be accessible to switch on/off thru-door. Transformer secondary shall feed remote front mount breakers in separate 120V AC compartment.



## PUMP CONTROL CENTER (PCC)

### PART 3 – INSTALLATION

- A. It shall be the installing Contractor's responsibility to secure from the PCC manufacturer – installation instructions prior to delivery. Contractor shall coordinate delivery with manufacturer at least 4 weeks prior to shipment of the PCC to the jobsite. The Contractor shall study the instructions and drawings provided and direct any questions they have to the PCC manufacturer representative for answers before proceeding with the station installation. The Contractor shall then install the PCC in complete conformance with the manufacturer's recommendations.

#### 3.1 CALIBRATION, ADJUSTMENTS AND TESTING

- A. Devices requiring field calibration shall be calibrated in the presence of the Owner's representative and be documented.

#### 3.2 STATION START-UP

- A. The Contractor shall include in their Bid Price the cost of a field installation inspection and equipment start-up trip performed by the equipment manufacturer's authorized representative. The authorized representative shall certify in writing to the Engineer that the installation is in accordance with the respective manufacturer's requirements and that the warranty is validated.
- B. The Contractor shall provide Operation & Maintenance manuals (including as-built wiring diagrams) for pumps, motors, controls, electrical, and instrumentation. The Operations and Maintenance manuals shall be submitted to and approved by the Contractor and then submitted to the Engineer. The manuals shall be complete at the time of the start-up. The Contractor shall also provide machine-specific Lockout and Tag-out procedures for all station equipment. Owner's representative shall sign off on the start-up. Start-up shall include the respective representatives for the following:
  - a. Pumps
  - b. Electrical Controls and Instrumentation
  - c. Owner
  - d. Engineer
- C. Demonstrate proper operation of all system features and functions to the Owner's representative and Engineer. Coordinate installation and start-up scheduling with Owner and Engineer.

#### 3.3 GUARANTEE

- A. Manufacturer of the PCC shall furnish a limited warranty of 12-months from start-up that all equipment shall be free from defects in design, materials, and workmanship. The manufacturer shall furnish replacement parts for any component proven defective within the provided equipment, whether assembled by them or other manufacturer during the warranty period, excepting only those items which are normally consumed in service.