

ARCSAFE PUMP CONTROL CENTER (PCC)

PART 1 - SUMMARY

- 1.1 In accordance with the plans and specifications, the Contractor shall provide and install a complete 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.
- 1.2 All materials used and work performed under this section shall comply with rules and regulations of the latest edition of the State Electrical Code and local ordinances. Shop drawings and materials lists shall be submitted for equipment listed under this section.
- 1.3 It will be the responsibility of the contractor to protect and maintain all materials and work furnished and installed under this section until acceptance.

PART 2 - QUALITY ASSURANCE

2.1 MANUFACTURER EXPERIENCE AND CAPABILITIES

- A. The manufacturer shall be normally engaged in the manufacture of the described system(s).
- B. The manufacturer shall be a company specializing in manufacturing the described system with minimum 10 years' experience.
- C. The manufacturer shall have provided at least twenty (20) successful installations of the described system in the last five (5) years.
- D. The manufacturer shall provide, or provide a modified version of, their standard product to meet these specifications.
- E. Upon request, the manufacturer shall provide the following information:
 - a. Successful installations list with locations, dates and drawings, as proof of conformance to the above requirements.
 - b. Minimum of three (3) end-user/customer references.

2.2 SUPPLIER CAPABILITIES

- A. Supplier shall have staffed services and parts office(s) within 150 miles of the project site. Office(s) shall have at least four (4) full-time personnel.

PART 3 - SUBMITTALS

- 3.1 Submittals shall be provided as described herein for the prefabricated control building. Submittal and Shop Drawings' format shall be as described below.
- 3.2 The Submittals shall be a PDF document organized as follows:
 - A. Cover with the following information:
 - a. Manufacturer product line.

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- b. Project name.
 - c. General description of equipment.
 - d. Project City and State.
 - e. Date of submittal in MM/YYYY format.
- B. Table of Contents:
- a. Control panel drawing set.
 - b. Control panel bill of materials.
 - c. Product Documentation.
- C. Control panel drawing set in the following format:
- a. Title block with the following information:
 - I. Project City and State.
 - II. Project number/name.
 - III. Drawing by, checked by, and approved by.
 - IV. Date.
 - V. Space for record of drawing revision (e.g. "As-built") with MM/YY date of revision.
 - VI. Manufacturer contact information.
 - VII. Drawing file save path.
 - VIII. Date and time of most recent drawing save.
 - b. Cover with the following information:
 - I. Product model number.
 - II. Project description.
 - III. Equipment description.
 - IV. Project locations.
 - V. Local area map with install location noted.
 - VI. Drawing set index.
 - c. Typical symbols and abbreviations.
 - I. Explanations for symbols and abbreviations commonly used in the schematics.
 - d. Control elevations and nameplate schedule.
 - I. Control panel(s) front elevation(s).
 - i. Tag/location for individual compartments/panels.
 - ii. Dimensions.
 - iii. Door component layout(s) with numerical ID for each component depicted.
 - II. Nameplate schedule.
 - i. Item tag/location.
 - ii. Numerical ID.
 - iii. Device tag (based on internal schematic tag).
 - iv. Notes.
 - v. Text height.
 - vi. Nameplate text.
 - e. Control subpanel layout.
 - I. Control panel(s) subpanel layout(s).
 - i. Tag/location for individual compartments/panels.
 - ii. Item type ID number.
 - II. Subpanel layout schedule.
 - i. Item tag/location.
 - ii. Numerical ID.

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- iii. Tag prefix.
 - iv. Component description.
 - f. Schematics
 - I. Each sheet shall have two sets of sequential rung numbers.
 - II. Component tags and wire numbers shall reference the first rung they appear at within the drawing set.
 - III. Voltage characteristics shall be identified.
 - IV. Ampacity/trip rating shall be identified for fuses, circuit breakers and similar.
 - V. Each component or circuit shall be described in a margin to the right.
 - VI. Spare rungs may be reserved between pages to accommodate future additions or for unused optional features.
 - g. Field connections page.
 - I. Termination points required to be connected to by the site electrician shall be duplicated at the end of the drawing set, so that all required field connections are depicted in one dedicated location.
- D. Product Documentation.
- a. Datasheets for all major equipment shall be included with specific selections indicated with red boxes, underlines, arrows, and/or text.

PART 4 - FACTORY TESTING

- 4.1 The completed assemblies and control panels shall be tested at the factory prior to shipment. Panels shall be energized at the main disconnect using the project specific voltage configuration. Controls shall be tested to confirm proper operation in all modes (floats, transducer, etc.).
- 4.2 Factory witness testing shall be available to the Engineer and Owner upon request.

4.3 PCC GENERAL DESCRIPTION

- A. PCC shall be a prewired automatic control system for pump control and alarming. The PCC shall be Starnet Model ArcSafe® PCC with the following included:
 - a. Submersible Transducer.
 - b. 4 Float Switches, anchor, and suspension kit.
 - c. Pump Protection Modules.
 - d. Telemetry equipment.
- B. Lifting and Mounting
 - a. The PCC shall be provided with integral lifting eyes.
 - b. Contractor shall coordinate delivery to the jobsite with the PCC manufacturer.
 - c. Contractor shall be responsible for providing proper equipment and provisions for offloading and setting.

PART 5 - CONTROL SYSTEM

5.1 PUMP CONTROL CENTER (PCC)

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- A. In accordance with the plans and specifications, the Contractor shall a complete 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.
- B. 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.

5.2 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. Citel DS70U series.
 - b. 75kA I_{max} per mode.
 - c. Configured for appropriate voltage, determined by the site utility power.

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- d. Accessory contacts to indicate condition of TVSS if "OK".
 - e. Separate press-to-test, 30mm White Indicating Light, door mounted.
 - f. UL 1449 Listed.
- G. Molded Case Circuit Breakers
- a. Eaton Series G molded case circuit breakers.
 - b. 65kAIC at 480Vac.
 - c. Thermal-magnetic protection.
 - d. UL Listed.
- H. 250Vac Distribution Circuit Breakers
- a. Eaton QC series.
 - b. 10kAIC at 240Vac.
 - c. Front-mount through-door cable-in/cable-out.
 - d. Thermal-magnetic protection.
- I. Uninterruptible Power Supply
- a. Puls U-series.
 - b. 24Vdc 10 Amp UPS System, in Pump Control Panel.
 - c. Input voltage range: 22.5-30Vdc (24Vdc nominal).
 - d. Integrated battery: 12V 5Ah.
 - e. Operational temperature range: 0 to 40 degrees celcius.
 - f. UPS shall provide temporary power to Primary Controller and Telemetry System when normal and/or generator power fails.
 - g. UL Listed.
- J. Automatic Transfer Switch (ATS)
- a. ATS shall be ASCO Series 300 (3ATS).
 - b. The ATS and accessories shall conform to the requirements of:
 - I. UL 1008 - Standard for Automatic Transfer Switches
 - II. CSA C22.2 No.178 – 1978
 - III. NFPA 70 - National Electrical Code
 - IV. NFPA 99 – Health Care Facilities
 - V. NFPA 110 - Emergency and Standby Power Systems
 - VI. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby
 - c. Power Systems for Commercial and Industrial Applications
 - I. NEMA Standard ICS10-2005 (formerly ICS2-447) - AC Automatic Transfer Switches
 - II. NEC Articles 700, 701, 702
 - III. International Standards Organization ISO 9001: 2008
 - IV. IEC 60947 – 6 – 1
 - d. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include over current disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
 - e. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

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- f. Main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- g. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
- h. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- i. Integrated User Interface Panel.
 - I. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
 - II. The 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, inherent serial communications capability, and the ability to communicate via the Ethernet through optional communications module.
 - III. A single controller shall provide single and three phase capability for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.1\text{Hz}$. Time delay settings shall be accurate to $\pm 0.5\%$ of the full-scale value of the time delay. The panel shall be capable of operating over a temperature range of -20 to $+ 70$ degrees C, and storage from -55 to $+ 85$ degrees C.
 - IV. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards.
- j. Accessory Package.
 - I. A fully programmable engine exerciser with seven independent routines to exercise the engine generator, with or without load on a daily weekly, bi – weekly, or monthly basis.
 - II. Event log display that shows event number, time and date of events, event type, and reason (if applicable). A minimum of 300 events shall be stored.
 - III. RS – 485 communications port enabled.
 - IV. Alarm output contact.
 - V. Withstand and Closing Ratings. (MCCB Rating are at 480 volts 60Hz)

ATS Size	w/ MCCB	w/ Current Limiting Fuse
30	10,000A	100,000A
70-200	22,000A	200,000A
230	22,000A	100,000A
260-400	42,000A	200,000A
600	50,000A	200,000A
800-1200	65,000A	200,000A
1600-3000	85,000A	200,000A
- k. Test and Certification
 - I. The complete 3ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the

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specification requirements.

- II. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
 - III. The ATS manufacturer shall be certified to ISO 9001: 2008 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2008.
- K. 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
- L. 24Vdc Power Supplies
- a. Idec PS5R-V series.
 - b. Power Supply Input: 85-264Vac / 100-370Vdc.
 - c. Power Supply Output: 24Vdc nominal.
 - d. Wattage rating sufficient for application.
 - e. DIN rail mount.
 - f. UL Listed.
- M. Pilot Devices
- a. Indicating Lights
 - I. Eaton 10250T or Rockwell 800T/800H.
 - II. 30.5mm Heavy Duty.
 - III. Full-voltage LED Type.
 - IV. Push-to-test.
 - V. UL Listed
 - b. Pushbuttons
 - I. Eaton 10250T or Rockwell 800T/800H.
 - II. 30.5 Heavy Duty.
 - III. UL Listed.
- N. Terminal Block (Interface) Relays
- a. Eaton XRU series.
 - b. Screw-type connection.
 - c. Pluggable relay.
 - d. LED status indication.
 - e. DIN rail mount.
 - f. Coil voltage and contact configuration to match application.
 - g. UL Listed.

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- O. Control Relays and Sockets
 - a. Idec RH or RR series.
 - b. 10 amp contact(s).
 - c. Compact power type relay.
 - d. LED status indication.
 - e. DIN rail mount socket base.
 - f. Coil voltage and contact configuration to match application.
 - g. UL Listed.

- P. Timer Relays
 - a. Eaton TRL series.
 - b. Multiple user-selectable timing functions and timing ranges.
 - c. LED status indication.
 - d. DIN rail mount.
 - e. 12-240 Vac/Vdc.
 - f. 250 Vac rated contacts.
 - g. UL Listed.

- Q. Elapsed Runtime Meters
 - a. Eaton E42DIR series.
 - b. Display: Six-digit LCD, 0.20 in.
 - c. Accuracy: $\pm 0.1\%$
 - d. Resolution: 0.1 hour (6 minutes).
 - e. Solid-state hour meter.
 - f. Record and display up to 99,999.9 hours, rollover and continue timing.
 - g. EEPROM memory.
 - h. Time accumulation indicated by flashing hourglass icon.
 - i. UL recognized.
 - j. Power Supply: 12–48 Vdc/20–60 Vac.

- R. Terminal Blocks
 - a. Eaton XB series.
 - b. Screw connection type.
 - c. Feed-through type.
 - d. UL Listed.

- S. Analog Isolators / Repeaters
 - a. Rockwell 931H series.
 - b. Active Converter, 3-Way.
 - c. Calibrated change over via DIP switch.
 - d. Power Supply: 24Vdc $\pm 15\%$
 - e. UL Listed.

- T. Temperature Transmitters
 - a. Omega EWS series.
 - b. Range: 0-135 degrees Fahrenheit.
 - c. Accuracy: $\pm 2.5^{\circ}\text{F}$

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- d. Repeatability: $\pm 0.3^{\circ}\text{C}$ ($\pm 0.5^{\circ}\text{F}$)
 - e. Output: 4 to 20 mA or 1 to 5 Vdc (user selectable)
 - f. Power Supply: 12-24Vdc
- U. Intrinsically Safe Barriers (For transducer connection)
- a. Phoenix Contact, or equal.
 - b. Repeater power supply and input isolation amplifier.
 - c. Sends fed or active 0/4-20 mA signals from the Ex area to a load (active or passive) to the safe area.
 - d. Electrical 3-way isolation, SIL 2 in accordance with IEC 61508.
 - e. Power Supply: 19.2-30Vdc (24Vdc nominal).
 - f. Screw type connection.
 - g. LED power status indication.
 - h. UL Listed.
- V. Intrinsically Safe Relays (For float connection)
- a. Phoenix Contact, or equal.
 - b. 2-channel Ex-i NAMUR isolation amplifier.
 - c. 3-way isolation, SIL 2.
 - d. Power Supply: 19.2 ... 253 Vac/dc
 - e. Screw type connection.
 - f. LED indicators for supply voltage, switching state, and malfunction according to NAMUR NE 44.
 - g. 2-Channel 2PDT contacts.
 - h. UL Listed.
- W. Phase Monitor Relay
- a. Time Mark model 257 3-phase monitor relay.
 - b. Detects phase loss, low voltage, phase reversal.
 - c. Automatic reset.
 - d. UL recognized.
 - e. 10 amp @ 240Vac resistive SPDT contacts.
- X. Pre-wired Field Terminals
- a. PCC shall arrive onsite with factory wiring to terminals for the following field connections:
 - I. Wetwell – Pumps, floats, and transducer.
 - II. Telemetry equipment.
 - III. Incoming Power – Normal and Emergency.

5.3 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.

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- 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 PCC shall not exceed a height of 80" or other dimensions as shown on the project plans.
- C. 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).
- D. Constructed as an assembly or assemblies 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.
- 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:
 - I. Line voltage, ungrounded: Black (Appropriately phase marked)
 - II. Line voltage, grounded: White
 - III. AC controls, ungrounded: Red
 - IV. AC controls, grounded: White
 - V. DC controls, ungrounded: Blue
 - VI. DC controls, grounded: White with Blue Stripe
 - VII. Interconnect, ungrounded: Yellow
 - VIII. Interconnect, grounded: White with Yellow Stripe
 - IX. 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. All lugs and terminals for line voltage field wiring shall be "finger-safe".
- J. All current carrying conductors shall be fully insulated. The use of bus bars and/or exposed metal lugs is not acceptable.
- K. 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

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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.

5.4 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 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:
 - I. ISO 9001:2009
 - II. 10 CFR 21
 - III. ASME NQA-1
 - IV. CAN/CSA-Q396.1.2
 - V. 10 CFR 50 Appendix B
 - VI. ANSI/ASME N45.2
 - VII. ANSI/IEEE 730.1
 - VIII. 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 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.

5.5 CONTROL SYSTEM – PRODUCTS AND PERFORMANCE

- A. The pumps shall be controlled as described herein. The wet well 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:
 - a. High Level Alarm (Redundant Pump Start)
 - b. Start Lag Pump
 - c. Start Lead Pump
 - d. Stop Lag
 - e. Stop Lead
 - f. 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)

- 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 digitals and 4 analogs, 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-7 700, 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

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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:
 - I. Force Backup
 - II. Off
 - III. 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.

5.6 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 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:
 - I. Nameplate showing HP, voltage, and FLA
 - II. HAND-OFF-AUTO Selector Switch
 - III. RESET Pushbutton
 - IV. RUN Indicator, Push-to-Test LED
 - V. POWER OK Indicator, Push-to-Test LED
 - VI. OVERTEMPERATURE Indicator, LED
 - VII. SEAL FAIL Indicator, LED
 - VIII. Electronic Overload Remote Display

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- IX. Elapsed Runtime Meter, non-resettable
- d. Each FVNR shall include the following panel mounted devices:
 - I. Thermal-Magnetic Circuit Breaker (Remote mounted)
 - II. Control Power Transformer
 - III. Starter
 - IV. Electronic Overload
 - V. Current Transformer
 - VI. Relays and Timers as required for proper operation
 - VII. Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
 - VIII. Thru-wall Pull-Apart Connection Terminals for interconnect wiring
- B. 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 isolated. No fans or filter-grilles shall be door-mounted on the starter compartment. Ventilation provisions shall include a separate air-intake and discharge fan, for the area containing the AFD heat-sinks.
 - d. Each AFD shall be supplied with IEC contactor combination for bypass operation.
 - e. Each AFD shall include the following door mounted devices:
 - I. Nameplate showing HP, voltage, and FLA
 - II. HAND-OFF-AUTO Selector Switch
 - III. AFD-BYPASS Selector Switch
 - IV. AFD Keypad
 - V. RESET Pushbutton
 - VI. RUN Indicator, Push-to-Test LED
 - VII. AFD TRIP Indicator, Push-to-Test LED
 - VIII. POWER OK Indicator, Push-to-Test LED
 - IX. OVERTEMPERATURE Indicator, LED
 - X. SEAL FAIL Indicator, LED
 - XI. Electronic Overload Remote Display
 - XII. Elapsed Runtime Meter, non-resettable
 - f. Each AFD shall include the following panel mounted devices:
 - I. Thermal-Magnetic Circuit Breaker (Remote mounted)
 - II. Control Power Transformer
 - III. Adjustable Frequency Drive
 - IV. DC Bus Choke (Powerflex 753) or 3% Line Reactor (SVX9000)
 - V. IEC Output Contactor
 - VI. IEC Bypass Contactor
 - VII. Bypass Electronic Overload
 - VIII. Current Transformer
 - IX. Relays and Timers as required for proper operation
 - X. Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
 - XI. Thru-wall Pull-Apart Connection Terminals for interconnect wiring

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- C. 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:
 - I. Nameplate showing HP, voltage, and FLA
 - II. HAND-OFF-AUTO Selector Switch
 - III. RVSS Keypad
 - IV. RESET Pushbutton
 - V. RUN Indicator, Push-to-Test LED
 - VI. POWER OK Indicator, Push-to-Test LED
 - VII. OVERTEMPERATURE Indicator, LED
 - VIII. SEAL FAIL Indicator, LED
 - IX. Electronic Overload Remote Display
 - X. Elapsed Runtime Meter, non-resettable
 - d. Each RVSS shall include the following panel mounted devices:
 - I. Thermal-Magnetic Circuit Breaker (Remote mounted)
 - II. Control Power Transformer
 - III. Reduced-Voltage Soft-Starter
 - i. Integral IEC Bypass Contactor
 - ii. Integral Overload
 - IV. Current Transformer
 - V. Relays and Timers as required for proper operation
 - VI. Fast-acting Class J fuses, with blown-fuse indicators, for short-circuit protection
 - VII. Thru-wall Pull-Apart Connection Terminals for interconnect wiring

5.7 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.

PART 6 - INSTALLATION

- 6.1 It shall be the installing Contractor's responsibility to secure from the 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 installation. The Contractor shall then install the PCC in complete conformance with the manufacturer's recommendations.

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6.2 CALIBRATION, ADJUSTMENTS AND TESTING

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

6.3 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.

PART 7 - OPERATIONS & MAINTENANCE MANUALS (O&Ms)

7.1 O&Ms shall be provided as described herein for the prefabricated control building. Manual and Shop Drawings' format shall be as described below.

7.2 The O&M shall be a PDF and hardcopy document organized as follows:

- A. Cover with the following information:
 - a. Manufacturer product line.
 - b. Project name.
 - c. General description of equipment.
 - d. Project City and State.
 - e. Date of submittal in MM/YYYY format.
- B. Table of Contents:
 - a. Control building drawing set.
 - b. Control panel drawing set.
 - c. Control building bill of materials.
 - d. Control panel bill of materials.
 - e. Product Documentation.

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- C. Control panel drawing set in the following format:
 - a. Title block with the following information:
 - I. Project City and State.
 - II. Project number/name.
 - III. Drawing by, checked by, and approved by.
 - IV. Date.
 - V. Space for record of drawing revision (e.g. "As-built") with MM/YY date of revision.
 - VI. Manufacturer contact information.
 - VII. Drawing file save path.
 - VIII. Date and time of most recent drawing save.
 - b. Cover with the following information:
 - I. Product model number.
 - II. Project description.
 - III. Equipment description.
 - IV. Project locations.
 - V. Local area map with install location noted.
 - VI. Drawing set index.
 - c. Typical symbols and abbreviations.
 - I. Explanations for symbols and abbreviations commonly used in the schematics.
 - d. Control elevations and nameplate schedule.
 - I. Control panel(s) front elevation(s).
 - i. Tag/location for individual compartments/panels.
 - ii. Dimensions.
 - iii. Door component layout(s) with numerical ID for each component depicted.
 - II. Nameplate schedule.
 - i. Item tag/location.
 - ii. Numerical ID.
 - iii. Device tag (based on internal schematic tag).
 - iv. Notes.
 - v. Text height.
 - vi. Nameplate text.
 - e. Control subpanel layout.
 - I. Control panel(s) subpanel layout(s).
 - i. Tag/location for individual compartments/panels.
 - ii. Item type ID number.
 - II. Subpanel layout schedule.
 - i. Item tag/location.
 - ii. Numerical ID.
 - iii. Tag prefix.
 - iv. Component description.
 - f. Schematics
 - I. Each sheet shall have two sets of sequential rung numbers.
 - II. Component tags and wire numbers shall reference the first rung they appear at within the drawing set.
 - III. Voltage characteristics shall be identified.
 - IV. Ampacity/trip rating shall be identified for fuses, circuit breakers and similar.
 - V. Each component or circuit shall be described in a margin to the right.

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- VI. Spare rungs may be reserved between pages to accommodate future additions or for unused optional features.
- g. Field connections page.
 - I. Termination points required to be connected to by the site electrician shall be duplicated at the end of the drawing set, so that all required field connections are depicted in one dedicated location.
- D. Product Documentation.
 - a. Datasheets for all major equipment shall be included with specific selections indicated with red boxes, underlines, arrows, and/or text.
 - b. Manufacturer's manuals shall be included for all components which are programmable, configurable, or have specific maintenance requirements.

PART 8 - GUARANTEE

- 8.1 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.