replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits. The logic board shall be identical through all ampere ratings and voltage classes and shall be conformally coated to protect from environmental conditions.

3. The paralleling bypass contactor shall energize when the motor reaches full speed and close/open under 1 x motor current. The contactor shall utilize an energy balanced contact closure to limit contact bounce and an intelligent coil controller which optimizes coil voltage during varying system conditions. The coil shall have a lifetime warranty.
4. The overload protection shall be electronic and be based on an inverse time/current algorithm. Overload protection shall be adjustable and Class 10/20 shall be selectable. Units using bimetal overload relays are not acceptable. Over temperature protection (on heat sink) shall be standard.
5. The solid-state logic shall be phase sensitive, and shall inhibit starting on incorrect rotation. Improper phase rotation shall be indicated on the starter.
6. Starters shall protect against a phase loss/unbalance condition shutting down if a 35% current differential between any two phases is encountered.

   A normally open (NO) contact shall annunciate fault conditions, with contact ratings of 60 VA resistive load and 20 VA inductive load. addition, an LED display shall indicate type of fault (uIn addition, an LED display shall indicate type of fault (current trip, phase loss, phase rotation).
7. The following adjustments are required:
   a. Ramp time: 1-45 seconds
   b. Initial torque:100-200% current
   c. Current limit: 100-500% current
      FLA of motor: 4-1 range of starter
8. Smooth stopping shall be available to provide a linear voltage deceleration. It is to be adjustable from 1-45 seconds.
9. Acceptable Manufacturers:
   a. Eaton IT
   b. approved equal

iii. Phase Converter – For smaller pump stations, if it is determined either that the Utility Company cannot provide 3-phase power to the site or the installation cost to bring 3-phase power to the site cannot be justified, use of Variable Frequency Drives (VFD's) in lieu of FVNR starters will be considered. This decision must be approved by the Owner. **(The Owner will determine the motor horsepower ratings for which use of VFD's as phase converters will be acceptable.)** This is the only type of phase converter that will be considered.
   1. If voltage conversion is required, a shielded and isolated step-up transformer rated at least 1.5 times the total pump load requirement

must be provided.

   2. The converter shall be a VFD set up to run at a pre-determined speed, preferably 100% speed.
   3. The VFD shall be derated for operating the 3-phase motor from the single phase source. The VFD supplier shall certify that the VFD used in this manner is rated to operate the motor being supplied. VFD shall be rated for no less than 50 Deg C.
   4. The operation of the single phase pump supplied from the VFD as a phase converter shall be identical to that of a 3-phase pump being supplied from a FVNR starter.
   5. Acceptable Manufacturers:
      a. Danfoss VLT Series
      b. approved equal
   6. An air conditioning unit shall be provided for the control panel section to remove the heat generated by the VFD's.
   7. For these units installed in panels mounted in a non-climate- controlled environment, provide an approximately 800 watt, 120 VFD section of the enclosure to maintain minimum temperatures in the enclosure as specified by the VFD supplier. The equivalent to this heater may be integral to the air conditioning unit for the panel section.
   8. VFD's shall be provided with 6-year manufacturer's warranty, including component failure and surge damage to the VFD. Warranty shall include factory on-site service.

iv. The control power shall be 120 volts AC. A minimum 5 KVA transformer shall be supplied with primary protection. Individual 120-volt circuit breakers shall be provided for each separate power requirement. The PLC shall be powered from a separate dedicated circuit breaker served by from the control circuit. A 15-ampere Ground Fault Interrupter receptacle shall be mounted on the inner door of the control panel.

v. Provide circuits to serve the generator battery charger and the generator block water heater. If the power requirements for the block heater exceed the capacity of a 1P-15A, 120 volt circuit breaker, the block heater shall be rated at 480 volts and shall be served from a 480 volt circuit breaker rated to serve 125% of the load.

g. Main Terminal Strip
   i. The main terminal strip at the lowest portion of the sub panel shall have a minimum clearance of six inches to the bottom of the section 2 enclosure. Provide labels to match the wiring diagrams.

h. Intrinsic Barriers
   i. The wet well area of the pump station is considered by NFPA 820 to be a Class I, Division 1, Group D hazardous area. Therefore Intrinsic Barriers shall be installed where the level floats are connected in the Control Panel to prevent arcing from occurring in these floats in the wet well.
   ii. The Hazardous Area Controller (HAC) shall provide intrinsically safe power to the Lead, Lag, and Stop floats for control of the pumps and shall have both alternator and duplexer functions. The alternator function shall change which pump is the lead pump for each on-off cycle of the pumps. The duplexer

function shall cause the lag pump to operate in the event of water continuing to rise in the wet well. When the water level in the wet well drops below the stop float, both pumps shall be stopped.

   iii. The Hazardous Area Relay (HAR) shall provide intrinsically safe power to the Wet well High Level and the Retention High Level floats for alarming these levels.
   iv. An intrinsic safe repeater shall be used as required for any analog device such as a pressure or level transmitter installed in the wet well. Verify exact requirements of devices to be served.
   v. Acceptable Manufacturer:
      1. Symcom
      2. approved equal

i. Relays
   i. For pump stations supplied with three-phase power, all control and time delay relays shall be at a minimum DPDT 8- or 11-pin octal base D.I.N. rail mounted.
   ii. Acceptable Manufacturer:
      1. Control Relay:
         a. IDEC RR2-ULAC120
         b. Finder 60.13.8.120.0050
         c. approved equal
      2. Time Delay Relays
         a. IDEC RTE-P11-120VAC
         b. Diversified TBC-120-ABA c.
         Finder 85.04.0.125.0000
         d. approved equal

j. Seal Fail and Over temperature Monitoring
   i. Motor high temperature switches shall be connected in the motor control circuits to stop the pump motor if a high temperature condition in the motor windings occurs.
   ii. A Seal Fail relay shall be included to monitor the moisture probes inside the pump motor housing. When moisture is detected, an alarm shall be initiated at a PLC input and a light on the control panel shall be illuminated but the pump motor shall not be stopped.
   iii. If the pump manufacturer or supplier requires that a specific seal fail and over temperature relay be used as a part of the system protection and alarming, that relay shall be supplied to the System Integrator fabricating the Control Panel and the System Integrator shall install and wire that device in the panel.

k. Forced Entry Limit Switch
   i. Forced entry limit switches for each of the Control Panel outer doors shall be wired directly to the PLC. The limit switches shall alarm the opening of the control panel outer doors, but shall not kill power.
      1. Acceptable Manufacturer:
         a. Micro Switch Model 1AC2
         b. approved equal

l. Work Lights

   i. LED work lights (approximately 12 inches long) with safety lenses shall be mounted inside the top of the control panel in Sections #1 and #2 without penetrating the panel outer skin with screws or fasteners. Each light shall be operated with an on/off switch mounted on the inner door.
   ii. Light may also be an LED bulb with a porcelain fixture.

m. Panel Heaters
   i. Low wattage strip heaters shall be installed inside the compartments of Sections #1, #2 & #3 to prevent the accumulation of condensation.
      1. Acceptable Manufacturer:
         a. Watlow #02012096A-40
         b. approved equal

n. Wiring
   i. All wires in the pump control panel shall be numbered at each end with either clip sleeve or heat shrink type markers. Wrap on or adhesive type wire markers shall not be allowed. Control panel schematic shall show wire and terminal numbers. All rungs shall be numbered with relay contacts referenced by these numbers. Relay contacts shall have socket terminals

   noted on drawing. A final 11" x 17" as-built schematic shall be laminated to the inside of the control pane1 exterior door.

o. Miscellaneous devices shall include, but not be limited to, the following:
   i. Selector Switches – Selector switches shall be 30 mm oil tight type with lever operators and a minimum 10 amp contacts. Knob operators shall not be accepted. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 VAC and 10 amps. The number and designation of positions for each selector switch shall be as indicated on the drawings.
   ii. Pushbuttons – Pushbuttons shall be oil-tight industrial units. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 VAC and 10 amps. They shall be maintained contact or momentary contact as required.
   iii. Pilot Lights – Pilot lights shall be push-to-test oil-tight industrial units utilizing 120 volts (unless otherwise indicated on the drawings). Lamps shall be high-intensity LED such that they can be reliably viewed in direct sunlight. Lenses shall be colored as shown on the drawings.
   iv. Elapsed Time Meters – Provide an elapsed time meter for each pump controlled for monitoring pump operating times. Each meter shall be 6-digit, non-resettable, reading in hours and tenths of hours. Run times and starting cycles shall also be recorded and displayed in SCADA.

7.2 PUMP STATION INTERIOR
(Wet Well & Valve Vault)

A. Six mercury level sensors or floats shall be provided with sufficient length cord to extend uninterrupted to the control junction box. The six float levels shall be: pumps off, lead pump on, lag pump on, wet well high water alarm, wet well low level alarm, and retention tank high level alarm. All floats shall be connected to intrinsic safety barriers located in the pump control panel.

B. Wet well level control float leads shall be hung with stainless steel kellem grips from a series J Halliday stainless steel cable holder. The holder shall be bolted to the inside of the wet well hatch, immediately below the hatch cover and shall be located to not interfere with the wet well entrance steps. The pump power cables shall be hung with stainless steel kellem grips from the upper pump guide rail brackets. Power and control wiring shall be routed with adequate separation. All excess wires shall be rolled up inside the valve chamber.

C. Passage of the pump and float wires from the pump chamber to the surface shall be made through two open ended lengths of 4-inch PVC conduit installed between the valve and pump chamber. A minimum of 12" separation should be maintained between the control and power wiring.

   There shall be no electrical connections made in the pump chamber. All wiring shall run unbroken from the pump chamber to the surface to a stainless steel junction box mounted on stainless steel unistrut supports. There shall be two junction boxes, one for control wiring and one for power cables.

D. Wiring from the pressure switches shall be 18 AWG S.T.O. portable cord T & B #25xx portable cord connectors shall be used on the switch end as well as the junction box end of the wire. The cord shall be neatly routed along the discharge pipe with ties, to the chamber joining walls and then run along the walls to the junction box.

E. All wiring in the valve chamber shall be routed and fastened securely along the chamber walls with non-corrosive wire straps and fasteners.

7.3 ELECTRICAL OPTIONS

A. All pumps shall operate using 480 VAC three phase power.

   208 VAC three phase power may be used if that is the only source available. This must be carefully coordinated with Owner and Engineer. Single phase motors should never be used.

B. The following is a list of the basic electrical requirements:
   a. The Utility will provide generic electrical drawings for a three-phase source.
   b. SCADA shall perform all monitoring and alarming functions.
   c. The transducer and float system and hardware shall perform all control functions.

7.4 STATION OPERATIONS

A. PROCESS CONTROL MODE SELECT

Basic process control is to pump down the wet well level, turning pumps on when level rises, and off when level falls.

Two modes of process control exist.

Primary mode of operation (Level Controller) is the normal operating mode. In this mode, a "LEVEL CONTROLLER" pilot light is illuminated. The system operates in this mode when the conditions are

normal (as explained in the following paragraphs). When in this mode of operation, the level controller runs the pumps based wet well level as sensed via a level transmitter. Wet well high/low alarm and pump start/stop setpoints may be set via the level controller. Pump alternation is accomplished via level controller programming.

Secondary mode of operation (FLOAT) is the backup operating mode. In this mode, a "FLOAT" pilot light is illuminated. The system operates in this mode when selected, or when conditions are abnormal (as explained in the following paragraphs). When in this mode of operation, hard-wired relays and timers run the pumps via based on wet well level as sensed via floats. Pump alternation is accomplished via hard-wired alternator. The system is capable of running in this mode as long as necessary.

Primary Control Selector Switch

A "Float-Level Controller-Reset" selector switch exists on the control panel and is used to select the wet well process demand control mode.

Float: Selects Float control. Wet well process demand is based upon floats and hardwired relays in control panel.

Level Controller: Selects LEVEL CONTROLLER control. Wet well process demand and is based upon level transducer, unless control mode has failed over to Float mode.

Reset: Momentary position. Switch returns to "LEVEL CONTROLLER" position. Control mode is reset to LEVEL CONTROLLER from Float. If all faults have not been cleared at the time the reset position is selected, the system may again fail over to the Float mode.

PRIMARY CONTROL FAIL

While conditions are normal (no high levels), the level controller operates the station.

A high level alarm from either the level controller or the float enables the float circuit. Primary control fail must be manually reset by selecting "Reset" on the panel-mounted selector switch.

Any of the following result in primary control fail:

1. Wet well High level float (hard-wired in control panel)
2. Wet well High level from transducer (programmed in level controller)

B. Starter Control and Monitoring

   a. The starters shall be controlled by the level sensors (transducer or floats) through a combination intrinsic safe barrier and alternator/duplexer. Monitoring of the

operation shall be by the PLC. Alarm floats, auxiliary starter contacts, seal fail alarms, and other monitoring/alarm functions shall be wired to the PLC as digital inputs. The Level Transducer and Flowmeter shall be wired to the PLC as analog inputs. A normally closed contact of a time delay relay shall interrupt the starter coil when expected pump discharge pressure is not sensed. Pump Failures shall be reset by switching the H-O-A switch to the OFF position. The contact ratings of the relays shall be 5 amperes minimum. Device Identification

   b. All devices mounted flush on the inner or exterior cabinet doors shall be identified with engraved phenolic legend plates using black letters on a white background.
   c. All devices mounted on the interior of the cabinets, including but not limited to starters, circuit breakers, terminals, relays, etc., shall be labeled with printed, not hand-written, adhesive-backed labels adhered to the subpanel. These are not required to be engraved phenolic legend plates. No labels shall be adhered to wire covers.

7.5 FIELD WIRING SPECIFICATIONS

A. Control panel wiring shall be as follows:
   a. All wiring installed on the line and load side of the electric meter shall be THHN/THWN or XHHW stranded copper wire.
   b. Electric service to the station shall be sized to provide the maximum total station amperage plus 25% of the largest motor's current with all installed pumps running under a fully loaded condition.
   c. All pump station control panels shall be provided with a minimum 100-amp service.

B. Analog wiring shall be as follows:
   a. Two-conductor #18 shielded twisted pair with outer PVC jacket.

C. Grounding system shall be as follows:
   a. Provide a minimum of two (2) 5/8" x 10' copperweld ground rods, one each side of the control panel, connected to each other and to both the control panel grounding connection and to the antenna pole/conduit using minimum #2 copper conductor.
   b. Underground connections shall use exothermic welding or other engineer-approved methods.

D. Wire Insulation Color
   a. 480 volt and 208 volt wiring shall follow industry (and NEC) standards.
   b. Conductors supplying 120 VAC on the line side of a disconnecting switch shall have black insulation for the ungrounded conductor.
   c. 120 VAC wiring (except for neutrals) shall have red insulation. 120 VAC neutral wiring shall have white insulation.
   d. 50 VAC or less shall have yellow insulation.
   e. 12/24 VDC wiring shall have blue insulation.
   f. Intrinsically safe wiring shall have purple insulation.

7.6 CONDUIT SPECIFICATIONS

A. The following conduit sizes are to be used on any combination of pumps with a total station HP of less than 60 HP. For larger HP stations, the design engineer should develop specific

conduit sizes. **(Note that these conduit sizes may be reduced for some pump stations based on wiring used for that specific project.)**

   a. A properly sized conduit shall be routed from Utility supply source to the electric meter mounted in control panel section #3. The meter and disconnect switch shall be connected together with a rigid steel conduit nipple in section #3.Two (2) properly sized conduits shall be routed from the bottom of section #3 to the Automatic Transfer Switch (ATS) – one from the disconnect switch in control panel section #3 to the Utility connections of the ATS and one from the Load connections of the ATS back to the control panel for connection to the main power distribution block.
   b. A properly sized conduit shall be used to route all power wires from the bottom of section #3 to the 12" X 10" X 6" power junction box in the valve chamber.
   c. Three (3) properly sized conduits shall be used to route all control wires from the bottom of section #1 to the 12" X 10" X 6" control junction boxes in the valve chamber. Intrinsically-safe (nonincendive) circuit wiring shall be installed in separate conduits from non- intrinsically-safe wiring. Analog wiring shall be installed in separate conduits from other wiring. These conduits shall be sized based on 40% fill of the conduits with the wiring in the design and 50% spare capacity.
   d. The transfer switch may be mounted on the back of control panel section #2.

B. A properly sized rigid conduit shall be used to serve as an antenna pole and to run the antenna coax from beneath the antenna into Section #1 of the control panel. This conduit/pole shall have a cap at the top to prevent intrusion of water and dirt and shall have a closure/mounting foot at the bottom for bolting to the concrete pad with anchors similar to those used to bolt the control panel to the pad. This conduit/pole shall be bonded to the grounding system and to the control panel. Coax may also be run to the under-side of section #2.

C. All conduits running to or from the control panel shall be run underground at a minimum depth of 36 inches below finished grade.

D. All below ground conduit and their stub-ups shall be PVC schedule 80 or fiberglass.

7.7 ARC FLASH ASSESSMENT

PART 1 GENERAL

A. SCOPE
   a. The scope of the studies shall include the electrical distribution equipment as identified by the Owner.

B. RELATED SECTIONS
   a. Drawings and general provisions. Drawings will be made available to the Contractor for review upon release of a purchase order if drawings for the equipment to be studied are available.

C. REFERENCES
   a. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      i. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

McKELVEY HOMES
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218 CHESTERFIELD TOWNE CENTRE
CHESTERFIELD, MISSOURI 63005
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10849 Indian Head Ind'l Blvd.
St. Louis, Missouri 63132
314.426.6212 Main
314.890.1250 Fax
www.volzinc.com
Authority #203

STATE OF MISSOURI
03/07/2022
TIMOTHY JOHN MEYER
NUMBER E-24665
PROFESSIONAL ENGINEER
TIMOTHY J MEYER
Professional Engineer
MO E-24665

INVERNESS

PUMP STATION - DETAILS

1575 BRYAN RD.

Project # 22450

PHASE 3

01/20/2022

C54

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