

ATTACHMENT A PUMPING EQUIPMENT & CONTROLS TECHNICAL REQUIREMENTS

MATERIALS

LIFT STATION PUMP AND MOTORS

Furnish and install non-clog submersible pumps as shown on the plans and conforming to the following:

- a. Design: Totally submersible, explosion proof, non-clog sewage type pump, capable of passing a minimum of 3" diameter spherical solid.
- b. Acceptable manufacturers for Submersible Pumps:
 - i. Flygt
- c. Performance and Design Requirements
 - i. Kist Lift Station
 1. Number of Pumps = 2
 2. Minimum Sphere Size = 3 inches.
 3. Rated Head = 18.5 ft
 4. Capacity at Rated Head = 600 gpm
 5. Minimum Shutoff Head = 35 ft
 6. Maximum Nominal Pump Speed = 1800 rpm
 7. Maximum Horsepower = 5 hp
 8. Minimum Pump Discharge Size = 6 inches.
- d. General Construction
 - i. Non-Clog: Provide pumps that are centrifugal, non-clog, solids handling, submersible, explosion proof wastewater type pumps capable of handling raw unscreened wastewater.
 - ii. The stator housing, oil chamber housing, and seal housing must be high quality grey cast iron, ASTM A48, Class 35B. Machine all external mating surfaces and seal with a Buna N Rubber O-ring. Provide 316 stainless steel fasteners for all fasteners exposed to the pumped liquids.
 - iii. Provide a pump with an oil chamber for the shaft sealing system. Provide a pump with the drain and inspection plug, with positive anti leak seal, that is easily accessible from the outside.
 - iv. Machine and fit all mating surfaces of major components with O-rings where watertight sealing is needed. Sealing accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

- e. Volute
 - i. Non-Clog Volute: Provide a pump volute (casing) made of A48 Class 35B gray cast iron with an integral spiral shaped cast groove(s) at the suction of the volute. The internal volute bottom or insert ring shall provide effective sealing between the pump volute and the enclosed or semi-open impeller. The sharp spiral groove(s) shall provide the shearing edge(s) across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.
 - ii. The pump volute shall be provided with a flanged cleanout handhole with contoured interior surfaces. The discharge nozzle shall be flanged, with dimensions and drilling conforming to ANSI B16.1, Class 125.
- f. Impeller (semi-open)
 - i. The impeller shall be a semi-open one-piece casting with not more than two non-clog passages. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut.
 - ii. The impeller(s) shall be of gray cast iron, ASTM A48, Class 35B.
 - iii. Shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
- g. Wear Plate (Semi-open)
 - i. An axially adjustable wearing plate shall be provided for semi-open type impellers and arranged to permit adjustment of the axial running clearance between the impeller and plate. The wearing plate shall have an outward spiraling groove designed to force stringy solids outward and away from the impeller.
 - ii. Wearing plate shall be Cast iron, Class 35B.
- h. Shafts
 - i. Pump and motor shaft shall be a solid continuous shaft. The pump shaft shall be an extension of the motor shaft.
 - ii. The pump shaft shall be stainless steel ASTM A479 S43100-T.
- i. Bearings
 - i. The pump shaft shall rotate on at least two grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearing shall consist of at least two angular contact ball bearings for axial thrust and radial forces.
 - ii. The pump bearings shall have a L10 bearing life of a minimum of 100,000 hours.
- j. Mechanical Seals
 - i. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate.

- ii. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant silicon or tungsten-carbide ring.
 - iii. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant silicon or tungsten-carbide seal ring.
 - iv. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. The seals shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement.
 - v. Shaft seals lacking positively driven rotating members or conventional double mechanical seals which utilize a common single or double spring acting between the upper and lower units and requiring a pressure differential to offset external pressure and effect sealing, will not be acceptable. The seals shall not rely upon the pumped media for lubrication.
- k. Motors
- i. The motors shall be submersible type that has been tested and approved by Factory Mutual or U.L. as explosion proof suitable for use in a Class I, Division I, Group D explosion proof area. The motor stator, rotor and bearings shall be mounted in a sealed submersible housing. The stator windings shall have Class H insulation. Motors shall be equipped with thermal overload protection shutdown and then resetting automatically after cool down.
 - ii. Motors shall be sized so they are not loaded above full load rating at any point on the impeller operating curve. Operation in the motor "service factor" range is not acceptable.
 - iii. Refer to Electrical Drawings for motors requirements. The motors shall be suitable for inverter duty. Maximum power required by the pump in the operating head range shall not exceed 90 percent of the motor nameplate rating.
 - iv. Motors shall be specifically selected for service with a variable frequency type speed controller and shall be derated to compensate for harmonic heating effects and reduced self-cooling capability at low speed operation so that the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the variable frequency drive. All motors driven by adjustable frequency drives shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG 1, Part 31, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600 volts ac. Manufacturer shall provide percentage of de-rating, if required.
 - v. The pump and motor shall be designed so that they may operate in a dry-pit condition or submerged in the water. The pump and motor shall be rated for continuous duty.

- vi. The motor stator shall be held in place by a removable end ring that may be easily removed in the field without the use of heat or a press. The electrical power cord shall be terminated in a terminal box, which is sealed on the top and bottom to allow disconnection of the power leads without allowing moisture entry into the motor casing.
 - vii. A heat sensor thermostat shall be attached to motor winding and shall be connected to the motor starter to stop motor if motor winding temperature reaches 250°F. Thermostat to reset automatically when motor cools. Two heat sensors are to be used on three-phase motors.
- I. Power and Control Cables
- i. The power and multi-conductor cable assemblies shall be routed in cable trays and/or conduits and shall extend from the pumps to the respective VFD locations on the operating floor of the pump station. A minimum of 10 feet of excess cable shall be provided for slack.
 - ii. The power cable(s) shall be submersible cable designed specifically for submersible pump applications and be sized according to NEC and ICEA standards for the length of cable required. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without the loss of watertight integrity to a depth of 65 feet.
 - iii. The control cable shall be multi-conductor submersible cable designed specifically for submersible pump applications. The cable shall be multi-conductor type with stainless steel braided shielding, a chloroprene rubber outer jacket and tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 V and 90 degrees C with a 40 degree C ambient temperature and shall be approved by Factory Mutual (FM).
 - iv. The cable entry water seal shall include a strain relief and a grommet type seal designed so that a specific fastener torque is not required to ensure a watertight, submersible seal. The cable entry junction box and motor shall be separated by a stator lead sealing gland or a terminal board. The junction box shall isolate the motor interior from moisture gaining access through the top of the stator housing. The assembly shall provide ease of changing the cable when necessary, using the same entry seal.
- m. Pump Guide Rails, Cable Holders, and Lifting Chains
- i. Pumps shall be equipped with dual stainless steel guide rails to guide the pump into proper alignment with the discharge elbow. The guide rails shall extend from the discharge elbow to the upper guide holder on the access door or wall. All guide rail piping and bracing inside the wet well structures shall be stainless steel. The guide rail diameter and guide rail bracing spacing shall be as recommended by the pump manufacturer. Intermediate guide rail braces shall be stainless steel.
 - ii. A stainless steel cable holder shall be provided to hold the cables.
 - iii. The pumps shall be equipped with a stainless steel lifting chain long enough and strong enough to raise the pump for removal and inspection.

- n. Sealing Discharge Connections
 - i. Each pump in a submersible application shall have a centerline discharge equipped with an automatic pipe coupling arrangement for ease of installation and piping alignment. The pumps shall automatically connect to the discharge piping when lowered into position.
- o. Factory Testing
 - i. Pumps shall be factory tested. Each pump shall be tested at the factory for capacity, power requirements, and efficiency at rated head, shutoff head, operating head extremes, and at as many other points necessary for accurate performance curve plotting.
- p. Start-Up
 - i. Provide services of an experienced, competent, and authorized representative of manufacturer or supplier and equipment to visit site of work and inspect, check, adjust if necessary, and approve equipment installation. Provide one 8-hour day for installation of each set of pumps.
 - ii. Assure that equipment supplier's representative is present when equipment is placed in operation.
 - iii. Verify that equipment supplier's representative revisits jobsite as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory in opinion of Engineer.
 - iv. Furnish to Owner, through Engineer, a written report prepared by equipment supplier certifying that equipment:
 - 1. Has been properly installed and lubricated.
 - 2. Is in accurate alignment.
 - 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
 - 4. Has been operated under full load conditions and that it operated satisfactorily.

LIFT STATION ELECTRICAL

Electrical general requirements are as follows:

- a. Give all necessary notices, obtain all permits and pay all government and state sales taxes, fees, and other costs in connection with electrical work.
- b. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required certificates of inspection for work and deliver same to the Engineer before request for acceptance and final payment of the work.
- c. Provide all material and equipment for the electrical portion of the system bearing the approval label, or listed by Underwriter's Laboratories, Incorporated.
- d. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the contract. Examine the engineering drawings and details for exact locations of fixtures and equipment. Obtain information from the Engineer when fixtures and equipment are not definitely located.

- e. Submit for approval, detailed work drawings of all equipment and all material required to complete the project. No material or equipment may be delivered to the job site or installed until the Contractor has in his possession the approved shop drawings for the particular material or equipment.
- f. Give full cooperation to other trades and furnish in writing, with copies to the Engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

ELECTRICAL EXCAVATING, TRENCHING, AND BACKFILLING

- a. General Backfill Requirements: For under equipment pads use material that has 100% passing 3/4" sieve and gradation to ensure compatibility with no more than 5% passing No. 200 sieve.
- b. Installation Procedures:
 - i. Strip topsoil from new construction and grading areas and stockpile enough for finish grading in area directed by Engineer. Remove excess from site.
 - ii. Provide electrical ribbon marker tape above conduits in each trench.
 - iii. Protect bottom of excavation from frost and do not place structures or conduit on frozen ground.
 - iv. Compact backfill to 90% maximum density, as determined by ND T180.
 - v. Restore surface to original condition.

ELECTRICAL POWER AND INSTRUMENTATION CABLE – LESS THAN 600V

- a. General Purpose Cabling: Provide Stranded Copper with THHN insulation for all general-purpose cabling.
- b. Shielded Twisted Pair: NFPA 70, Type CMP Single pair, twisted, 100% shield coverage, Class B, 16 AWG, stranded (19 x 29) tinned copper conductors (7 strand minimum), 600V Rated.
- c. Installation Procedures:
 - i. Draw conductors into conduit only after conduit system is complete. Install in a manner so as not to injure insulation.
 - ii. Make splices on branch circuit conductors with solderless staple-less, mechanical wire connectors.
 - iii. Provide stranded copper wire for all motor and control circuits 10AWG and smaller. Provide solid copper wire for branch circuits for lighting and convenience outlets.
 - iv. Provide minimum #10 for all branch circuit homeruns greater than 50 feet.
 - v. Use factory color-coded conductors with separate color for each phase and neutral conductor by integral pigmentation for all conductor sizes.
 - vi. Splice only in accessible junction or outlet boxes.

GROUNDING

- a. Furnish and install a complete grounding system for all electrical equipment at the facility and for each antenna mast.

- b. Bond electrical equipment, control panels, panelboards, etc., to the metallic conduit system through conduit connectors or bonding jumpers, as required, to provide effective electrical continuity.
- c. Ground Rods: Copper clad steel, 5/8-inch diameter, 10 feet long.
- d. Provide a properly sized copper grounding conductor in all branch circuit and feeder conduits. Size the conductor according to Table 250-122 of the National Electric Code. Connect the grounding connector to grounding points (grounding bars, ground studs, etc.) in all electrical enclosures, electrical equipment, junction boxes and outlet boxes.
- e. Provide all concealed ground fittings meeting the requirements of the IEEE 837 irreversible compression fitting type.

CONDUIT

Furnish and install a complete conduit system for all conductors. Install low voltage control conductors and fiber optic cabling within a conduit as well.

- a. Rigid Metal Conduit:
 - i. Provide Galvanized Rigid Metal Conduit for all above grade, exposed conduit.
 - ii. Utilize PVC Coated Rigid Metal Conduit and/or fittings as manufactured by Rob Roy Industries for transitions from below grade or existing from concrete.
- b. Schedule 80 PVC Conduit:
 - iii. Use Schedule 80 PVC for all below grade or cast in place conduit.
- c. Installation Procedures
 - i. Size conduits as shown on the Drawings or as required by National Electrical Code (whichever is larger) for number and size of conductors installed.
 - ii. Minimum trade size for home runs is 3/4-inch.
 - iii. Cut conduit joints square and ream smooth. Make bends with an approved bender or utilize standard conduit elbows.
 - iv. Provide sleeves or reinforced concrete boxed out openings through footings for all underground conduits. Coordinate with General Contractor.
 - v. Utilize stainless steel Unistrut and clamps for all applications. Use lead, expansion type with stainless steel hardware for all anchors. Route all conduits parallel to and at right angles to building lines. Conduits mounted directly in contact with wall surface will not be acceptable.
 - vi. Tie wires to hang or strap conduits not permitted.
 - vii. Locate conduits poured in concrete entirely in the middle 1/3 of the concrete member.
 - viii. Conduit systems must be installed complete before conductors are pulled in.
 - ix. Provide watertight installation where conduits pass through the vault wall.

WIRING DEVICES

- a. Furnish and install specification grade devices as manufactured by Hubbell or Equal for all wiring devices.
- b. Provide devices gray in color using stainless steel faceplates.
- c. Provide weatherproof device covers on all exterior devices.

CONTROL SYSTEM

- a. Owner provided PLC and OIT programming as indicated herein. Coordinate details as required with owner/engineer.
- b. This project requires the services of a pre-qualified control systems manufacturer.
 - i. Acceptable Control System Manufacturers are:
 - 1. Integrated Process Solutions, Fosston, MN (218) 435-1703.
 - 2. Sweeney Controls, Fargo, ND (701) 232-3644.
 - 3. Primex, Plymouth, MN (763) 556-0568.
 - 4. Prior Approved Equal.
- c. For full consideration of "Approved Equal" manufacturers, additional information must be provided ten calendar days prior to bid opening. Provide the following information at a minimum:
 - i. A description of company organization, listing types and numbers of registered engineers, other engineers, technicians and other technical employees, production staff and plant production capabilities, lead times, etc.
 - ii. List of service personnel (minimum of 4). Provide their qualifications, locations, dates of hire, and prior experience.
 - iii. A list of insurance carried for:
 - 1. Professional liability "errors and omissions".
 - 2. General liability.
 - 3. General business insurance.
 - 4. Provide carrier, terms for each type, and limits of insurance.
- d. The naming of a manufacturer of equipment in this Specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a minimum standard of quality, and to indicate a principle of operation desired for this project. Other manufacturers of similar system controls are encouraged to submit for prior approval.
- e. No control system manufacturer, or their agent or supplier, shall submit for approval without the full understanding on the part of the control systems manufacturer, Contractor, agent or supplier, that the Engineer will use their own judgment; that their decision is final. No claim of any sort or kind can be made against the Owner or Engineer in the event of adverse decision.

INSTRUMENTATION

- a. Submersible level transducer
 - i. Manufacturer/Model
 - 1. Level transducer manufactured by Keller Part #: LevelRat 1023.15807.0513XX.13 (Where 'XX' is the appropriate cable length modifier that is field determined).
 - 2. Or prior-approved equivalent.
 - ii. Accessories
 - 1. Attach cable and transducer to Anchor Kit.
 - 2. Provide an Intrinsically Safe Barrier for the submersible level transducer as the wet well is rated Class 1 Division 2 per NFPA 820.

b. Anchor Kit

i. General Specifications:

1. 15Lb vinyl coated cast iron anchor.
2. 1/8" 316 stainless steel chain as shown on the Drawings.
3. Stainless steel bracket and hardware.

ii. Manufacturer/Model:

1. Anchor Scientific WRW.
2. Or prior-approved equivalent.

c. Float Switches

- i. Polypropylene with encapsulated single pole mercury switch.
- ii. Contact rating: 3 amps, 120 VAC, resistive.
- iii. Operating differential: 3 inch, nominal.
- iv. Extra flexible cord in length as required for application.
- v. Contact type – SPDT NONC
- vi. Provide an Intrinsically Safe Barrier for the float switches as the wet well is rated Class 1 Division 2 per NFPA 820.
- vii. Manufacturer/Model:
 1. Anchor Scientific GW60NO.
- viii. Schedule:
 1. See Drawings.

d. Ambient Air Temperature Sensor/Transmitter

- i. Continuous averaging, 1000 ohm, suitable for wall mounting platinum RTD type temperature sensor.
- ii. Provide a transmitter by the same manufacturer designed and calibrated for use with the supplied RTD sensor. The transmitter must be capable of producing a 4-20mA signal calibrated for the operating range.
- iii. Operating Range: -13 to 167°F.
- iv. General Specifications:
 1. Tolerance: $\pm 0.1\%$ at 32° F.
 2. Stability: $< 0.05\%$ drift per year.
 3. Repeatability: $\pm 0.1^\circ$ C.
 4. Averaging Sensors: $\pm 1^\circ$ F at 70° F.
 5. Temperature coefficient: 0.00385 ohm/ohm/degree C.
 6. Self-heating coefficient: $< 5\text{mW}$ / degree C.
 7. Reference Resistance: 1000 ohm at 32° F.
 8. Response time in air 1 m/s (90% response): 25 sec.
 9. Interchangeability: $\pm 0.3^\circ$ C at 32° F.
 10. Conformance: IEC 751.
 11. Electrical: 5 mA maximum; 1 mA recommended.
- v. Furnished and installed for the following applications:
 1. Lift Station Control Panel
- vi. Spares:
 1. Provide one (1) spare Temperature Sensor/Transmitter
- vii. Manufacturer/Model:
 1. Omega EWSA-PT100-TX
 2. TCS/Basys Controls - TX1505
 3. Prior approved equal.

e. Control Devices

- i. Provide heavy duty, oil tight type selector switches, limit switches, and indicating lights. Provide contacts meeting NEMA rating designation A600. Provide Cutler Hammer Type T, Allen Bradley Bulletin 800T, or Square D Class 9001 units, Idec, Omron, or equal. Supplied complete with escutcheon and nameplate.
- ii. Provide the following control devices:
 - 1. Pump HOAs (qty. as shown on drawings).
 - 2. Float Test Switches (qty. as shown on drawings).
 - 3. 3-Position Alternator Switch (qty. as shown on drawings).
 - a. Positions for Alternator: 1-2, 2-1, AUTO.
 - b. Positions for Pump Switches: Hand, Off, Auto.
 - c. Positions for Alternator Test Switch: Auto, Test.
 - 4. Area Pole Light HOA (qty. 1).
 - 5. Light Switches (qty.1).

f. Programmable Logic Controllers:

- iii. Base the PLC system for each control panel on the Allen-Bradley (A-B) CompactLogix platform. Provide equipment as indicated on the Electrical Drawings and/or specifications.
- iv. Provide PLC system(s) consisting of a processor, communications modules, and I/O modules, as specified on the Electrical Drawings. In the occasion that the specified item is not available, submit intent to use an alternate module to Engineer and receive approval from Engineer prior to installation of the alternate module.
- v. Provide the following components:
 - 1. Power Supply: Allen-Bradley 1769-PA4
 - 2. Processor: Allen-Bradley 1769-L30ER
 - 3. Analog Input Card: Allen-Bradley 1769-IF4
 - 4. Analog Output Card: Allen-Bradley 1769-OF4
 - 5. Digital Input Card: Allen-Bradley 1769- IA16
 - 6. Digital Relay / Contact Output Card: Allen-Bradley 1769-OW8I
- vi. See I/O Schedule on the 'E' Drawings for exact I/O requirements.

g. Radio Telemetry System:

- i. Provide the following Equipment:
 - 1. Cellular Antenna:
 - a. LTE Multi-Band Omni-Directional Antenna.
 - 2. Connector Type: N-Female
 - 3. Maximum Power: 100W
 - 4. Manufacturer/Model: Surecall SC-588W
 - 5. Lightning Protection:
 - a. Polyphaser TSX-NFF or Prior Approved Equal.
 - 6. Radio:
 - 7. Radio Details: Cradlepoint IBR600C
 - 8. Communications Ports: RJ-45 Ethernet X2, SMA Antenna X2
 - 9. Mounting Bracket
 - 10. Power Supply Adapter

- h. Control Panel (See drawings for additional requirements):
 - i. Provide a Control Panel carrying a UL label applicable to the application.
 - ii. Provide an Interior LED light activated by a door switch.
 - iii. See Sec. 20 drawings for door mounted devices and associated labeling.
 - iv. Contractor is responsible for control panel layouts that ensure all required components fit within respective enclosures with reasonable space remaining.
 - v. Provide a Stainless Steel NEMA 4X enclosure.
 - vi. Enclosure manufactured by SCE and be provided with sunshield panel constructed of stainless steel. Reference drawing number "SCE SUN-SHIELD" when coordinating with SCE.
 - vii. Provide sunshield panels on Top, Front, Back and All Sides.
 - viii. Provide the following items with the panel:
 - 1. Provide a pad-lockable door handle.
 - 2. Inner door pocket for storing wiring diagrams.
 - 3. Enclosure insulated with 1/2" insulation on all sides.
 - 4. Provide a dead front enclosure.
 - ix. Provide the following equipment mounted within the control panel:
 - 1. Incoming Power Surge Protection Device (SPD): Square-D Class 6671 or approved equal.
 - 2. Panel Heater: Hoffman DAH Series or Approved Equal.
 - 3. Terminal Blocks: Allen Bradley 1492-J4 or Prior Approved Equal.
 - 4. Miniature Circuit Breakers: Eaton WMZT or Prior Approved Equal.
 - 5. Fuse Terminals: DIN Rail Mounted 300VRMS, 1/4" x 1-1/4" as manufactured by Allen-Bradley, Phoenix Contact, or Prior Approved Equal.
 - 6. 120 VAC - Surge Suppressor: 120 VAC inline device. Listed for protection from ANSI/IEEE C62.41 Category A and B transients. Required rating of 300 V peak clamping voltage. Provided with a Dry contact status indicator. Manufactured by Critec, Phoenix Contact, or Prior Approved Equal.
 - 7. 24 VDC Power Supply: Provide power supply sized that it allows for a 50% spare capacity. Manufactured by Allen-Bradley or Prior Approved Equal.
 - 8. Control Relays: Provide plug-in type with associated sockets and retaining clips and dust covers. All contacts rated for not less than 10 amps at 120 VAC with 3/16" diameter gold flashed silver cadmium oxide moving and stationary points. Provide insulation resistance of 1000 megohms, nominal, at 500 VDC between all non-connected terminals. Provide dielectric withstand of 2,000 VAC between non connected terminals. Manufactured by Allen-Bradley, Idec, or Prior Approved Equal.
 - 9. Managed Ethernet Switch: Provide managed Ethernet switch equal to Allen-Bradley Stratix 5700 with full software.
 - 10. Operator Interface Terminal (OIT)
 - a. Screen:
 - 11. Size: 10.0-inch
 - i. Type: Color TFT
 - ii. Input Type: Touch
 - b. Communications:
 - i. Ethernet TCP/IP - 10/100
 - c. Memory:
 - i. On board memory.
 - ii. USB Port for Data storage and application backup.

- d. Power:
 - i. 24VDC
- e. Manufacturer/Model:
 - 12. Allen Bradley Panel View Plus 7 Series 2711P Standard 1000
- 13. Uninterruptable Power Supply (UPS)
 - a. 24VDC UPS
 - b. 10A output, 240VA
 - c. 24VDC Power Supply, 120/240V Primary, 5A, 120W, Din Mount
 - d. UPS Battery, Din rail Mounted with cable
 - e. Manufacturer: Sola Hevi-Duty
- i. Circuit Breakers
 - i. Provide UL labeled circuit breakers size as shown on the Construction drawings.
Provide all breakers having an interrupting rating of not less than 35,000 amps, sym.
- j. Receptacles
 - i. Provide a 20 amp specification grade, UL listed ground fault interrupter for the interior convenience receptacle for portable tools, etc.
 - ii. Provide (1) 20A specification grade receptacle in weather proof metal padlockable box with in-use cover and install on the exterior side of the control panel.
 - iii. See the Electrical Drawings for additional information.
- k. Generator Receptacle
 - iv. Provide an Appleton ADR20044RS with angle adapter Appleton AJA200 and back box for the exterior generator power receptacle and ensure plug is compatible with Owners portable generator.
 - 1. Note: Electrical contractor to field test phase rotation to match Owner's generator.
- l. Full Voltage Non-Reversing (FVNR) Starters
 - i. Manufacturer/Model:
 - ii. Square-D
 - iii. Eaton
 - iv. Prior Approved Equal
 - v. NEMA size 2 minimum unless noted on drawings
 - vi. Control circuits as determined by the control integrator
 - vii. Fused control circuit transformer.
 - viii. Hand-Off-Auto selector switch, green "Run" indicating light as indicated on drawings and red "Fail" indicating light where indicated on drawings. Provide other specific control switch/indicating light configurations as indicated on drawings.
 - ix. Minimum normally open auxiliary contacts.
 - x. Three resettable, ambient compensated thermal overload devices (one per phase).
Electronic overload relays are considered acceptable for this requirements.
 - xi. Elapsed time meter.
 - xii. Provide single phase protection either by the electronic overload relay or separate power monitor device.
- m. Terminals and Wiring
 - i. Terminate all field wiring on terminal strips.

- ii. Provide barrier type terminal strips with each terminal being the two-screw type. Provide tin plated copper contacts, capable of carrying 10 amps at 600 VAC, large enough to accept up to and including No. 12 AWG wire.
 - iii. Provide barrier strip with a minimum voltage withstand of 5,000 volts.
- n. Indicating Lights
- i. Nominal 1 inch diameter, opaque colored lens.
 - ii. Press-to-test feature.
 - iii. Heavy-duty, oil-tight.
 - iv. Indicating lights must be large enough to allow hand replacement without the use of special tools.
 - v. LED type.
 - vi. Provide the following indicating lights (color as indicated in the drawings):
 - 1. Pump Run Lights (qty. as shown on drawings)
 - 2. Pump Fail Lights (qty. as shown on drawings)
 - 3. 3-Phase Power OK Light (qty. as shown on drawings)
- o. Enclosure Heat
- i. Manufactured unit with aluminum housing and integral thermostat and 0 - 100F adjustable range.
 - ii. Provide panel heaters for all exterior mounted control panels.
 - iii. UL labeled.
 - iv. Provide quantity and size as required to meet temperature requirements specified.
 - v. Hoffman DAH Series or equal.
- p. Alarm Light (Control Panel Mounted)
- i. Weatherproof, vandal proof unit with polycarbonate globe and operated from 120VAC.
 - ii. Suitable for top mounting on panel.
 - iii. UL labeled.
 - iv. Approved Models:
 - 1. High Level/Common Alarm: Red Constant On: Edwards Model #: 125XBRMR120AB
 - 2. Pump(s) Running: Green Constant On: Edwards Model #: 125XBRMG120AB
 - 3. 3-Phase Power OK: Blue Constant On: Edwards Model #: 125XBRRMB120AB
- q. Power Monitor
- i. Provide a power monitor capable of de-energizing the motor control circuits upon an abnormality. When "normal" power is restored, the unit shall automatically re-energize the control circuits.
 - ii. Provide a unit fitted with instrument fuses and featuring a 0.5 second delay to prevent nuisance operation.
 - iii. Provide a relay that senses negative sequence voltages when a single phasing condition occurs and "pick up" when the negative sequence voltage exceeds 4% (nominal).
 - iv. Provide a relay that senses line-to-line undervoltage conditions and "pick up" at 83% (nominal) of the normal conditions with an inverse time/voltage relationship.
 - v. Manufacturer/Model
 - 1. SymCom MotorSaver 460.
 - 2. Or prior approved equivalent.

SEQUENCE OF OPERATIONS

- a. Duplex Site Operation:
 - i. The operator shall be able to select through the OIT which pump is to be placed into service. Program the PLC such that the two pumps will alternate.
 - ii. Normal Pump Operation - Automatic
 - 1. Start the lead pump when the level in the wet well rises to the lead pump start set point. The external indicating light shall be illuminated green anytime the pump is running.
 - 2. Call to start the 1st lag pump if the capacity of the lead pump is less than the influent flow. Call to stop the 1st lag pump if the influent flow decreases to less than the capacity of both pumps running in parallel.
 - 3. If the high level float is reached & the PLC is offline, the floats take over. (See the Backup Pump Operation description below) When the low level float is reached the system resets to normal mode. Set the external alarm light to illuminated red anytime the floats are controlling the station as described above. An alarm is logged as "Backup float Operation Initiated" in PLC alarm History.
 - 4. Provide the following level set points for control. Provide a typed "set point" schedule which indicates the final settings for all level and time delay settings indicated in this section and/or appear on the set points screen of the OIT. Protect this schedule and make it viewable through a plastic sleeve adhered to the inside of the outer door of the control panel. Provide the final schedule for each lift station to the owner in Microsoft Excel format.
 - iii. PLC Programmed Set Points
 - 1. Start Lead Pump XX.X ft
 - 2. Stop Lead Pump XX.X ft
 - 3. Start Lag Pump #1 XX.X ft
 - 4. Stop Lag Pump #1 XX.X ft
 - iv. Float Elevations
 - 1. High Level Alarm
 - 2. Low Level Float
 - v. The following timers shall be adjustable from the "Timers" screen on the OIT as explained in this section.
 - 1. Lead Pump Start Delay XX.X sec
 - 2. Lead Pump Stop Delay XX.X sec
 - 3. Lag Pump #1 Start Delay XX.X sec
 - 4. Lag Pump #1 Stop Delay XX.X sec
 - vi. Backup Pump Operation (Independent of PLC)
 - 1. The lift station "High Level" float is set at an elevation similar to the elevation used for normal control of the pumps. The float is only used for control purposes when the transducer fails to provide a backup control mode of the pumps which is entirely independent of the primary pump controller.
 - 2. Provide the required emergency control circuitry to backup the primary controls. If the wet well level increases and reaches the "High Level" float in the wet well, override the primary controls and start the lead pump followed by lag pump #1. Lag pump #1 is started if the high level float is active for X seconds.

3. Latch the backup control mode until the station is automatically placed back into normal operation via the wet well reaching the "Low Level" float. Design the backup mode such that the primary controls are entirely isolated from controlling the pumps once the backup mode is active. Any configuration which does not provide a latched backup mode will not be acceptable.