

7.0 ELECTRICAL

7.1 PUMP CONTROL PANEL

- A. GENERAL SPECIFICATIONS: The intent of this specification is to provide a complete, integrated Pump Control System as described herein. It shall be factory assembled, wired and tested. The panel manufacturer shall supply 4 sets of AutoCAD As-Wired drawings upon completion of construction. Two copies of these drawings shall be provided inside the pump control panel and the other 2 sets given to the City's representative.

An equipment data tag shall be permanently affixed on the inside of the exterior door with the station designation, power source, pump horsepower, and pump full load amps. In addition to the label requirements of UL 508A, an engraved legend plate shall be permanently affixed on the inside of the exterior door with the name, address and telephone number of the service representative for the pumps and control panel.

The wet well is classified as a Class I, Division 1 or 2, Group D hazardous location per NFPA Article 820. All applicable installation procedures per NEC, ANSI, EPA, and all other codes and laws for this installation requirement shall be followed. Intrinsically safe barriers shall be provided for the float switches located in the wet well. All pump and control conduits entering or exiting the pump control panel shall have explosion proof conduit seals suitable for Class I, Division 1 or 2, Group D environments. These seals shall be provided and installed by the installing contractor.

1. Quality Assurance: The pump control panel shall be supplied by the pump manufacturer and fabricated by a current UL 508A Listed industrial control panel manufacturer. The panel manufacturer shall show its UL follow-up service procedure file number on submittals. All devices within the panel shall be UL listed and/or recognized where applicable and shall be mounted and wired in accordance with the most current edition of UL508 and NFPA. The panel manufacturer shall have a minimum of 5 years experience manufacturing systems specifically for wastewater applications.

The pump control system(s) shall be fully tested by the factory prior to shipment. It shall include testing of both power and control devices as well as all control functions. A

final inspection shall be performed prior to shipment and a copy of this form shall be provided with the panel.

The panel shall be designed with the following features to operate the specified pumps. The pumps, pump control panel and related accessories shall be supplied by the pump supplier to insure compatibility and assure matching controls to pumps.

2. Basic Operation: The pumps shall be operated automatically or manually as a pump down, lead/lag, common off system. Each pump shall be controlled primarily through a "Hand-Off-Auto" 3-position maintained selector switch. Control function requirements are further defined in the control section of these specifications.
3. Position Commands:
 - (a) OFF - In this position the applicable pump will not run under any circumstance.
 - (b) HAND - In this position the applicable pump shall run without regard for the level sensing commands and will rely on operator discipline to run and stop.
 - (c) AUTO - In this position both pumps shall be controlled by float switches. These switches will sense the appropriate level in the wet well and initiate start and stop commands to the pumps. All floats shall be interposed with intrinsically safe UL. Listed relays installed per NEC Article 504, ANSI/ISA-RP12.6 and all other applicable codes.
4. Pump Sequence: A total of 4 mercury level sensors shall be provided with sufficient length cord to run between the sensors and the junction box unspliced. The 4 levels shall act as:

LEVEL 4 - High Level Alarm
LEVEL 3 - Start Lag Pump; both pumps running
LEVEL 2 - Start Lead Pump; shall alternate on each call
LEVEL 1 - Off; all pumps stop
5. Utility Power: Utility power to the panel shall be 480 volts, 3 phase, 60hz. It is the responsibility of the contractor to bring

the necessary utility power to the pump station site.

- 6 Wet Well: The wet well is classified as a Class I, Division 1, Group D hazardous location as per NFPA Article 820 recommendation.

B. CONTROL PANEL ENCLOSURE

1. General: A UL Listed and NEMA Type 4X enclosure properly sized to contain the required components shall be used. The enclosure shall be constructed of 14 GA stainless steel body and door(s) with continuous stainless steel piano hinge. A dripshield shall be welded on the top of the enclosure; screws to secure the dripshield shall not be allowed. Welded on mounting feet shall be provided; they shall be oversized to readily accommodate mounting the panel on 1 5/8-inch strut. All hardware shall be corrosion resistant. A 3-point latch with nylon rollers and padlock provisions on handle shall be provided. Oil-resistant door gasketing around all 4 sides of opening shall be applied. A painted white enamel steel mounting panel shall be provided for mounting of components. All hardware shall be corrosion resistant. Voltage identification labels and comprehensive warning labels shall be provided. To maintain the environmental rating of the specified equipment and enclosure, install in the openings only certified or recognized devices with the same integrity as the enclosure, in compliance with the installation instructions of the device. The enclosure with the installed inner swing door shall be NEMA Type 4X and UL Type 4X. The enclosure shall be designed specifically for municipal waste water applications.
- 2 Enclosure Accessories: The enclosure shall also provide for and include the following mechanical and electrical facilities:
 - (a) Inner Swing Panel: Provision of a “dead front” feature shall be provided using a full size hinged inner door to mount all operator devices. Material shall be 0.125 inch aluminum with turned down flanges on all 4 sides for added rigidity. The inner door and components shall have a “dead back” feature in order to avoid accidental shock hazard. The inner door shall be large enough to fill the entire opening of the enclosure. The screws used to secure the inner swing door mounting hardware to the enclosure shall be UL and NEMA Type 4X rated/listed and shall not violate the environmental integrity of the enclosure. Mounting hardware which penetrates the enclosure and violates the environmental

rating of the enclosure shall not be allowed. All hardware shall be corrosion resistant. Quarter-turn latches shall be provided for securing the inner door in the closed position; captive screws are not acceptable. In addition, an inner door handle shall be provided for operator convenience.

- (b) Condensation Heater: A 100 watt (minimum), 120 VAC heater shall be provided to protect the enclosure from the harmful effects of condensation corrosion and low temperatures. The heater shall be complete with an adjustable thermostat. Branch protection shall be provided.
- (c) Work Light: A 12-inch fluorescent work light with a safety lens shall be mounted inside the top of the control panel without penetrating the panel outer skin with screws or fasteners. The light shall be operated with an on/off switch mounted on the inner door.

C. HIGH VOLTAGE SECTION

1. Main Lug Only: A power distribution block sized for the incoming power conductors shall be provided for the main power connection. A separate fused service entrance disconnect switch shall be provided and installed by the contractor. The disconnect switch shall be have padlock provisions.
2. Individual Branch Disconnect and Short Circuit Protection: Each pump motor shall be provided with a combination circuit breaker motor starter. Circuit breakers shall be thermal magnetic, "E" frame or better and rated for 14,000 AIC at 480 VAC. Starters shall be NEMA rated. Starters smaller than Size 1 and half sizes will not be allowed. Coils and contacts shall be replaceable without removing the motor starter from the enclosure. Overloads shall be ambient compensated, quick trip (Class 10) type. Overload reset operators shall be provided to reset the overloads without opening the enclosure door.
3. Power Distribution System: Associated with this installation will require the individual branch disconnect and short circuit protection to have a UL interrupting rating of 14 kA at 460 VAC.
4. Control Power: The 120 VAC, single-phase power shall be derived from a properly sized transformer.
 - (a) Control power shall have an over current protection device

suitable interrupting requirements of the system. Fused disconnect shall be provided in accordance with NEC and the system requirements.

5. Lightning Arrester: The system shall be protected by a lightning arrester for the electrical service and shall be capable of handling up to 600vac. It shall be parallel MOV design and provide protection for Category C Transient Surges as defined in ANS/IEEE C62.41 without degradation of components. The arrester shall provide protection between each phase line and the ground line. The arrester shall be UL listed as a secondary surge arrester, UL category OWHX. The enclosure shall be molded UV resistant polycarbonate or equal material. All electrical connectors shall be sealed in a UL component recognized epoxy to exclude moisture, dirt and corrosion. A 1/2-inch conduit nipple and lock nut shall be provided. Leads shall be color-coded and a minimum of 18 inches long. It shall be provided loose for mounting on the exterior of the utility service entrance disconnect by the installing contractor.
6. Ground Lugs: Ground lugs shall be provided for both incoming service and for each motor.
7. Three-Phase Power Monitor: A UL recognized 3-phase power monitor shall interrupt the control power in the event of phase loss, phase reversal, low voltage and phase unbalance. It shall have primary fuse protection. Contacts shall be rated for 15A resistive at 120 VAC. The 3-phase power monitor shall automatically reset when proper power is re-applied.
8. Components: Operator control devices shall be 22mm, NEMA and UL listed for Types 1, 12, 3R, 4 and 4X. Contact blocks shall be self wiping and color-coded bridge type rated at 10A and must have a rated insulation of 600V. Terminal connections shall be suitable for two 14 AWG control wires. All control and time delay relays shall be DPDT rated 10A @ 120 VAC, 8-pin socket mount type. Sockets shall have pressure plate terminals that accept two 14 AWG wires and shall be rated a minimum of 300V. All terminal blocks supplied shall be box lug type rated at the proper voltage/ampereage and shall accept two 14 AWG wires.

D. CONTROL SECTION

1. General: All control wiring shall be minimum 16 AWG, MTW and shall be color-coded in accordance with all applicable codes and

laws. Spiral wrap, tie wrap, fasteners and wire duct shall be provided as required for aesthetics and safety.

All components mounted on the door shall be wired with insulated connectors (where “finger proof” terminals are not provided) to prevent accidental shock hazards. All components on the backpanel shall be mounted on DIN rail or fastened via drilled and tapped screws to facilitate easy component replacement. Pop rivets shall not be allowed. Ammeter loops shall be provided between the disconnect switch and combination starter for better heat dissipation and an easy means of meter reading.

Self-adhesive Brady BMX-C + System vinyl cloth printed adhesive wire markers shall be supplied at both ends of every wire. All components on the backpanel shall be identified by a Brady BMX-C + System metallized polyester printed adhesive label. Dymo labels are not acceptable. These labels shall include all pertinent data applicable to ratings and sizes. Components on the door of the enclosure shall be identified with custom engraved plastic legend plates. Voltage identification labels and comprehensive warning labels shall also be provided.

2. Alternating Relay: An 8-pin socket mount DPDT alternating relay shall alternate each pump on each successive start command. It shall be complete with LED indicating lights showing the status of the internal relay and a lead selector toggle switch which will allow the alternation to be canceled and omit a disabled pump. Contacts shall be rated 10A at 120VAC.
3. Mode Select: Method of operation shall be by a 3-position green illuminated maintained “Hand-Off-Auto” selector switch for each pump which shall provide for mode selection and run indication.
4. Pump Thermal Trip and Seal Leak Detection: A temperature monitoring relay shall be supplied for all pumps. One relay shall be provided for each pump. The relay shall monitor the stator temperature of the pump motor. Over temperature shall be detected by a normally closed low temperature switch mounted on the stator. An over temperature condition will cause immediate shutdown and the pump(s) shall remain locked out until manually reset. The over temperature function shall incorporate a bistable relay that retains its position during power failures. LED's located on the relay shall indicate thermal trip.

Seal leakage detection shall be provided for all submersible

pumps. Seal leakage shall be detected by a resistive float switch in the seal cavity. Detection of a seal leak occurring within the motor chamber shall not shutdown or lockout the pump. LED's located on these relays shall indicate a seal leak condition.

An over temperature pilot light and a seal failure pilot light shall be provided on the inner door for each pump.

5. Elapsed Time Meters(s): A 6-digit non-resettable type hour meter shall be provided for each pump to record hours of operation. These shall be wired with insulated connectors to prevent accidental shock hazards.
6. Intrinsically Safe Relay(s): ISR relays will be provided per Article 504 of the N.E.C. and ANSI/ISA-RP12.6. These relays shall be interfaced with each float switch. Intrinsically safe relays shall be UL 913 listed and shall be 8-pin socket mount style.
7. Convenience Outlet: A 15A GFI duplex outlet shall be provided. It shall be mounted on the inner swing door. A dedicated 15A circuit breaker shall be provided for this outlet.
8. Start Delay: A time delay relay shall be provided to delay the start of the lag pump. This relay shall be adjustable from 1 to 10 seconds and shall be an 8-pin socket mount type with contact ratings as previously specified.
9. Alarms: A weatherproof red flashing incandescent alarm light and a horn rated 90dB at ten feet shall be provided to indicate a high level alarm condition. Alarm power shall be derived from the 120V control power and battery backup. They shall be mounted on the exterior of the pump control panel or fiberglass pump cover and shall be UL recognized for NEMA 4 to maintain the environmental rating of the enclosure. The alarm shall be activated by the level four mercury level sensor (high water sensor) or a power failure.
10. Dialer: An automatic phone dialer shall be provided and placed inside the control panel. The dialer shall be a solid state component capable of dialing from 1 to 8 phone numbers, each up to 30 digits in length. Unit shall have battery backup and be capable of utilizing standard pulse dialing or Touch Tone DTMF. If the control power fails, the dialer shall internally generate and automatically annunciate a power failure alarm. Unit shall be capable of being configured locally or remotely from a standard touch-tone phone.

A pump failure alarm shall occur if a pump is called and the motor starter does not energize within 5 seconds. A pump failure alarm shall also occur if the pump is operating and the motor starter de-energizes for any reason other than as required by the automatic level control. The pump failure timer shall be factory adjustable in one-second increments.

Acceptable manufactures are Microtel "DIALSTAT", Sensaphone model 1108 or approved equal.

- (a) Phone Line: The dialer is to operate on a standard rotary pulse or Touch Tone "dial-up" phone line and is to be F.C.C. approved. A regular private line is to be provided by the contractor. Connection to the telephone is through an industry standard 4-pin modular jack (RJ-11).
- (b) Power: Dialer shall be powered by a dedicated 15-amp circuit. Dialer shall have battery backup.
- (c) Alarm Channels
 - (1) A minimum of 4 alarm channels is required
 - (2) Channel 1 shall indicate pump #1 failure
 - (3) Channel 2 shall indicate pump #2 failure
 - (4) Channel 3 shall indicate high wet well level
 - (5) Channel 4 - Spare or pump 3 fail if needed

E. CONTROL PANEL ACCESSORIES

1. Junction Box: A UL Listed NEMA Type 4X, Explosion Proof enclosure shall be provided for connection of the floats and pumps. It shall contain tubular screw type terminal blocks for floats, pump power and control leads. In addition, it shall have intrinsically safe circuit provisions per NEC Article 504 and ANSI/ISA-RP12.6 and be provided complete with heavy wall fittings and sealing compound. This will be supplied mounted to the Mounting Rack and wired to the pump control panel. The appropriate seal packing and compound shall be provided loose for the installing contractor. The conduits between the pump control panel and the junction box and the wet well and junction box shall be sealed by the installing contractor AFTER start-up tests have been completed. The installing contractor must seal the conduit between the junction box and the wet well with a removable mechanical duct seal.
2. Transfer Switch: Pump stations that are not equipped with back-up

generators shall be provided with a thermal magnetic normal power main circuit breaker and emergency power main circuit breaker for transferring power between the utility and the portable generator. The 2 circuit breakers shall be mechanically interlocked to prevent both breakers from being in the "ON" position at the same time. The normal power circuit breaker shall be sized according to system load per the NEC. Generator size, generator receptacle size and system load shall be considered when sizing the emergency power main circuit breaker. Both circuit breakers shall be rated for a minimum of 10,000 AIC at 240 VAC or 14,000 AIC at 480 VAC.

Pump stations equipped back up generators shall be provided with an automatic transfer switch to switch from utility power to generator power. The switch shall be properly sized for the load served as dictated by NEC and the manufacturer. The switch shall be certified to meet the latest adopted transfer switch standards as defined by UL. Acceptable manufacturers are ASCO, Zenith, Russ Electric or approved equal.

3. Generator Receptacle: A generator receptacle shall be mounted on the side of the control panel. It shall have male contacts and include the required poles to properly interface with the generator system voltage requirements. The generator receptacle shall be suitable for connections in an outdoor environment. The generator receptacle shall be a model CROU ARE6425 RCPT ASSEM-S22 as manufactured by Crouse-Hinds.

7.2 THREE-PHASE MOTORS

All pumps shall utilize be 3-phase motors. Single phase motors shall not be acceptable. Pump stations shall be served by utility supplied 3-phase power. The use of single phase power and a phase converter will only be considered when the cost of having 3-phase power brought to the pump station exceeds twice the cost of single phase power and a phase converter. If a phase converter is to be used, submitted plans shall detail the converter installation. All phase converter installations shall meet the following requirements:

- A. Only converters using a static phase shift method of conversion will be acceptable. Rotary-type converters are unacceptable.
- B. All wiring ahead of the 3-phase panel shall be protected with single phase fusing sized to meet the total single phase amperage; conductors shall be sized based on single phase amperage and fusing.
- C. Converters shall be sized to operate the total installed pump station

amperage with all pumps running.

- D. The converter shall be a Ronk "Add-a-phase", manufactured by Ronk Electrical Industries, Inc. (or approved equal). The converter shall be housed in a locking NEMA-3R rain-tight stainless steel enclosure.

7.3 STATION INTERIOR WIRING

The following electrical requirements shall be followed for wiring installed in the station interior:

- A. All pump power, control leads and level control float leads shall be hung with stainless steel kellum grips from the bracket supplied by the pump manufacturer. The bracket shall be bolted to the inside of the wet pit hatch frame or firmly bolted to the concrete immediately below the hatch frame, immediately below the hatch cover. The bracket shall be located so as not to interfere with the pump chamber entrance steps. All wires shall be neatly passed from the bracket to the raceway.
- B. Passage of the pump and float wires from the pump chamber to the junction box shall be made through a length of conduit installed between the junction box and pump chamber. The power lead for each pump shall be placed in separate conduit. All of the float leads shall be placed in one conduit.
- C. There shall be no electrical connections made in the pump chamber. All wiring shall run unbroken from the pump chamber to the junction box through the conduit and spliced inside of the junction box.

7.4 FIELD WIRING SPECIFICATIONS

Control panel wiring shall be as follows:

- A. All wiring installed on the line and load side of the electric meter shall be THHN copper wire.
- B. Electric service to the station shall be sized to provide the maximum total station amperage 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.

7.5 CONDUIT SPECIFICATIONS

- A. All conduit installed between the pump chamber to the junction box shall be 2-1/2-inch diameter (minimum).
- B. A separate conduit shall be provided for the power leads of each pump. One conduit shall be provided for the float leads.
- C. All conduit running to or from the control panel, should be run underground at a minimum depth of 30 inches below finished grade.
- D. All below ground conduit shall be PVC schedule 80 conduit.
- E. Conduit installed above grade may be PVC schedule 80 or stainless steel conduit. Galvanized steel conduit will not be acceptable.

7.6 MOUNTING RACK

The station pump control panel and junction box shall be mounted on one prefabricated stainless steel structure. The panel shall be placed as follows:

- A. The structure shall be firmly anchored to the top of the pump chamber as shown in the Standard Details. The structure shall be anchored with six 3/8-inch stainless steel Wej-It type stud anchors. Anchor holes shall be drilled to the manufacturer's recommended depth. Anchors shall be Hilti Quick Bolt Two or approved equal.

7.7 EMERGENCY GENERATOR

- A. Pump stations with pumps equal to or greater than 20 hp shall be equipped with a complete and operable emergency/standby electric generating system. The equipment shall be new, factory tested, and delivered ready for installation. The packaged engine generating system shall include, but not limited to, diesel engine, generator, main circuit breaker, controls, fuel tank, exhaust piping, exhaust silencer, batteries, battery charger and other miscellaneous items needed to provide a complete operational system that is capable of automatic start-stop operation. The generator shall be sized so that all the pumps and appurtenances contained in the pump station can run simultaneously.
- B. Acceptable manufacturers are Caterpillar, Onan or approved equal.