

Section 10

Pumping Stations

A. General

1. The information contained in this section is meant to serve as a general guide for pumping station design. All pumping station designs must be submitted to the Authority for review and approval prior to construction.

2. State Requirements

Sanitary sewage pumping stations shall be properly designed to conform to all applicable regulations of the Pennsylvania Department of Environmental Protection (PADEP), Occupational Safety and Health Administration (OSHA) and the Pennsylvania Department of Labor and Industry.

3. Pumping Station Types

Both wetwell/drywell and submersible type pumping stations will be considered. The type of pumping station is subject to the approval of the Authority.

These requirements pertain to pumping stations which will serve multiple and/or industrial or other developments which discharge sewage by gravity to the pumping station site. They do not apply to individual effluent or sewage pumps in low-pressure systems.

4. Permits

The Applicant shall secure, in the name of the Authority, all permits that are required in the name of the Authority such as those from PADEP, Conrail and the Pennsylvania Department of Transportation (PennDOT). The Applicant shall secure, in his own name, all required construction permits such as local street opening permits. Costs of all permits, including any and all bonds required, shall be the sole expense of the Applicant. Any existing street, highway or other improvements disturbed during construction shall be restored to the satisfaction of the appropriate municipality or Owner before the facilities will be accepted for final acceptance by the Authority.

5. Environmental Class

Special consideration must be given to the fact that wetwells, other than those in residential properties, are considered a hazardous Class 1, Group D environment.

6. Safety Requirements

All gears, chains, couplings, projecting set screws, keys and similar rotating or reciprocating parts shall be protected in accordance with the American National Standards Institute (ANSI).

7. Drawings and Details

Prior to approval by the Authority, detailed construction drawings, specifications, design calculations and pump curves must be submitted for review by the Engineer. The drawings will be reviewed for general design, general dimensions and apparent suitability and will be approved or returned for revisions. Such approval will not relieve the Applicant of the responsibility for furnishing equipment which will satisfactorily perform under the conditions specified.

B. Design Criteria

1. Municipal Requirements

All aspects of the site design shall be in accordance with county and local municipal zoning and land development requirements.

2. Site

- a. The pumping station site shall be properly graded to eliminate any storm water problems and/or ponding conditions. After grading, the site shall be seeded and landscaped. Provisions shall be made to include shrubbery or trees in the landscaping to enhance the appearance of the station. The Applicant is responsible for obtaining a good stand of grass until the time of first cutting.
- b. The site shall be of sufficient size to accommodate the pumping facilities and to permit the turn-around of service vehicles.

3. Access Road and Turn-around

- a. The access road and turn-around at the pumping station shall have a paved surface. The minimum width of the paved surface of the access road shall be 12 feet and the access road and turn-around shall be constructed to the following minimum requirements:

Formed, shaped and compacted subgrade

Bituminous concrete base course - 6" thick

Bituminous concrete binder course - 1-1/2" thick

Bituminous concrete wearing course - 1" thick

- b. The paved area within the fenced area must be large enough and be designed so as to allow the turn-around of a single unit utility vehicle with a wheelbase of 20' and width of 8'-6".

4. Fencing and Lighting

- a. The site shall be fenced with vinyl-coated chain link fence 6'-0" high with sliding/rolling link fence gate and personnel gate. The personnel gate may be integral with the sliding/rolling gate or separate. Locking devices must be provided on both gates.
- b. The site shall be provided with overhead exterior lighting.

5. Flow Metering

- a. A magnetic flow meter capable of continuously recording pumped flows shall be provided.
- b. A pen recorder and totalizer shall be provided to record the flow on a circular 10" or 12" diameter chart. The chart speed shall be adjustable to record either 7 days or 24 hours per sheet of chart paper. A one-year supply of pens and charts shall also be provided.

6. Water Supply

- a. Where public water supply is available, furnish and install a 3/4" diameter metered water service terminating at a frost-proof yard hydrant in the case of a submersible type pumping station, and terminating inside the drywell in the case of a wetwell/drywell pumping station. A back flow preventer shall be provided inside the generator building as required by the City of Lancaster. Outdoor installations of the backflow preventer shall not be permitted. Service shall include all fees and charges for the provision thereof.
- b. Where public water supply is not available, furnish and install a well and well pump with all controls, power supply, frost-proof hydrant, and necessary appurtenances. The well and well pump must be capable of producing a minimum of 5 gpm at a pressure of 50 – 70 psig at the hydropneumatic tank.

7. Power Supply

The power supply for each new pump station shall be three-phase power. Additionally, all new pump motors shall operate on three-phase power. Phase

converters shall not be allowed. Any exceptions to this requirement must be reviewed by the Engineer on a case by case basis.

C. Materials and Equipment

1. Description of Equipment

The Applicant shall furnish a complete description of all equipment to be supplied including manufacturer's information and relevant pump characteristic curves based on laboratory tests of existing similar pumps. The curves shall show the capacity, head, efficiency and brake horsepower throughout the head and capacity range.

2. Spare Parts and Tools

- a. The Applicant shall furnish one complete set of all tools that are necessary for the maintenance and repair of the pumps. One pressure grease gun for each type of grease required for pumps and motors shall be furnished.
- b. Spare parts shall consist of one extra set of ball and/or roller bearings, two sets of mechanical seals for each pump, and one extra shaft sleeve for each pump size.

3. Pipes and Fittings

Suction and discharge piping shall be Class 52 (min) ductile iron: ANSI A21.50 and ANSI A21.51. Fittings shall be gray iron or ductile iron: ANSI A21.10, up to 12" inclusive, 250 psi rated. Flanged joints shall be used inside structures. Mechanical joints shall be used for buried pipe.

4. Valves

All valves of the same type shall be provided by the same manufacturer.

a. Gate Valves

(1) Valves shall open to the left (counter-clockwise). Operating nuts or wheels shall have an arrow and the word "open" indicating the direction of opening cast on the valve body.

(2) Acceptable manufacturers: (1) Clow Corporation; (2) American Cast Iron Pipe Co. (ACIPCO); (3) Kennedy Valve; (4) or equal.

b. Check Valves

(1) The valve shall be designed for a minimum working water pressure of 150 psi.

- (2) The valve shall be iron body, bronze mounted, full opening swing check type with bolted cover, stainless steel hinge and malleable iron clapper arm. Disc shall be of cast iron with bronze seat ring.
- (3) Valves 10" diameter and larger shall be furnished with outside lever and spring.
- (4) Valves less than 10" diameter shall be furnished with outside lever and weight.

5. Emergency Generator Building

An emergency generator shall be mounted permanently in a building together with all appropriate electrical controls (including automatic "switch over" controls). The building shall also house the pump control panel and the backflow preventer, meter and hose bibb for installations using public water. The building shall be a masonry type building blending aesthetically with the surrounding environment. Construction details of the building shall be subject to approval by the Authority. Temporary structures will not be accepted, nor will fiberglass generator housings.

D. Station Construction

1. Wetwell/Drywell Type Pumping Stations

a. General

- (1) The wetwell must be capable of being isolated from the incoming flow by means of a gate valve located upstream of the wetwell.
- (2) The station shall be designed and constructed in accordance with the requirements of PADEP, OSHA, and the Pennsylvania Department of Labor and Industry.

b. Pumping Facilities

- (1) A minimum of 2 pumps (one duty, one standby) shall be provided and installed. Pumps shall be of the non-clog type capable of passing a sphere with a minimum diameter of 3 inches. Pump casing shall have built-in suction elbow. Each pump shall be close coupled and shall have two sets of ball bearings designed for both radial and vertical thrust.
- (2) The pump shaft shall be sealed by self-aligning, double tandem mounted mechanical seals immersed in an oil bath chamber. Seals shall be stainless steel construction with a carbon rotating seal face and Ni-resist stationary seal face on the upper seal, and carbon or silicon

carbide rotating seal face and ceramic or tungsten carbide stationary seal face on the lower seal.

- (3) A manually-operated brass valve shall be provided to vent the pump volute.

c. Motors

- (1) The pump motors shall be specifically built NEMA P base, open drip-proof induction type, suitable for 3-phase, 60 Hz, 230/460 volt electrical service. The motors shall have a service factor of 1.15. They shall have normal starting torque and low starting current, as specified for NEMA Design B characteristics. The motors shall not be overloaded at the design condition, nor at any head in the specified operating range.
- (2) Motors shall have Class F insulation, Class B temperature rise, 40° ambient. Insulation shall be of non-hygroscopic materials which resist moisture and are fungus resistant.
- (3) Each motor shall have oversized, grease-lubricated ball bearings with the thrust bearing at the bottom locked in position to eliminate shaft end-play. The motor shaft shall be solid stainless steel.
- (4) The motor-pump shaft shall be centered, in relation to the motor base, within 0.005. The shaft run-out shall be limited to 0.003.
- (5) A special varnish treatment shall be applied to the stator windings and rust preventative compounds shall be used to coat the rotor and stator air gap surfaces and protect the motor against corrosion.

d. Controls

The control equipment shall be as for submersible type stations (Refer to Section 9 – Individual On-lot Sewage Pumps).

e. Dehumidifier

The Applicant shall install an automatic refrigeration type dehumidifier to maintain the relative humidity of the air in the pump chamber as low as possible. The dehumidifier shall be capable of removing three gallons of moisture per twenty-four hours, and shall be automatically controlled by an adjustable thermostat and a panel-mounted humidistat. The condensation shall drain to a sump.

f. Sump Pump

The Applicant shall install in each pumping station a submersible sewage or grinder sump pump with motor mounted directly above the impeller. The volute casting shall have feet to support the impeller entrance the proper distance above the bottom of the sump. The pump shall have a minimum capacity of 100 gpm. The pump shall be controlled by a level control switch, capable of operation on a 2" differential water level. It shall discharge to the wetwell through a 1-1/4" - 2" pipe with two check valves and a gate valve within the pump chamber.

g. Mechanical Ventilation

Mechanical ventilation shall be provided for the pump chamber and wetwell. The equipment must be capable of providing the number of air changes per hour as dictated by the requirements of PADEP and OSHA.

h. Wiring

The pumping station shall be completely wired at the factory, except for the power feed lines, and shall be in accordance with the National Electric Code. All wiring in the pumping station shall be color-coded as indicated on the wiring diagram. Minimum wire size shall be #12 AWG copper. All wiring outside the panel shall be in rigid galvanized steel conduit, 3/4" minimum, except for 115 volt accessory items which are provided with connecting insulated service cord by the manufacturer. Accessory items such as the sump pump, dehumidifier, and air compressors shall be plugged into polarized, grounded convenience outlets, located close to their installed position so that such items can be readily removed and serviced if necessary.

i. Heater

Electrical heaters shall be installed in the station and sized to maintain a minimum ambient temperature of 60° F in the drywell. The heater shall be thermostatically controlled. The heater shall not be placed within two (2) feet of the control panel.

j. Station Painting

In wetwell/drywell pumping stations the following shall apply:

- (1) Metal Surfaces: All motors, pumps, bases, brackets, ladders, piping and steel supports shall be properly primed and painted with two coats of rust inhibitor paint in strict accordance with the manufacturer's recommendations.

- (2) Plastic Surfaces: One coat of epoxy primer followed by one coat of acrylic urethane.
- (3) Concrete and Masonry Walls and Ceilings: One coat of epoxy primer followed by one coat of washable enamel paint.
- (4) Wetwells: Paint all surfaces with sulfide resistant system such as Sauereisen Sewergard - Trowelable No. 210 or approved equivalent.

All paint, painting procedures and application methods shall be as recommended by a reputable paint manufacturer and approved by the Authority.

2. Submersible Type Pumping Stations

a. General

A minimum of two pumps (one duty, one standby) must be provided and installed. The station, including pump and valve chambers, manholes, meter pits, and other structures constructed below grade shall be watertight and must meet current ASTM Specifications. A separate valve chamber must be provided in accordance with PADEP requirements.

b. Wetwell and Cover

The wetwell shall be of reinforced concrete and shall be provided with a hinged stainless steel cover of non-skid pattern. The cover shall be large enough to comfortably accommodate the pumps. The cover shall have angle frame with rectangular opening of sufficient size to permit easy removal of the pumps. Cover shall have a hold-open bar that can be locked in open position, and shall have a lock that uses a key or special insert to open. All hardware shall be 316 stainless steel. All interior concrete surfaces shall be lined with either a PVC or HDPE liner as specified in Section 5 – Precast Reinforced Concrete Manholes.

c. Valve Chamber

- (1) A separate valve chamber shall be provided on the discharge side of the wetwell. The valve chamber shall accommodate a check valve and a gate valve for each pump, and shall be large enough to comfortably accommodate the valves and fittings.
- (2) A NEMA 4 light switch shall be provided on each check valve to signal open/close operation. The switches shall have N.O. (normally open)/N.C. (normally closed) contacts rated 120 volts, 10 amps. These switches shall be connected to the pump fail circuitry.

- (3) The valve chamber shall be provided with a stainless steel hatch cover with a non-skid pattern.
- (4) Chamber shall be minimum 6'-6" deep with aluminum access ladder with rungs at 12" on center or steps of ½ " reinforcing bar encased with copolymer propylene. A 3" diameter drain shall be provided from the floor of the chamber to the wetwell. The floor shall be sloped towards the drain. The drain shall have a check valve to prevent backflow from the wetwell in case of high water level in the wetwell.
- (5) A 120V single phase receptacle shall be provided in the valve chamber for operation of a dehumidifier.

d. Meter Chamber

- (1) A separate meter chamber shall be provided on the discharge side of the valve chamber. The valve chamber shall accommodate a magnetic flow meter and restrained dismantling joint on the downstream side of the meter. A buried plug valve and box shall be installed on the downstream side of the meter chamber.
- (2) The meter chamber shall be provided with an aluminum hatch as manufactured by Bilco, Halliday Products or approved equal. Chamber shall be a minimum 6'-6" deep precast or reinforced concrete structure with aluminum access ladder with rungs at 12" on center or steps of ½ " reinforcing bar encased with copolymer propylene. A 3" diameter drain shall be provided from the floor of the chamber to the wet well. The floor shall be sloped towards the drain. The drain shall have a trap and check valve to prevent backflow from the wet well in case of high water level in the wet well.
- (3) A 120V single phase receptacle shall be provided in the valve chamber for operation of a dehumidifier.

e. Lift-out Rail System

Station shall be provided with a rail system to facilitate easy removal of the pumps. Rails shall be made of stainless steel and are to be firmly fixed with stainless steel rail supports and hardware to the wall of the wetwell or the frame of the cover. However, the rails shall not interfere with the opening and closing of the cover.

f. Submersible Pumps

- (1) Casings: Pump casing and motor casing of ASTM-A48 cast iron. Pump casing of the single volute type, ribbed to prevent excessive

deflection and hydrostatically tested to twice the design head, or 150% of the shutoff head, whichever is greater. Volute sized at all points to pass solids which can pass through the impeller and internally finished to provide smooth, unobstructed flow.

- (2) Impeller: Non-clogging type of ASTM-A48 cast iron, statically, dynamically and hydraulically balanced, capable of passing 3" solids. Key seat the impeller and secure it to the shaft by a hex head impeller nut.
- (3) Pump Shaft: Stainless steel of sufficient strength and size to safely transmit the maximum torque developed by the drive unit. Shaft sized to provide rigid support of the impeller and prevent excessive vibration.
- (4) Pump Shaft Bearings: Ball or roller type, oil lubricated. Upper bearings to support full dead load and hydraulic thrust. Design bearings with a 20,000-hour B10 minimum bearing life per AFBMA test procedure.
- (5) Shaft Seals: Provide each pumping unit with a double mechanical seal, running in an oil-filled reservoir, composed of two separate lapped faced seals, each consisting of one stationary and one rotating tungsten carbide ring each held in contact by a separate spring, so that the outside pressure assists spring compression in preventing the seal faces from opening.
 - (a) Protect the compression spring against exposure to the pumped liquid. Seal the pumped liquid from the oil reservoir by one face seal and the oil reservoir from the motor chamber by the other.
 - (b) Equip each pumping unit with a liquid sensing device to prevent damage to the motor in the event of a shaft seal failure.
- (6) Pump Motor: Provide a motor having Class F insulated windings (which are moisture resistant) housed in watertight casing. The motor shall have cooling characteristics suitable to permit continuous operation in a totally, partially, or non-submerged condition. Motors shall be rated Class 1, Group D hazardous.
- (7) Pump Accessories: Provide the following accessories with each pumping unit.
 - (a) Stainless steel chain of adequate strength and length to permit raising of the pump to the outside of the wetwell for inspection and

removal. Chain must have large secondary links attached at minimum 10' intervals.

- (b) Stainless steel guide rails.
- (c) Stainless steel upper guide rail brackets.
- (d) Pump mooring plate with discharge elbow and lower guide rail support brackets.
- (e) Power cable of adequate length.

g. Controls

- (1) Mercury Float Switch Controller: Provide a control system consisting of mercury float switch and other necessary appurtenances. Switches to be molded into an epoxy-filled polypropylene float. Provide two spare floats with cables to the Owner.
- (2) Pump Controls: One circuit breaker disconnect unit per pump with magnetic trip sized for individual pump protection. This unit shall provide the maximum electrical motor protection available, serving as a circuit breaker and manual disconnect switch.
 - (a) One across-the-line starter per pump, sized in accordance with NEMA horsepower standards.
 - (b) One N.O. auxiliary contact for run status and one N.C. auxiliary contact for stop status, overload relay, and all other controls and accessories necessary for proper operation and protection.
 - (c) Low voltage (24 VAC) level sensing circuitry for intrinsically safe relaying.
 - (d) Solid state alternator for duplex controls.
 - (e) Individual toggle type selector switches to provide "Auto-Off-Hand" control of each pump.
 - (f) 24 Volt AC control transformer, protected by circuit breakers or fuses on both the primary and secondary.
 - (g) Terminals shall be provided for connection of the level sensors.
 - (h) A removable dead-front panel shall be provided to protect the operator.

- (i) All operator controls, toggle switches, circuit breakers, etc. shall be accessible without removing the dead-front panel.
- (j) NEMA 1 enclosure with latch mechanism Duplex 3-phase 240 or 480 volt power supply as dictated by the power company and motor requirements.
- (k) A relay that automatically reconnects the control circuit to Pump No. 2 if the Pump No. 1 circuit breaker trips.
- (l) High level and low level alarm relays with unpowered contacts and terminals shall be included.
- (m) Pump running transformer type pilot lights (red) mounted on operator's control panel. Pump stopped pilot lights (green) mounted on operator's control panel.
- (n) Non-resettable running time meters mounted on operator's control panel.
- (o) Seal leak detector for each pump with unpowered relay contacts for alarming.
- (p) 3-phase power monitor with adjustable settings, stops pump for low voltage, single phasing and phase reversal.
- (q) One pump to be locked off during generator operation with ability to switch to other pump should selected pump fail.
- (r) A "Hand-Off-Auto" selector switch provided for each of the two pumps controlled with the following operation:
 - 1. Hand Position: In this position, the pump controlled by the switch will run regardless of the wetwell level. The pump will continue to run until the switch is turned to "Off" or "Auto".
 - 2. Auto Position: In this position, the operation of the pumps is controlled automatically by the level sensors in the wetwell as follows:
 - a. The control circuit is placed in standby mode when the liquid level rises to tilt the lowest level sensor that is a redundant cutoff and low water alarm.
 - b. As the level continues to rise, the control circuit is energized when the pump off level sensor rises.

- c. As the level continues to rise and the next level sensor is tilted, the first (lead) pump will start. In this step, the pumps will alternate on successive cycles. If Pump No. 1 starts first on one cycle, Pump No. 2 will start first on the next cycle. This insures equal operating time and wear on each pump.
- d. As the level in the well is pumped down, the pump(s) will continue to operate until the level drops just below the pumps' off level sensor.
- e. If the level in the well continues to rise with one pump in operation, the second pump will be turned on when the level reaches the lag pump on high water alarm level float.
- f. If the water continues to rise, the high water alarm level sensor will activate an alarm.

h. Flow Meter

- (1) A flow metering device which is capable of continuously recording pumped flows and displaying instantaneous flow rate and totalized flow shall be provided. Meter shall be a COPA-X, Series 10D14654, magnetic flowmeter by ABB. It shall have a polyurethane liner; ANSI 150, 304 stainless steel flanges and metering tube; 316 SST bullet nose type electrodes; Division 2, Hazardous Location, safety rating; operating on 120 V ac, 60 Hz power; 120 V ac, 60 Hz remote mounted electronics; occasional submergence enclosure; process temperature to 190° F; 4-20 mA dc output signal. Meter shall be factory calibrated with a copy of the report in the O & M manual. Meter grounding shall be in accordance with the manufacturer's recommendations. Meter shall be capable of running empty indefinitely without damage to any component. Meter shall also have communication capabilities to allow for output of flow signal via future telemetry by others.
- (2) A flow converter / transmitter shall be furnished with the meter. It shall operate on 120 V, 60 Hz power, have an isolated 4-20 mA output into a 0 to 1,000 ohms; with a NEMA 4X wall mount; connecting signal cable between flow meter and signal converter; and a seven digit, non-reset totalizer on the face of the enclosure and a scalable pulse output to drive the totalizer with a multiplier power of 10.
- (3) A microprocessor based circular chart pen recorder and totalizer shall be provided to record the flow on a circular 10" or 12" diameter chart, 7-days/24 hour adjustable chart speed and a one year supply of pens and charts. Recorder shall be by ABB, Bristol or Honeywell. It shall

operate on 120 V, 60 Hz power, and an input signal of 4 20 mA DC. Recorder shall integrate and display the totalized flow and be of the non-reset type and shall not reset on loss of power. Pens shall be of the disposable ink type. The mounting case shall be NEMA 3 or 4, as required, for wall or panel mounting.

E. Alarm System

1. An alarm system capable of monitoring the following functions and transmitting the relevant signal to the designated location shall be installed:
 - a. Wetwell/Drywell Type Pumping Stations
 - Power failure
 - High wetwell
 - Low wetwell
 - Water in drywell
 - Generator failure
 - Louver failure
 - Pump failure
 - b. Submersible Type Pumping Stations
 - Power failure
 - High wetwell
 - Low wetwell
 - Seal Leak
 - Generator failure
 - Louver failure
 - Pump failure
2. The dialer shall be a real voice type with 8-channel capacity. Acceptable dialer manufacturers: Verbatim by RACO or MCS 500 by Microtel.
3. Provide a wall-mounted pushbutton telephone and RJ-11 jack. Acceptable manufacturer: Bell, AT&T, G.E., or approved equal. Applicant shall make all

arrangements with telephone company and pay all relevant installation charges and fees.

F. Tests

Field tests shall be carried out at the expense of the Applicant to insure that pumps and all equipment meet the design criteria. The Authority's personnel will witness the field tests.

G. Emergency Power

1. The Applicant shall install a diesel emergency generator set and automatic transfer switch required to run the pumps and all equipment within the station upon loss of normal power.
2. The system components shall be new equipment of current design, not one-of-a-kind, and consist of a state-approved engine-driven, electric generator with mounted start-stop controls, an automatic load transfer control, fuel, oil and anti-freeze, and necessary accessories. All components shall be completely built, tested and shipped by a manufacturer who has been regularly engaged in the production of such equipment for the past ten years and who has a local parts and service facility. The generator shall be as manufactured by Kohler, Caterpillar, Cummins Onan or approved equal.
3. The generator shall be mounted on a welded steel skid base, which in turn shall mount on 6" high I-beams securely mounted to the frame and a concrete pad. The pad shall be sloped to prevent standing water from accumulating under the generator set. The starting batteries shall be placed on a cast iron rack inside the housing. The muffler shall be a hospital-grade silencer attached to the exhaust line by 125-lb. standard pipe flanges. The exhaust line shall contain a condensate trap with drain cock at the first point of rise in the line from the engine. Only long radius elbows shall be used in the exhaust line.
4. All required anchor bolts shall be furnished and installed. A stainless steel flexible pipe shall connect the engine to the exhaust system.
5. Exhaust air ductwork between radiator and exhaust louver shall be 20-gauge galvanized sheet steel. Engine radiator shall have a flexible duct adapter.
6. A thermostatically controlled jacket water heater shall be provided to maintain a jacket water temperature of 90° F. This unit shall be as manufactured by Chromalox or approved equal.
7. Provide a line circuit breaker with the generator. Breaker shall be rated to handle the generated fault currents and shall be one of those listed by the

transfer switch manufacturer. Breaker shall have the required number of poles and current rating capable of handling required load.

8. Provide generator control panel with the following: voltmeter, ammeter, selector switch, start controls, voltage level adjustment rheostat, oil pressure gauge, fault indicators for safety shutdown, "Auto/Manual" switch, water temperature gauge, battery charge rate ammeter, field circuit breaker, running time meter, panel face illumination from the battery, generator failure output contacts.
9. Provide base-mounted diesel fuel tank of sufficient capacity to sustain a minimum of 24 hours running at full load, fuel gauge, fuel lines, threaded vent opening and a full tank of diesel fuel.
10. The use of propane gas as an alternative energy source will be considered by the Authority.
11. A current-limiting battery charger shall be furnished to automatically recharge the starting batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, and fused AC input. AC input voltages shall be 120 volts. Amperage output shall be no less than 5 amperes. Charger shall be LaMarche Manufacturing Company, Magnevolt or approved equal.

H. Transfer Switch

1. The automatic transfer switch shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power. The switch shall afford complete protection. The switch shall be rated as suitable for all classes of loads without de-rating, either open or enclosed.
2. The transfer switch shall automatically transfer its load circuit to an emergency or alternate power supply from failure of its normal or original supply. Upon restoration of the normal supply, the transfer switch shall automatically retransfer its load circuits to the normal supply.
3. All pilot devices/relays shall be of the industrial type rated 10 amperes with self-cleaning contacts.
4. Components of the operating mechanism shall be insulated or electrically dead.
5. All electrical equipment or apparatus of any one system must be the product of one manufacturer, or equivalent products of a number of manufacturers which are suitable for use in a unified system. No circuit breaker types are acceptable, nor parts thereof.

6. For complete protection, close differential voltage sensing relays shall be provided to monitor each phase of the normal supply. A drop in voltage in any phase below the predetermined dropout value of the relay shall initiate load transfer. The relay shall initiate retransfer of the load to normal supply as soon as the voltage is restored in all phases beyond the predetermined pickup value of the relay.
7. The transfer switch shall obtain its operating current from the sources to which the load is being transferred.
8. The automatic transfer switch shall also be furnished with the following options: adjustable 2 to 120 second time delay on normal to emergency; adjustable 0 to 15 second time delay on engine starting; adjustable 12 second to 30 minute time delay on emergency to normal; adjustable 0 to 30 minutes, set at 5 minute time delay for engine cooloff; frequency/voltage relay for emergency source; test switch in cover of switch; normal supply pilot lights, emergency supply pilot light; engine start-stop contacts; relay auxiliary contacts on normal and emergency source, 1 N.O. and 1 N.C.; solid neutral bar assembly; plant exerciser for automatic test operation of plant with transfer of load for pre-selected intervals (adjustable 0-168 hours in multiples of 15 minutes) at least once a week.
9. All accessories and equipment shall be front accessible for ease of maintenance or removal.
10. Transfer switches and options shall be as manufactured by ASCO 940, Kohler, Cummins Onan or approved equal.

I. Lighting

1. The Applicant shall furnish all lighting equipment and components shown on the drawings, listed in the fixture schedule and specified herein.
2. The Applicant shall install lamps and accessories as required. Prior to acceptance of building by the Authority, all fixtures shall be cleaned, free of dust, insects and all foreign matter.
3. The light fixture schedule is as follows: industrial, ceiling mounted fluorescent, 2-lamp, 4 foot, 10-15 apertured up-light porcelain enamel reflectors, 120 volts.
4. Outdoor wall-mounted high pressure sodium, 120 volts, photo control.

J. Electrical Unit Heaters

1. Horizontal forced air unit heaters shall be rated for the building size. Mounting brackets designed for either ceiling or wall swivel mounting shall be

furnished for each heater. The cabinet shall be of 18 gauge die-formed furniture grade steel. Individual adjustable louvers shall be furnished to provide desired control of discharge air. All metal surfaces of the casing shall be phosphate coated to resist corrosion, with a baked enamel finish.

2. Automatic reset thermal over-heat protection shall be provided.
3. Motors shall be of the totally enclosed fan-cooled continuous duty (TEFC), sleeve bearing type, equipped with built-in thermal overload protection.
4. Fans shall be aluminum, directly connected to fan motor, dynamically balanced and designed specifically for unit heater application.
5. Heaters shall be equipped with built-in comfort control thermostats and necessary control transformers and contactors. Heaters shall be equipped with cord and twist lock plug for connection to receptacle and shall be Chromalox, Berko or approved equal.

K. Metal Louvers and Dampers

1. The Applicant shall furnish and install all metal louvers and dampers required for installation in the generator building. Separate louver and damper assemblies shall be supplied for each opening, with the louver assembly on the exterior side and the damper assembly on the interior side.
2. The metal louvers shall be of stationary, weatherproof design complete with screens, trim and closure pieces for a complete installation. It shall be the responsibility of the Applicant to check all opening sizes and completely coordinate the installation.
3. The louver frame and blades shall be extruded aluminum section, 6063T5 alloy. The heads, sills and jambs shall be one-piece structural members with integral caulking strips and retaining beads. All fasteners shall be stainless steel or aluminum. All louvers shall be provided with a ½ -inch mesh aluminum bird screen secured by an extruded aluminum frame.
4. Gravity dampers shall be furnished for installation on the generator discharge. The dampers shall be fully automatic with the blades normally in a closed position and set to open when air pressure is applied. Dampers shall have parallel blades (opposed blades shall not be allowed).
5. A motor-operated damper shall be furnished for installation on the generator air intake. This shall be a fully automatic damper with the operating blades in a spring open position and held closed by a motorized operator. In the event of a power failure, the blades shall open. The intake shall automatically open when the emergency generator starts, and shall remain open until the generator shuts down. All necessary controls, relays and wiring necessary for

a complete working installation shall be furnished and installed. Dampers shall have parallel blades (opposed blades shall not be allowed).

6. The dampers are to be sized to suit the generator air requirements. The exhaust damper shall be sized so that the maximum pressure drop shall not exceed 0.1" of water when the generator is operating at full speed. The intake damper shall be sized 25% larger than the exhaust damper.
7. Damper frames shall be 6063T5 extruded aluminum wall thickness with mitered corners. Blades shall be formed aluminum with extruded vinyl edge seal or 6063T5 extruded aluminum with extruded vinyl edge seals.
8. The operating blades for the motorized dampers shall be operated by an electrically-controlled motor operator. The motor shall be totally enclosed and suitable for operation on 120 volt, 60 Hz, single-phase service. The unit shall be furnished with all controls and accessories for a complete working installation. The actuator motor shall be sized so that it can open the damper in sufficient time to prevent the formation of a vacuum within the generator room.
9. The motor-operated intake damper shall be wired for both manual and automatic operation. A selector switch shall be provided for manual open-close operation.
10. A thermostat shall also be provided to automatically open the intake damper on excessive heat build-up within the generator building. The thermostat shall have a control range of 70° to 140° F, and shall be by Honeywell, Chromalox or approved equal.
11. A limit switch shall be installed at the intake damper location, and shall be positioned so that the switch is operated by the opening of the damper blades. If the damper and switch do not open after a preset time, a relay shall signal a "damper failure" condition to the alarm system. Limit switch shall be as manufactured by Westinghouse, Square D or approved equal.
12. Both louver and damper assemblies shall be free of scratches and blemishes and provided in a baked enamel finish in a color to be selected by the Authority.
13. The louvers and dampers shall be manufactured by Ruskin, American Warming & Ventilating or approved equal.

L. Electrical Construction

1. The Applicant shall meet with the electric company and the local telephone company to determine all requirements at the site for service and metering.

Any excess charges by the utilities for furnishing the required service shall be the responsibility of the Applicant.

2. The Applicant shall furnish and install a service pole at each pumping station if the service is overhead. Service conductors and raceways shall be installed from the generator building underground to the service pole and up the pole terminating in an approved entrance fitting. The power company will furnish and install an overhead service drop to the pole and connect to service conductors. Poles shall be guyed if required to offset pull of power company's service drop.
3. If the service is underground, the Applicant shall furnish and install underground conduit, current transformer cabinet, and meter base. Current transformer cabinet or self-contained meter base, as necessary, shall be mounted on the generator building. The utility companies will furnish and install the service lateral.
4. A grounding grid shall be provided at the service pole. Metal raceways, metal enclosures of electrical devices, transformer frames, neutral conductor and other equipment shall be completely grounded in accordance with the National Electrical Code. All necessary conduit, conductors, clamps, connectors, etc. for the grounding system shall be furnished and installed by the Applicant.
5. Provide a main service entrance approved disconnect switch with current limiting fuses as required. Heavy-duty type, NEMA 1 enclosure indoors, NEMA 3R enclosure outdoors with padlock attachment; Square D, Eaton Cutler-Hammer, G.E. or approved equal.
6. The panel board shall be rated for the voltage present, dead-front type, lockable with thermal-magnetic bolt-on circuit breakers, neutral and ground bus, typed circuit directory.
7. Lightning protection shall be provided on the feeders immediately on the load side of the main disconnect switch, grounding lead as short as possible to grounding system, Innovative Technology, Inc. "P-Plus" series, no equal. A plug-in protector shall be used which has receptacles and RJ-11 jack for the telephone/dialer connections, Innovative Technology, Inc. Model PIU, no equal.
8. Light switches to be 20 amp, 120/277 volt rated, P&S Series 20AC or approved equal; if weatherproof use P&S WP-1 lever handle weathersealing cover with FS box.
9. Receptacles shall be 20 amp rated, 120 volt, two-pole, grounding duplex, P&S 5362 or approved equal; ground fault type to be P&S 2091-F; if weatherproof

use FS box with wet location cover; power outlet receptacle rated as required, heavy-duty, twist-lock, P&S Series or approved equal.

10. Underground conduit shall be PVC Schedule 40 as manufactured by Carlon, Sedco or approved equal. All bends in duct lines of 40° and greater shall be manufactured steel elbows of the same size as the PVC ducts. Ducts shall be encased in four inches of concrete. Where conduits pass under roadways, parking lots, or on filled ground, a mat shall be provided in concrete, consisting of two longitudinal #4 bars with #3 ties, 12" on center. Trenches shall be backfilled with clean dirt, thoroughly compacted.
11. All conduit shall be rigid galvanized steel or intermediate type, conforming to Federal Specifications WW-C-581E and be U.L. listed and manufactured by Triangle Conduit & Cable Company, National, Allied Tube & Conduit or approved equal.
12. Fittings for IMC conduit shall conform to Federal Specifications W-F-408 and shall be threaded type.
13. Install sealing fittings, Crouse-Hinds type EYS or EZS, Appleton type EYS or ESU, or approved equal, wherever a conduit passes into a hazardous area or extends between areas having widely different temperatures.
14. Wires and cables minimum size shall be #12, medium hard drawn copper. For 600 volt service and under, wire shall have Type THHN-THWN insulation. Wire size of #10 and larger shall be stranded. All wiring shall be color coded in accordance with current NEC requirements.
15. For wire size #10 and smaller, a solderless type press connector similar to "Buchanan" shall be used with snap-on type nylon insulator; splices of larger sizes of wire shall be made using an indenter type coupling applied with a hydraulic pressure tool.
16. All materials and workmanship shall meet the minimum requirements of the following standards where applicable:
 - a. National Electrical Code (NEC) - National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts
 - b. National Electrical Manufacturers Association (NEMA), 155 East 44th Street, New York, New York - Standards
 - c. Institute of Electrical and Electronic Engineers (IEEE), 33 West 39th Street, New York, New York - Standards

- d. The U.S.A. Standards Institute, 29 West 39th Street, New York, New York - Standards & Definitions of Electrical Terms (U.S.A.S.)
 - e. National Bureau of Standards, Washington, D.C. - National Electrical Safety Code
 - f. Reflector and Lamp Manufacturers Institute, Inc. 307 North Michigan Avenue, Chicago, Illinois - Lamp Reflector
 - g. Underwriter's Laboratories Inc. - Standards
 - h. OSHA Standards, where applicable, shall also be met, including those for temporary wiring on construction sites.
17. All necessary permits and fees for this work shall be secured and paid for by the Applicant. Inspection shall be by an approved inspection agency licensed by the Commonwealth of Pennsylvania and final certificate of approval shall be delivered to the Authority prior to acceptance.

M. Start-Up

1. The Applicant shall provide the services of fully qualified manufacturer's representatives for services during installation, at start-up, and for instructing the Authority's personnel in the operation, routine maintenance, and trouble-shooting for all equipment, mechanical and electrical, furnished with the pumping station. Applicant shall full load test the generator for four (4) continuous hours using Applicant-furnished load bank. Notify Engineer 48-hours prior to the test. If testing stops for any reason, correct the problem and start new four (4) hour test. Submit test results.
2. The Applicant shall provide five (5) bound copies of a manual fully explaining the operation, routine maintenance and trouble-shooting for equipment. The manuals shall include copies of all shop drawings with all required revisions. These manuals must be submitted to the Authority for approval prior to acceptance.
3. The manuals must include information relative to suppliers of spare and replacement parts.

N. Detail Drawings

Relevant detail drawings are:

- 29 Typical Pumping Station Security Fence and Access Gate

END OF SECTION