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801 General

In situations where gravity flow is not feasible, the TOWN will consider the installation of a wastewater pumping station and a force main. Certain factors must be addressed by the developer for the project for consideration by the Town of Apex. The factors include:

1. Determine the wastewater flow that would be generated by the total natural drainage basin based upon the existing zoning. Design flow factors for this use are found in Section 700 of these Specifications.
2. Evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the line could handle the transferred sewer flow.
3. Perform a cost analysis of the pumping versus gravity alternative to demonstrate that gravity service is not feasible. The estimated installed cost of the gravity alternative must be not less than 3.5 times more costly than the pumping station alternative in order for the Town to allow a pumping station.
4. Adherence to the Town of Apex Policy on Private Pump Stations and Force Mains.

The above information shall be furnished to the *Water Resources Department* for consideration. The *Water Resources Department*, in collaboration with the Town Manager shall determine whether a pumping station will be permitted.

802 Design

A. General Requirements

Site or subdivision plans which propose a wastewater pumping station shall show in summary form the number of lots or units served, the off-site drainage area and zoning, the average daily flow, peak daily flow, and the rated capacity of pumps at a specified total dynamic head.

Pump stations may only be the following type: Submersible Pump Station with guide rail

pump removal system. Pumps shall meet all DENR requirements.

B. Standby Power

All wastewater-pumping stations shall be equipped with an automatic alternative power source. Alternative power sources include on-site standby power generator or dual power feed from a separate electric substation. Standby power generators may only be of the type fueled by either diesel or propane.

C. Site Work

The site work shall be generally graded level to remove runoff from site in a non-erosive manner.

Drainage swales shall be provided to direct drainage away from the site.

The site shall be stabilized by concrete slab or pavement, crushed stone, low maintenance vegetative ground cover or other suitable materials.

The site area shall be secured by a 6-foot high chain link fence topped with 3 strands of barb wire. Fence products shall be only new materials using hot dipped 9-gauge galvanized iron or steel components and aluminum coated fabric after fabrication. Gates shall be slide type and located so as to provide vehicle accessibility to lift the pumping units. There shall be a minimum gate opening of 16 feet to facilitate truck access.

An all-weather (stone base) access road shall be provided to the pumping station site. The access road shall consist of a standard concrete curb tie and apron through the right of way and transition to an asphalt-concrete section with an 8-inch stone base and a 3-inch surface course. The access road shall be a minimum of 12 feet in width, with shoulders and side ditches, as applicable. The maximum roadway grade shall be ten-percent. The site shall feature adequate turn around areas for service vehicles.

A 150-watt high pressure sodium industrial grade light fixture shall be strategically located upon a lighting standard or timber utility pole. The light fixture shall be operated by a circuit breaker in the main control panel; or if a timber pole is used, a pole mounted disconnect switch shall be installed. Mounting height shall be 20-feet (minimum) above finished grade.

A grounding electrode system shall be provided for all pump station site wiring systems and shall be connected to the fence, generator, and electric service.

D. Odor Control

An adequate odor control facility shall be required at a proposed wastewater pump station where deemed necessary by the *Water Resources Department*. This type of facility shall be required when lengthy detention times are anticipated thus creating anaerobic conditions resulting in the release of hydrogen sulfide gas. Detention time, length of the

force main, slow build out of design capacity, etc., will factor in this determination.

E. Piping & Valves

Suction and discharge piping shall be ductile iron flanged pipe designed and manufactured per AWWA Specifications C150 and C151.

A check valve and a plug valve shall be provided for the discharge line of each pump. Valves shall be rated for 175 psi (minimum) working pressure. The plug valve shall be capable of passing a 3-inch solid. Check valves and plug valves shall be mounted in the horizontal position. The valves located in the valve vault shall have a minimum of 3 feet separation between each valve body and the outside walls. All valves shall be centered on the vault door for maintenance access and valve removal.

All piping, couplings, fittings, valves, etc. shall be Class 125 flanges meeting ANSI B16.1 Specifications, unless class 250 flanges are required for high head installations.

Piping shall be designed to provide adequate thrust restraint during pump operating cycle.

F. Structural

All pump station structures shall be designed to withstand the hydrostatic forces that they will be subjected to, including uplift and shall be equipped with buoyancy collars.

Cover slabs for wet well and valve vaults shall be reinforced concrete with integral cast in place access hatch covers. Cover slabs shall be reinforced as per ACI Code and specially reinforced around openings. Access covers shall be double leaf or single leaf (as required) aluminum diamond pattern floor hatch of 1/4-inch (minimum) thickness capable of withstanding 150 psf without permanent damage. Each leaf shall open 90 degrees and be attached to the frame by steel hinges. The door shall have a lock in the open position and vinyl grip handle to release lock for closing.

A separate valve vault shall be required for submersible pump stations. The valve vault shall consist of a precast manhole base section, or a cast-in-place custom built section, or a precast rectangular structure all complete with drain, access ladder, and access cover cast in the structure roof. A clearance of 4 feet is required between the check-valve and the vault wall.

Wet well structures may be cast in place of reinforced concrete or precast concrete construction. If precast manhole units are utilized, they shall conform to the requirements of ASTM C478, with watertight joints per ASTM C443 with durable mastic sealing compound. Structures may be either circular or rectangular in shape but shall have vertical walls. Special requirements of wet wells for submersible pumping stations are noted in Section 803 hereof.

G. Wet Well Features

- 1) Vents - All wet well structures shall have screened vents to allow the escape of

gases and to enable air intake during pump down. Vents shall be of ductile iron flanged elbows with an insect screen at the exposed end of the vent. The insect screen shall be of bronze or aluminum mesh.

- 2) Ladders - Each wet well shall be equipped with removable extension ladder as specified to enable access. The PROJECT ENGINEER shall designate the location on the plans during the review process.
- 3) Interior Corrosion Protection - The interior surface of the wet well shall be thoroughly cleaned of all oils, latence, dirt, loose concrete, etc. All voids or surface blemishes shall be filled or repaired using Calcium Aluminate (mortar). The joints of pre-cast units shall receive three (3) coats of mortar so as to achieve a smooth surface at each joint. After the interior patching has thoroughly dried, the entire surface of the wet well interior shall receive 2 coats Sherwin Williams Sher-Flex or equivalent with a total dry film thickness of 80-125 mils, and all nicks and scratches shall be touched up prior to acceptance. If material other than Sherwin Williams Sher-Flex is proposed, it shall be approved by the DPW prior to use.
- 4) Waterproofing - Precast structures shall have a Sherwin Williams Sher-Flex or equivalent applied to the outside of all tongue and groove joints. Prior to backfilling the wet well structure, the entire surface shall receive 1 coat. The material used for exterior coating shall meet the requirements of Corps of Engineers Specification C-200. The exterior coating shall be applied as to achieve a total dry film thickness of 80-125 mils. The exterior surface shall be clean and dry prior to application of the coating.

All bolted connections (including pipe flanges) inside the wet well shall be made using stainless steel bolts, nuts and washers.

- 5) Handrail Around Hatch Opening - Submersible Pumping Stations - An aluminum handrail shall be provided around the wet well opening of all submersible pumping stations. The handrail shall be closed on three sides, with the fourth side closed by a latching chain. The handrail shall be permanently attached to the concrete cover slab. The chained side of handrail shall face the chain link fence gates for access and pump maintenance. A minimum horizontal clearance of 10 feet between the chains and handrail is required. Hand rails shall be grounded to the primary ground on-site.
- 6) Fall-Through Prevention System - A fall-through prevention system shall be provided with the wet well hatch doors. The system shall be a grate consisting of two leafs made of 6061-T6 aluminum hinged on the same side of the hatch. The grate shall be designed to withstand a minimum pedestrian load of 300 lbs. per square foot. The grate openings shall be 4" x 6" to allow both visual inspection and limited accessibility for maintenance purposes when the grate is closed. The leafs of the grate will pivot on aluminum hinge devices with 316 SS hardware that permit them to rotate upward 90 degrees and automatically lock in place. Aluminum pull rods will be attached to the grate's leafs so the operator is positioned with the grate between him and the hatch's opening whenever he raises a leaf. Each grate leaf

will have a rod made from 316 SS that automatically engages to secure the leaf in its open position, and can be lifted upward to permit the grate leaf to close. The hatch cover will not be able to shut until the grate is closed, thereby insuring the grate is in position when the next operator opens the hatch cover. The grate shall have an OSHA safety yellow finish to increase visual awareness of the safety hazard.

H. Electrical Controls

Power service to wastewater pumping stations shall be 3-phase.

- 1) Control Sequence - On rising liquid level in the wet well, a conductive level probe shall initiate operation of the lead pump at the elevation indicated on the drawings. Should the liquid level continue to rise, a second elevation on the probe would initiate operation of the Lag Pump. The pump (s) would continue to operate until the liquid level recedes to the point where a third elevation on the probe would stop the pumps. Should the liquid level continue to rise above the "Lag Pump On" level, a fourth elevation on the probe would activate the alarm circuit.

The 2 pumps shall automatically alternate between the "lead" and "lag" positions by means of an electric alternator in the panel. The alternating relay within the panel requires lockout capability.

- 2) Control Panel - The duplex pump control panel shall be furnished by the pump manufacturer, completely pre-wired, factory assembled, tested and ready for service. Where possible, pump controls shall be housed in a single panel.

For outside installations at submersible stations, the panel shall be a NEMA 3R door-in-door enclosure, fully gasketed with drip cap. The panel shall be suitable for mounting on the panel board as indicated on the drawings.

The panel shall contain the following elements:

- Acceptable manufacturers such as Square 'D', Cutler Hammer, or ABS;
- Separate Manual Disconnect for each pump with 2-pole adjustable overload protection for each phase;
- Magnetic starter for each pump motor with all leg quick trip ambient compensated overload protection for each motor. Overloads are to have an auxiliary contact for automatic dialer;
- Hand-Off-Auto selector switch for each pump;
- Automatic Electric Alternator with ability to designate either Pump 1 or Pump 2 as lead;
- Circuit Breaker for Control Circuit;

- Motor Thermal protection - Motor control circuit is to shut down if high temperature occurs. Manual resets to be provided;
- MPE LPC420-R-RM Level Control Mode;
- MPE Level Probe-Mode-LP-10;
- Backup float system with 3 floats shall be included as backup to the MPE Level Control;
- Test dial shall be provided to allow simulation of wet well level on MPE Control;
- ≥ 40 hpw shall be 'soft start';
- Horn signaling;
- Control Disconnect;
- Seal failure light for each pump and contact closure for automatic dialer (submersible installations only);
- High temperature light for each pump and contact closure for automatic dialer (submersible installations only);
- Running light for each pump;
- Non-resettable, elapsed time meter for each pump, reading in tenths of hours. Capacity 100,000 hours;
- High-level alarm light with Red Globe and contact closure for automatic dialer (remote mounting for "package" pumps station where panel is inside pump compartment);
- All necessary internal wiring, relays, etc. to provide the operation as described;
- All functions and internal wiring shall be labeled accordingly;
- Junction box shall be stainless steel and installed 4 feet above final grade to ensure water does not damage the internal wiring;
- Automatic Dialer / Scada;
- AC Voltmeter.

Transient Voltage Surge Suppressors (TVSS) shall be specified for the electrical

distribution system.

- 3) Protection from Weather - All external electrical control apparatus shall be protected from the weather by means of a weather shield fabricated of aluminum sheet, 3/16-inch thickness. The weather shield shall be of adequate size to accommodate all electrical control apparatus, including meter base, service entrance disconnect switch, automatic transfer switch, alarm dialer, and pump control panel (submersible pump stations only). The weather shield shall have a clear height of 7 feet, and a minimum overhang of 4 feet. The width shall not be less than 8 feet. The weather shield structure shall consist of structural steel supports with horizontal members as required for individual support of each equipment item and the weather shield. The steel shall be hand tool cleaned, primed and painted with a high-build epoxy polyamide coating system, Tnemec Series 66 or equal. All outside panels shall covered by a canopy.

- 4) **Provide concrete pad, minimum 8' x 4' x 6", for electric control panel.**

I. Alarm Dialer

On all wastewater pumping station installation, an automatic alarm dialer shall be furnished and installed. The dialer unit shall be Aquavx or other approved system.

For Submersible Pump Installations - The system shall be housed in a heavy gauge, UL listed steel cabinet painted with epoxy or baked-on enamel paint, NEMA 4. The unit shall be mounted adjacent to the control panel beneath the rain shield.

J. Water Service Lines

Each pumping station shall have a metered potable water supply service line consisting of a 1-inch service line with a USC approved reduced pressure back-flow preventer and terminating at the pump station site with a freeze-proof yard hydrant.

803 Submersible Pump Stations

A. General

Submersible pumping stations shall be furnished with the following principal features:

- 1) Duplex, Non-Clog Pumps - capable of passing a 3-inch sphere.
- 2) Guide Rail System - including a quick-connect, base discharge elbow mounted to the wet well floor. Guide rails shall be stainless steel pipe, 2-inch minimum diameter, Schedule 40.
- 3) Submersible Pump Motors - shall meet UL requirements for Class I, Division I, Group D for hazardous locations. Dual seals shall be provided and all leads shall be epoxy sealed. Pumps shall be fitted with seal moisture sensor and thermal sensor, both wired to the control panel and alarm system. Motors shall be furnished

with a minimum of 50 feet of waterproof, multi-conductor power and control cable for direct feed to control panel without splicing.

4) Precast Concrete Wet Well

- Minimum size: 6' (round, inside diameter), 6' x 6' (square), or 6' x 8' (rectangle). All wet wells must be concentric.
- Base Slab: cast in place, reinforced concrete having a minimum 28-day compressive strength of 4,000 psi. Precast base sections may be used upon approval of DPW.
- Riser Sections: precast concrete sections conforming to ASTM C-478 with watertight joints per ASTM C-443.
- Top Slab: Cast-in-place, reinforced concrete having a minimum 28-day compressive strength of 4,000 psi.

- 5) Separate Precast Valve Vault - with cast in place concrete cover slab with waterproof, lockable aluminum access hatch. Vault shall be sized to provide adequate clearance around valves and fittings. The valve vault shall consist of a precast concrete manhole base section minimum six-foot diameter, or a precast concrete rectangular structure a minimum six-foot square. Valve vault shall have floor drain and a drain line to the wet well equipped with a backwater valve.

The access cover shall be a square hatch of ¼-inch aluminum diamond pattern plate with steel hinges on an aluminum frame cast in place in the cover slab. The access cover shall provide full access to the valve vault.

B. Manufacturer

Submersible pumps, motors and accessory equipment shall be as manufactured by Fairbanks Morse, ABS Pumps or Hydr-O-Matic. Pumps of other manufacturers may be considered by the DPW upon submittal of complete data, including specifications, performance curves, etc. and also including a list of references of other municipal users, and names and telephone numbers of contact persons.

C. Shop Drawing

Prior to purchase of submersible pumping equipment, the CONTRACTOR shall submit not less than 4 Site Plan sets of data to the *Water Resources Department* for approval, including pump performance data, control panel wiring diagrams and other material required to determine compliance with these Specifications.

D. Operation & Maintenance Manuals

The CONTRACTOR shall submit 3 bound complete O & M Manuals shall be furnished to the *Water Resources Department* covering all equipment furnished - pumps, motors,

controls, alarm dialer, etc. Manuals shall be delivered prior to pump start-up.

E. Spare Parts

At the time that the pumping station is accepted for operation and maintenance by the Town of Apex, certain spare parts shall be furnished, consisting of any items, which may be recommended by the equipment manufacturer and listed, in the O & M Manual. In the case of submersible pump stations, it is anticipated that the spare parts requirements will be minimal. For submersible pumps, a replica of the nameplate with serial number, model number, manufacturer, operating conditions, etc. shall be provided.

F. Warranty

The manufacturers of the pumping equipment, control panel, and dialer shall warrant to the Town of Apex that the equipment which is supplied shall be free of defect in materials and workmanship for a period of 12 months following acceptance of the facility for maintenance by the TOWN. The warranty shall name the TOWN as warrantee and shall be delivered to the *Water Resources Department* at the time of final acceptance.

G. Testing

All pumps shall perform a drawdown test to verify pump capacity flow rates. Town representatives (Pump Maintenance Supervisor and INSPECTOR) shall be present during the test. Documentation of the test shall be provided to the Town before approval is granted.

804 Standby Power Generator System

A. General

All pump stations shall have an automatic standby power generation system conforming to these specifications. The system shall consist of a diesel or propane (0% butane) fueled standby generator in a weatherproof enclosure complete with all equipment and accessories required to automatically supply power to the pump station during a utility power failure. The engine generator set shall start the 2-wastewater pumps in sequence and will run both simultaneously under full load. Simultaneous starting is not required.

Diesel fueled generators may be considered on large installations (greater than 50 KW). Units 50 KW and smaller shall be propane fueled. No natural gas connections shall be utilized to supply fuel.

B. Engine

The engine shall have the following features:

- 1) Engine shall be diesel or propane fueled. Engine shall be 1800 rpm, unless the TOWN waives this requirement.

- 2) Engine shall be liquid cooled and shall have a radiator, coolant pump, thermostat and fan. Air-cooled engines may be approved by the Town for installation of less than 10 kW.
- 3) Fuel system shall be for either diesel or gaseous propane.
- 4) Governor shall be mechanical flyweight type with a speed regulation of 5 percent maximum.
- 5) Lubrication shall be by a positive displacement lube oil pump with positive pressure lubrication to all bearings. Full flow lube oil filter shall be provided.
- 6) Starting system shall be 12 volt, positive shift gear engaging starter.
- 7) Battery charging alternator shall be belt driven, 12 volts, 35 amps with solid state voltage regulator. A battery float charger shall be provided.
- 8) An engine block heater shall be provided with control thermostat. The unit shall be 120 volt.

C. Alternator

The alternator shall have the following features:

- 1) Alternator shall be revolving field, broad range, brushless type designed for minimum resistance, low voltage, waveform distortion, and maximum efficiency. Rotor shall be dynamically balanced permanently aligned to engine by flexible disc coupling. Maximum allowable voltage dip shall be 30%.
- 2) Exciter shall be 3 phase, full-wave rectified with silicon diodes mounted on a common motor shaft, sized for maximum motor starting.
- 3) Voltage regulator shall be solid state with silicon-controlled rectifiers with phase controlled sensing circuits.
- 4) Temperature rise at rated load shall be within limits for class F insulation in accordance with NEMA MG 1-22.40.
- 5) Insulation system shall be Class F in accordance with NEMA MG1-1.65. Rotor shall be vacuum impregnated with 100% solid epoxy resin for complete environmental protection. Stator shall be impregnated twice with varnish conforming to MIL-I-24092, Type M, Class 155.
- 6) Output circuit breaker shall be 3-pole, rated at 145% of alternator full load current.

D. Unit Performance

Frequency regulation of the generator unit shall be 3 hertz maximum, no load to rated

load. Voltage regulation shall be plus or minus 2 percent, no load to rated load. Voltage drop during motor starting shall not prevent the successful starting of the pump motors in the pump station.

E. Control Panel

A unit mounted control console shall be furnished with the following items, completely wired and installed:

- 1) Engine start/stop controls
- 2) Run/Stop/Remote switch
- 3) Remote start/stop terminals for 2-wire starting from automatic transfer switch
- 4) Oil pressure gauge
- 5) Coolant temperature gauge
- 6) Charge rate ammeter
- 7) Overcrank protection and alarm light
- 8) Low Pressure shutdown and alarm light
- 9) High coolant temperature shutdown and alarm light
- 10) Overspeed shutdown and alarm light
- 11) AC Voltmeter and selector switch
- 12) AC ammeter and selector switch
- 13) Voltage adjusting rheostat
- 14) Running time meter
- 15) Exciter circuit breaker, manual reset
- 16) Alarm contact for automatic dialer (generator fail signal)
- 17) Frequency Meter
- 18) Canopy (stainless steel) hood light (florescent)

F. Accessories

All accessories needed for the proper operation of the generating set shall be furnished

and installed. These shall include, but are not limited to, the following:

- 1) Muffler with residential silencing
- 2) Flexible exhaust connection
- 3) Exhaust pipe
- 4) Starting batteries (maintenance free)
- 5) Battery cables
- 6) Battery rack (inside weatherproof enclosure)
- 7) Battery float charger
- 8) Propane tanks, pressure regulator, air and fuel filters, valves and piping
- 9) Flexible fuel line connections to the engine
- 10) Sound retention enclosure (maximum decibel level 65)

G. Weatherproof Enclosure

The generator control panel, batteries and battery charger shall be installed in a weatherproof enclosure.

The weatherproof enclosure shall be welded reinforced sheet steel, 14 gauge, prime coated and finished painted, and shall have hinged or lift-off doors for access to the generator set and all other equipment inside.

H. Gaseous Fuel System

All equipment and piping for the propane fuel system shall be furnished and installed. The fuel system shall conform to NFPA 58

- 1) Fuel Tank – shall be a minimum 250 gallon above ground tank sized to ensure starting and running of the generator set under full load for a period of not less than seventy-two (72) hours, or longer if required by State regulatory authorities, at an ambient temperature of 20 degrees F. Design pressure rating shall not be less than 250 psig.
- 2) Fuel Piping - shall comply with NFPA 58 for a design working pressure of 250 psig. Pipe size shall be per manufacturer's recommendations, but not less than ½-inch.
- 3) Vapor Withdrawal System - shall include a manual shut-off valve at the tank(s), a vaporizer, dry full filter, line service regulator, solenoid fuel shut-off valve to open when engine runs, flexible pipe connection at the engine, and a gas flow regulator.

I. Fuel, Antifreeze, Oil

An 80% charge of propane in the propane storage tank shall be provided at the time of final acceptance by the TOWN. Complete charges of antifreeze and oil shall be provided.

J. Tests

After installation of the engine generator set is complete, and prior to its acceptance by the TOWN, the supplier shall demonstrate the capability of the system to perform in accordance with these specifications to the satisfaction of the TOWN.

A 4-hour load bank test shall be performed to load the generator set to the alternator kW rating at 1.0 power factor. The TOWN shall witness the test.

Any defects that become evident during this test shall be corrected.

Safety shutdown features shall be tested by simulating the primary device contact closure.

K. Manufacturer

The standby power generator set shall be AIRMAN, KOHLER, CATERPILLAR, or GENERAC.

L. Parts & Service

The generator set, controls, and transfer switch shall be furnished by a single supplier.

The engine-generator set supplier shall be the authorized dealer of the engine-generator set manufacturer, and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. Parts and service shall be available 24 hours per day 7 days a week, from a location within a 100-mile radius of the location of the installed generator set.

M. Automatic Transfer Switch

The transfer switch, supplied as part of the standby power supply, shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriter's Laboratories, Inc., Standard UL-508.

The transfer switch shall be housed in a NEMA 3R enclosure. Switch size/rating shall be as indicated on the approved Drawings.

The transfer switch shall be double throw, actuated by a single electrical operator momentarily energized, and connected to the transfer mechanism by a simple overcenter type linkage with a total transfer time not to exceed ½ second from line-to-neutral and

from neutral-to-line. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

An adjustable time delay in the neutral position (0.5 sec.) between the opening of the closed contacts and the closing of the open contacts shall be provided to allow the loads to be demagnetized before transfer. This type transfer switch shall allow the motor and transfer loads to be re-energized after transfer with normal inrush current.

The normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing.

Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs, and shall be silver tungsten alloy protected by arcing contacts, with magnetic blow-outs on each pole. Interlocked molded case circuit breakers are not acceptable.

The transfer switch shall be equipped with a manual operator that is designed to prevent injury to the operating personnel if the electrical operator should suddenly become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flash over from switching the main contacts slowly.

In addition to the above, the transfer switch must have a short circuit with capability in excess of the UL minimum requirements as follows:

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|---------------------|--------------------------------|
| 100 - 150 amperes | 16,000 RMS amperes symmetrical |
| 225 amperes | 20,000 RMS amperes symmetrical |
| 400 - 800 amperes | 40,000 RMS amperes symmetrical |
| 1000 - 1600 amperes | 50,000 RMS amperes symmetrical |
| 2000 - 3000 amperes | 73,000 RMS amperes symmetrical |

Engine starting contacts shall be provided to start the generating plant if any phase of the normal source drops below 80% of rated voltage, after an adjustable time delay period of 3 seconds to allow for momentary dips. The transfer switch shall transfer to standby as soon as the voltage and frequency have reached 90% of rated voltage. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time-delay period of 0-30 minutes shall delay retransfer to normal power until it has had time to stabilize. If the standby power source should fail during the time delay period, the time delay shall be bypassed, and the switch shall return immediately to the normal source. After the switch has retransferred to normal, the engine generator shall be allowed to operate at no load for an adjustable period of time (0-15 minutes) to allow it to cool before shutdown. The transfer switch shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed on normal or standby, and 2 auxiliary contacts on the main shaft; 1 closed on normal, the other closed on emergency. In

addition, 1 set of relay contacts shall be provided to open on loss of the normal power supply. All relays, timers, control wiring and accessories shall be front accessible. Contacts shall be provided to the alarm dialer for generator "RUN" and generator "FAIL". In addition, contacts interlocked to the pump control shall be provided to open when the switch is in the EMERGENCY position to lockout the "LAG" pump.

As a pre-condition for approval, all transfer switches, complete with timers, relays and accessories shall be listed by Underwriter's Laboratories, Inc. in the Electrical Construction Materials Catalogue under Standard UL-1008 (Automatic transfer switches) and approved for use on Emergency Systems.

A programmable exerciser shall be provided which will allow the operator to schedule the starting and transfer time based on the TOWN'S standard exercising schedule. The exerciser program shall allow the operator to monitor run time.

N. Submittal Data

The CONTRACTOR shall provide 3 copies of complete data and 2 copies of shop drawings for the generator set to the *Water Resources Department*.

O. Operating Instructions

Three (3) complete copies of operating instructions and parts list shall be provided prior to acceptance of the unit. Parts list shall include schedule of type and quantity of parts recommended for stock.

P. Warranty

The complete standby power generating system shall be warranted for one year after the acceptance of the generating system by the TOWN. The warranty shall cover all defects in equipment, parts, assembly and installation. The warranty shall be issued in writing by the supplier and delivered to the *Water Resources Department*.

805 Force Main Materials

A. General

Force mains shall be constructed of ductile iron or PVC pipe as specified herein.

Force mains from pumping stations which are to be maintained by the Town of Apex shall not be less than 4-inch nominal diameter, so as to convey a 3-inch solid which may be passed by a non-clog solids handling wastewater pump. Temporary force mains, which may connect to privately maintained grinder pump stations, where permitted by the Town, may be 3-inch or smaller in size.

B. Ductile Iron Pipe

All ductile iron pipe shall be designed as per AWWA Standard C150 for a working

pressure of 150 psi, laying condition 1. Pipe shall be manufactured in accordance with all applicable requirements of AWWA Standard C151.

Pipe joints shall be of the push-on or restrained joint type as per AWWA Standard C111. Pipe lining shall be 401-type ceramic epoxy, all in accordance with AWWA Standard C104.

The pipe shall be furnished in 18-foot or 20-foot lengths.

The following table lists approved manufacturers of DIP, DIP fittings, and RJDIP that are allowable for installation within the Town's system.

| Product Category | Approved Manufacturer | Model/Series | Pressure/Load Rating | Reference Standard | Requirements |
|--|-----------------------|-------------------------------|----------------------|------------------------------------|--|
| Ductile Iron Pipe 4-inch & Larger Diameter Protecto 401 Lined | US Pipe | Tyton Joint | 250-350 psi | AWWA C150 & C151 & DIPRA Standards | 40-mils of Protecto 401 Lining (lining must be less than 1 year old); McWane pipe stamped "McWane by Atlantic States or Clow" only |
| | American (ACIPCO) | Fastite Joint | | | |
| | McWane | Tyton Joint | | | |
| Ductile Iron Fittings 4-inch & Larger Diameter Protecto 401 Lined | Sigma | Mech. Joint | 250-350 psi | AWWA C110/C111 & AWWA C153 | Shall always meet or exceed pipe pressure rating |
| | Tyler Union | Mech. Joint | | | |
| | SIP Industries | Mech. Joint | | | |
| | Star | Mech. Joint | | | |
| | American | Mech. Joint | | | |
| Ductile Iron Restrained Joint Pipe 4-inch & Larger Diameter Protecto 401 Lined | US Pipe | TR Flex | 250-350 psi | AWWA C150 & C151 | Boltless restraint unless otherwise specified |
| | American (ACIPCO) | Flex Ring | | | |
| | McWane | TF Flex (pipes 24" & smaller) | | | |

C. PVC Pipe

C900 PVC pipe may be used when approved by the *Water Resources Department* and shall conform to AWWA C900/C905 and the following requirements:

- 1) Outside diameter shall conform to that of ductile-iron pipe.
- 2) Pipe shall have plain end and elastomeric-gasket bell ends.
- 3) Air release valves shall be 2-inch ARI D-02P sewage dual ARV with plastic body.

D. Fittings

Fittings for ductile iron force mains, 4-inch diameter and larger, shall be ductile iron conforming to the specifications for fittings as previously presented for water distribution under Section 600 of these Specifications. Interior of fittings shall be lined with 401-type ceramic epoxy, all in accordance with AWWA Standard C104.

E. Pipe Lining

- 1) The liner manufacturer shall have a minimum of ten (10) years of successful experience and be able to demonstrate successful performance on comparable projects.
- 2) The material shall be an amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.
- 3) Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
- 4) The following tests must be run on coupons from factory lined ductile iron pipe:
 - a) ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years.
 - b) ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5mm undercutting after 30 days.
 - c) Immersion testing rated on using ASTM D-714-87.
 - 1) 20% Sulfuric Acid – No effect after two years.
 - 2) 140°F 25% Sodium Hydroxide – No affect after two years.
 - 3) 160°F Distilled Water – No effect after two years.
 - 4) 120°F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect.
 - d) An abrasion resistance of no more than 3 mils (0.075mm) loss after one million cycles using European Standard EN 598: 1994, Section 7.8 Abrasion Resistance.

F. Tracer Wire

Tracer wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located in line over the utility to be located. The grade level/in-ground trace wire access box shall be delineated using a concrete marker with a brass plate per Standard Detail.

- 1) All tracer wire and trace wire products shall be domestically manufactured in the U.S.A.
- 2) All tracer wire shall have HDPE insulation intended for direct bury, green color coated per APWA standard.
- 3) Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- 4) Wire installation method requirements are
 - a. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE

- insulation thickness.
- b. Directional Drilling/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
 - c. Pipe Bursting/Slip Lining - Trace wire shall be 7 x 7 Stranded Copper Clad Steel, Extreme Strength with 4,700 lb. break load, with minimum 50 mil HDPE insulation thickness.
- 5) Direct bury wire connectors – shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion, and shall be installed in a manner so as to prevent any uninsulated wire exposure.
 - 6) Non locking friction fit, twist on or taped connectors are prohibited.
 - 7) Termination and access requirements as follows:
 - a. Tracer wire access points are to be no more than 500' apart.
 - b. All tracer wire termination points must utilize an approved tracer wire access box (grade level/in-ground access box as applicable), per Standard Detail.
 - c. All grade level/in-ground access boxes shall be appropriately identified with “sewer” cast into the cap, per Standard Detail.
 - d. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
 - e. All tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the grounding anode wire connection.
 - f. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
 - 8) Test Stations shall be 2 ½” diameter with 2 terminals, green and be equivalent to Bingham and Taylor model P225 SR or Copperhead model LD12 TP and shall be installed in a valve box per Standard Detail.
 - 9) A grounding anode shall be installed at each test station equivalent to Copperhead model ANO-1005.

806 Force Mains - Installation Methods

A. General Requirements

All force main construction methods, including trench excavation, bedding, backfill, etc. shall conform to the requirements for water main installation as specified herein under Section 600.

The engineering drawings for all force mains shall include a profile drawing for the entire length of the main.

Force mains shall be installed in dedicated public rights-of-way or in dedicated utility easements conforming to Section 700.

B. Sewer Air Valves

Sewer air valves and/or air and vacuum valves shall be installed at all high points ≥ 10

vertical feet of change in elevation on the force main per DENR 4.05 A2. The sewer air valves shall be installed in a 5-foot diameter precast concrete manhole per the Standard Detail. The manhole interior surface shall receive 2 coats Sherwin Williams Sher-Flex or equivalent with a total dry film thickness of 80-125 mils, and all nicks and scratches shall be touched up prior to acceptance.

C. Receiving Manholes - Special Requirements

The interior surface of the receiving manhole at the discharge end of the force main and the first manhole downstream of a force main connection shall receive 2 coats of Sherwin Williams Sher-Flex or equivalent. Coatings shall conform to Corps of Engineers Specification C-200. The coating shall have a total dry film thickness of 80-125 mils, and all nicks and scratches shall be touched up prior to acceptance.

Force mains shall discharge at the invert of the receiving manhole and at an angle which is as close as possible to 180-degrees of the outlet pipe.

D. Force Main Identification

All force mains shall be appropriately identified upon installation so that the pipe will not be confused with potable water distribution mains. The force main pipe shall be marked on top of the pipe with warning and identification tape. Tape shall be a minimum 3-inch wide polyethylene plastic tape manufactured specifically for identification of buried utilities including tracer wire enabling detection by a metal detector to a minimum depth of 3 feet. Tape shall be green color and continuously imprinted with warning and identification markings in bold black letters to read "CAUTION – BURIED FORCE MAIN LINE BELOW". Color and printing shall be permanent, unaffected by moisture or soil. Tracer wire shall be green-coated #12 wire. Tape shall be by Blackburn Manufacturing, Joseph G. Pollard Company, or Reef Industries, Inc.

E. Testing of Force Mains

All force mains shall be subjected to a hydrostatic test according to the provisions of Section 600 of these Specifications.