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## SANITARY SEWER LIFT STATION AND FORCE MAIN SPECIFICATIONS CITY OF LOCUST, NORTH CAROLINA

### PART 1: GENERAL

#### 1.01 SCOPE

All sanitary sewer lift stations and their associated force main(s) shall be designed, constructed, and tested in accordance with all provisions of the North Carolina Division of Water Quality's Administrative Code and Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains, and all applicable local building codes. At a minimum, all lift stations shall include duplex submersible pumps with motors installed in a wetwell, lift-out rail systems, valves installed in a valve vault, access hatches, controls, piping, and related appurtenances as described herein. All equipment shall be new, designed for the service intended, and suitable for contact with raw wastewater.

All pumping station lots shall be deeded fee simple to the City of Locust and its successors, assigns, or designees. **The lots shall be sized to provide ample area for the City to adequately maintain the station. At a minimum, the pump station lot shall include a 40' X 40' fenced area, and an additional 5' of property outside the entire perimeter of the fenced area (total minimum lot size = 50' X 50'). Deviations from the minimum lot size must be approved by the Director of Public Works.**

Prior to construction, all designs shall be submitted to the City of Locust Public Works Department for review, evaluation, and approval. The submittal shall include complete final drawings, including mechanical, electrical and site plan drawings for the station. The submittal shall also include design calculations and buoyancy calculations for the station, and operating curves for the proposed pumps to be installed in the station. All plan sheets and design calculations shall be signed and sealed by a professional engineer licensed in North Carolina. **Upon written approval by the City of the submitted documents, the lift station shall be permitted by the North Carolina Division of Water Quality prior to construction.**

#### .02 STATION DESIGN

1. The lift station shall have a 100% reserve peak pumping capacity (dual pumps) and, at a minimum, be capable of pumping at a rate of 2.5 times the average daily flow rate with any one pump out of service. Pump on/off elevations shall be set to achieve 2 to 8 pumping cycles per hour at the average flow rate.

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2. The power source, voltage, and phasing shall be verified by the Engineer before ordering pumps.
3. The City of Locust reserves the right to require odor control facilities at lift stations.
4. All control panels must be weatherproofed and have weather proof identifying labels attached with stainless steel screws.
5. **Design of the station shall include rigid conduit that is appropriately sized by the engineer such that no more than 30% of cross-sectional area of the conduit is filled with wiring.**

**PLEASE NOTE THAT THE REQUIREMENTS HEREIN STATED MAY BE MODIFIED AT THE DIRECTION OF THE CITY OF LOCUST PUBLIC WORKS DEPARTMENT.**

## **1.03 ACCEPTABLE MANUFACTURERS**

Submersible pump suppliers acceptable to the City of Locust Public Works Department are Fairbanks-Morse or equal.

## **1.04 WARRANTY**

The pump manufacturer shall warrant the units being supplied to the owner against defects in workmanship and material for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

In addition, the facility, including all accessories and appurtenances, shall be warranted against defects in workmanship and materials for a period of one (1) year, from the date of written acceptance by the City of Locust.

## **1.05 OPERATION AND MAINTENANCE MANUALS AND RECORD DRAWINGS**

Prior to placing the lift station into service, the manufacturer shall furnish the City with three (3) complete sets of operation and maintenance manuals for the pumps, emergency generator, and related appurtenances supplied on the project.

**In addition, the engineer shall provide the City with three (3) complete sets of record drawings and one (1) copy of the NCDWQ final engineering certification prior to placing the station into operation. The record drawings shall indicate all significant**

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**elevations of the station, including the bottom of the wetwell, pumps off, lead pump on, lag pump on, high water alarm, all pipe penetration inverts, top of wetwell, and top of ground elevations. All sheets of the record drawings and the engineering certification shall be signed and sealed by a licensed North Carolina professional engineer.**

## **PART 2: PRODUCTS**

### **2.01 PUMPS**

1. At a minimum, lift stations shall include duplex submersible pumps capable of comminuting solids into a liquid slurry for force mains of 2-inch diameter or smaller, or non-clog types capable of passing a 3-inch diameter object for force mains 4 inches or greater. Submersible sewage pumps shall be designed to handle raw, unscreened wastewater. Pumps shall be furnished complete with mounting assembly and easy lift-out capability, internal piping and controls, accessories, and all appurtenances required for complete installation and operation as per manufacturer's requirements or these specifications whichever is more stringent. Pumps shall be installed in such a way that solids are fed in an upflow direction to the impeller with no obstructions below the inlet.
2. Pumps shall be designed to accommodate peak design flows with any one pump out of service. Additional capacity may be incorporated into the lift station design if requested and/or approved by the Director of Public Works. Pumps shall be selected such that the motors shall be non-overloading over the entire pumping range, and the pumps are a minimum of 45 percent efficient at the operating point.
3. The discharge connection elbows shall be permanently installed in the wetwell along with the discharge piping. The pumps shall be automatically connected to the elbows when lowered into place, and shall be easily removed for maintenance purposes. The pumps shall be guided by no less than two (2) guide rails extending from the top of the station to the discharge elbows. Removal of pumps shall not require City maintenance personnel to enter the wetwell.
4. All lift-out rail systems shall be stainless steel Type 316. The guide rail supports shall be adjustable so that perfect vertical alignment can be obtained. A welded, stainless steel lifting chain shall be permanently attached to each pump to remove the pumps from the wetwell.

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5. All exposed metal items, such as nuts, bolts, screws, washers, supports, etc., shall be made of Type 316 stainless steel.
6. Pumps shall be provided with two (2) separate tandem-mounted mechanical seals to prevent the pumped liquid from entering the rotor/stator cavity area to ensure reliability of operation. The upper and lower seals shall be mounted to rotate in the same direction. Upper seals shall have ceramic stationary faces and carbon rotating faces using stainless steel springs. Lower seals shall have tungsten carbide stationary and rotating faces with stainless steel springs.
7. Pumps shall be tested in the factory prior to shipping to the jobsite in accordance with the pump manufacturer's recommendations. Pumps shall be delivered, stored, and handled in accordance with the manufacturer's recommendations.
8. All iron and steel parts which will be in contact with the pumped liquid or submerged after installation, including the inside of the casing, the impeller, the discharge elbow, and the pedestal mount, shall be shop cleaned in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. At least 1 quart of the finish coat material shall be furnished with each pump for field touchup.

## **2.02 MOTORS**

1. Motors and motor housings shall be designed for contact with raw, unscreened wastewater. Motors shall be sealed, submersible type, suitable for 480-volt, 60 Hz, three phase current operation with 1.15 service factor. The motors shall be sized so that they will not be overloaded at their rated capacity at any point on the pump performance curve.
2. Motors shall be squirrel cage induction type housed in an oil-filled cast iron watertight enclosure. Motors shall be continuous duty NEMA Design B, insulation shall be Class F for continuous duty in 40 degree C ambient. Stator winding shall operate in clean high dielectric oil that lubricates bearings and seals and transfers heat from windings to outer shell. Motor shall be heat shrunk into housing for proper alignment and superior heat transfer.

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3. Motor shall have two heavy duty ball bearings to support pump shaft and take radial and thrust loads and a sleeve guide bushing directly above the lower seal to take radial load and act as a flame path for seal chamber. Ball bearings shall be designed for a minimum B10 life of 30,000 hours.
4. A heat sensor thermostat shall be imbedded in top of winding and be connected in series with the motor starter coil in control box to stop motor if temperature rises in motor to over 220° F for any reason. Thermostat to reset automatically when temperature drops to a safe limit. Motors shall also be equipped with a moisture sensor which signals an alarm if moisture is present between the two seals.
5. Pump motor cables shall be suitable for submersible pump applications. Cable sizing shall conform to NEC requirements for the full load currents of the motors.

## **2.03 PRECAST CONCRETE WETWELL**

1. Wetwells shall consist of precast concrete, and shall be designed and sized to accommodate wastewater flows expected to become tributary to the lift station for the entire project/development at build out. For regional lift stations, the design shall take into consideration the tributary area, potential growth in the area, and expected service life of the lift station.
2. The minimum size for any wetwell shall be 6-feet in diameter. Wetwells shall be designed with an emergency storage capacity of at least forty-five (45) minutes at average daily design flow in the event of pump failure unless otherwise approved by the Director of Public Works. The required detention volume shall be measured between the pump-off elevation and six inches from the elevation where wastewater could escape to daylight (i.e. six inches below the wet well rim or six inches below the lowest upstream manhole, whichever is lower).
3. The wetwell shall include an access hatch as described elsewhere in these standards. The term “Confined Space” shall be posted on a highly visible sign. Support steps shall NOT be used in wetwell/storage basins unless specifically approved by the Director of Public Works.
4. The wetwell shall be constructed on a solid foundation. The bottom slab of the wetwell shall be set on a minimum of 18 inches of stone, and additional foundation shall be provided in unstable soils conditions.

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5. In general, wetwells shall be designed to have only one inflow inlet pipe. Deviation from this requirement must be approved by the Director of Public Works.
6. If required by the Director of Public Works, the lift station shall be designed with a trash collection basket to catch solids prior to entering the lift station. Trash baskets included on lift stations shall be easily removable for maintenance by City staff.
7. Wetwells shall be vented to the atmosphere and shall be screened to prevent vermin access. Vents shall be located as far as possible from maintenance work stations. Vent pipes shall be a minimum 6-inch diameter ductile iron pipe.
8. Buoyancy shall be considered and flotation of the wetwell shall be prevented with appropriate design and construction methods where high groundwater conditions are anticipated.  
  
Prior to construction of the lift station, complete buoyancy calculations shall be submitted to the City of Locust Engineer and Public Works Director. The buoyancy calculations shall be signed and sealed by a registered professional engineer licensed in North Carolina. At a minimum, in completing the buoyancy calculations, the engineer shall assume a water elevation no lower than the top of the wetwell structure. In addition, the buoyancy calculations shall assume that the wetwell is empty, with the exception of liquid below the pump off elevation.
9. Surface water shall be directed away from the station pad in all directions.
10. Wetwell components shall be located such that normal maintenance and operation of the components can be performed without having to enter the wetwell.
11. All electrical conduit installed between the wetwell and the control panel shall be adequately sealed to prevent gas entry into the panel and pump house enclosure.
12. All bolts, mounting brackets, pump lift chains, etc. must be of proper corrosion resistance, sized to support the applicable static and dynamic loads imposed by the equipment.

## **2.04 VALVE VAULT**

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1. The lift station shall include a concrete valve vault, installed adjacent to the wetwell inside the fenceline of the station. The valve vault shall contain plug valves and check valves on the discharge force main of each pump. The plug valves shall be installed past (downstream of) the check valves on the force main piping. The valve vault shall include an access hatch as described elsewhere in this document.
2. All valve vaults shall be sized to provide 12-inch minimum overall clearance (top, bottom, sides) between the walls of the box and internal components. The valve vault shall include a 4-inch drain line with trap, connected to the wetwell. The valve vault drain shall include a back-flow prevention device (Troy Model A2540 cast iron flap valve or equal). The floor of the box shall be shaped/sloped to drain. All piping through the walls of the pit shall be of ferrous material. All valve pit boxes shall be set on a solid foundation with a minimum of 18 inches of stone.

## **.05 PLUG VALVES**

1. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs. In general, valves installed underground shall be mechanical joint and exposed valves shall be flanged. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard. Mechanical joint ends shall be to the AWWA Standard C111-64.
2. Bodies & Plugs shall be of ASTM A126 Class B cast iron. Bodies in 4" (100 mm) and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel. Valve bodies shall be hydrostatically tested to 270 psi for all valves smaller than 14" and 230 psi for 14" and above. Every valve shall be given a hydrostatic and seat test with test results being certified when required by the specifications. Port area of all valves shall be equal to 100% of the full pipe area. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. Plug shall have Chloroprene, Neoprene or other resilient facing suitable for use in domestic sewage or sludge applications.
3. Bearings shall be sleeve type metal bearings and shall be permanently oil impregnated. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and repackable without removing the actuator or bonnet from the valve under pressure.

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4. Flanged valves for manual service shall require a lever operator through 6", and valves larger than 6" shall be operated with a geared operator using a handwheel or chainwheel. Buried or submerged valves shall be operated by a 2" operating nut. All valves for buried or submerged service 6" and larger shall have a totally enclosed gear operator with all exposed nuts, bolts and washers being stainless steel. Each valve shall be sized for drip tight shut-off based on its application, but as a minimum provide direct pressure shut-off (flow against the back of the plug) of 100 psi and reverse pressure shut-off of 50 psi.
5. All external and internal ferrous components and surfaces of the valves, excluding stainless steel and bearing surfaces shall receive two coats of a premium epoxy coating to 8 mils thickness.

## **2.06 CHECK VALVES**

1. Each pump shall have a full flow swing check valve. Swing check valves smaller than 3" shall be single disc with renewable bronze seat rings, bronze discs or disc rings and bronze disc hinges and pins and shall be designed to give a full diameter passage.
2. Swing check valves 3" and larger shall be constructed with heavy castiron or caststeel body with a bronze or stainless steel seat ring and a noncorrosive shaft for attachment of weight and lever. Check valves shall absolutely prevent the return of water back through the valve when the inlet pressure decreases below the outlet pressure. The valve disc shall be of castiron or caststeel and shall be suspended from a noncorrosive shaft.

## **2.07 ACCESS HATCHES AND DOORS**

1. Access doors/hatches for the wetwell and valve vault shall be sized and located so as to provide easy and direct access for maintenance crews and equipment. Hatches shall be cast into the concrete tops of the wetwells and valve vaults. Sizes shall be selected by the pump manufacturer to assure the pumps can be adequately removed through the hatches. Placement shall also factor non-interference with other station components and safety concerns as relating to working in close proximity when in the open position.
2. Access doors and all appurtenances to the valve vault shall be of all aluminum construction. Access frames and covers shall be provided with a continuous concrete anchor, as part of the one-piece extrusion. All access



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doors shall be mounted in such a way that concrete completely supports the bottom face of the frame, and the basin material shall be designed to support the hatch support loading. The frame shall be a self-draining channel with a 1-1/2 inch draining coupling located in the channel frame.

3. The doors shall be provided with tamperproof fasteners. The doors shall open to 90 degrees and lock automatically in that position with a positive locking arm and a release handle. Doors shall close flush with the top of the frame, resting on a 1/2-inch minimum wide lip around the entire inside of the frame. All accessory components of access hatches (hinges, handles, locking arms, etc.) shall be of manufacturer's recommendations and specifications to meet the required loadings and serviceability.
4. All nuts, bolts, washers, and miscellaneous hardware shall be stainless steel Type 316. In no case shall carbon steel components be allowed that will present a rusting or sparking condition. All access doors at the lift station facility shall be made as to be lockable. Elevation of the top of all accesses shall be at least 6 inches above final grade and installed level. Finished grade shall be such as to leave no voids under the top slab and shall be stable as to erosion potential.

## **2.08 FORCE MAIN PIPING**

1. All pipe materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. Exposed piping inside the wetwell and valve vault shall be flanged joint, Class 350 ductile iron pipe. Ductile iron piping and fittings shall comply with the most current ANSI/AWWA specifications.
2. Force main piping outside the lift station site to the point of discharge may be either Class 350 ductile iron pipe or C-900 PVC pipe. Specific pipe materials may be required by the Director of Public Works.
3. Minimum force main diameter shall be 4-inches unless grinder type pumps are provided. Minimum force main diameter with grinder pumping stations shall be 2-inches.
4. Prior to acceptance, force main piping shall be subjected to a hydrostatic pressure-leakage test. Force mains shall be tested in sections not to exceed 4,000 lineal feet per test section. The main shall be subjected to a hydrostatic pressure of 100 psi for a period of two hours. The rate of

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leakage shall be determined in 15 minute intervals, and shall not exceed ten (10) gallons per inch of pipe diameter per mile of pipe per 24 hours.

5. Cracked or defective pipe, joints, fittings, or valves discovered in consequence of this test shall be removed and replaced with sound materials, and the test shall be repeated until the test results are satisfactory. Precautions shall be taken to remove or otherwise protect equipment in, or attached to, pipe to prevent damage or injury thereto.

## **2.09 CONTROLS**

1. Controls for operation of the duplex pumping system shall be furnished by the Supplier of the lift station in accordance with the following requirements. All controls and accessories shall be of the pump manufacturer's model and type specified and approved by the City of Locust Public Works Department and the Building Inspection Department having local jurisdiction. Controls shall be intrinsically safe.

### **A. Pump Control Panel**

Each submersible pump system shall be furnished with pump control panel, control devices, and level switches. The control panel shall be designed to operate from a 120/240 or 277/480-volt, 60-Hz, single- or three-phase external source. Terminals shall be provided for connections of all external wire. Panel shall be intrinsically safe. All control and electrical panels shall be supplied with single line drawings and blue prints to show the actual physical location of all components shown on the single line drawing. All control panels shall have a cover, either integral to the panel and support or freestanding, to provide protection from the weather while working in the panel.

### **B. Wiring**

All internal device wiring shall be as normally furnished by the manufacturer. All interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C. All wiring shall be in accordance with the National Electrical Code Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG.

Indicating light circuits shall be minimum 16 AWG. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors

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and shall agree with the color-coding legend on the system Supplier's panel wiring diagrams. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. The panel fabricator shall provide such additional circuits as required for proper operation. Wiring in enclosed panels will be numbered to match prints and all drawings.

## **C. Nameplates**

Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends consistent with the control descriptions included in the following paragraphs for each device, and shall be made of laminated phenolic material having engraved letters approximately 3/16-inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel.

## **D. Cabinet**

Cabinet shall be a custom-engineered enclosure that is intrinsically safe. In all applications, unless specifically approved by the City of Locust Public Works Department, all controls and devices associated with the pump control system, shall be placed within the interior of this control panel enclosure. All circuits which are routed between backplate-mounted components within the enclosure shall be physically protected in flexible non-metallic conduit. The enclosure shall be NEMA 4X stainless steel. Condensation protection space heaters with thermostat control shall be provided for enclosure internal temperature control as recommended by the manufacturer. The enclosure shall be fabricated from 12-gauge stainless steel and shall be equipped with full-size gasketed doors with a three-point latch and stainless steel hinges. The bottom of the cabinet shall be equipped with a screened louver with replaceable filter to facilitate ventilation within the panel; screen mesh openings shall be maximum 1/8 inch square to prevent insect and debris from entering the enclosure. The control panel enclosure shall include a noncorrosive aluminum backplate.

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## **E. Motor Starters**

The pump Supplier shall match the sizes of control power transformers, overload devices, heaters, and starters to the equipment furnished. Control power transformers shall have both primary leads fused, one secondary lead fused, and one secondary lead grounded. One bimetallic, ambient temperature compensated thermal overload relay shall be provided in each phase lead.

All motor starters shall be NEMA rated. Each starter shall be provided with an external, manually reset push button for resetting the thermal overload relays. The external reset push buttons shall be accessible by opening the outer door of the control panel enclosure, and mounted on hinged interior panel front within the enclosure. Each starter shall include auxiliary RUNNING status contacts wired to terminals for external connection by others for remote indication, plus one spare NO and one spare NC contact. Each starter shall be provided with interlocking mechanism which, when the disconnect handle is moved to the "OFF" position, disconnects all external sources of power from the terminal blocks within the starter, such as external power across motor auxiliary status contacts. Solid state reduced voltage starters ("soft starts") shall be provided for all motors 5 HP and greater. Variable Frequency Drives (VFD) with soft start capabilities may be substituted for soft starts if approved by the Director of Public Works.

### **(a) Three Phase Starters**

Three-phase starters shall be circuit breaker combination type consisting of three-phase, 60 Hz contactors with electronic adjustable overloads, a 120-volt ac coil, a dry type control power transformer where required, and a circuit breaker disconnect. Overload relay shall be provided with one normally open dry contact. The contact shall close on motor overload and open when manually reset. Control power transformers shall be sized to handle all simultaneous loads. Starters shall be at least NEMA Size 1 or shall be sized as indicated on the Drawings. Circuit breakers shall be 600-volt magnetic motor circuit protectors. If an inverse time thermal magnetic circuit breaker is used, the thermal characteristic shall be externally adjustable from the face of the breaker. Each breaker shall be manually operated with a quick-make, quick-break, trip-free toggle mechanism. The complete three-phase starter shall have an interrupting rating of at least 25,000 amperes at 480 volts.

### **(b) Single Phase Starters**

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Single-phase starters shall consist of single-phase, 60 Hz contactors with thermal overloads and an integral or separately enclosed short-circuit protection device. Starters shall be at least NEMA Size O or shall be sized as indicated on the Drawings. Integral short-circuit protection devices for single-phase starters shall be 120/240 volt, magnetic motor circuit protectors. The short-circuit protection devices shall have an interrupting rating of at least 10,000 amperes at 120 volts, and 18,000 amperes at 240 volts.

## **F. Convenience Receptacle**

A single 120-volt, 20-ampere, ground fault interrupting convenience receptacle shall be provided with the control panel enclosure, including a step-down transformer to provide 120-volt power to the receptacle shall be provided as necessary. If the receptacle cannot be located within the control panel enclosure, then it shall be located on one exterior side of the control panel enclosure, within its own lockable access receptacle box, which shall be waterproof, dustproof, and weatherproof.

## **G. Area Light Control**

A snap action switch shall be furnished and installed on the interior panel within the control panel enclosure. The switch shall be connected to a branch power circuit of minimum 15 amperes at either of 120- or 240-volt single phase, supplied from the control power transformer within the control panel enclosure.

## **H. Control Operation**

The pumps shall be controlled in a typical duplex lead-lag manner. Wetwell level shall be controlled with five (5) float level sensors. Systems shall include high level alarm, lead pump on, lag pump on, pumps off, and low level alarm setpoints. The float shall be a weighted, pear shaped enclosure, hermetically sealed, housing a double-pole mercury switch, and shall control the high water level.

An intrinsically safe controller shall be furnished and capable of monitoring up to two separate float switches. The controller shall be provided with an inner door mounted module equipped with push-to-test buttons and LED's that shall indicate float switch position. The Supplier shall provide a NEMA 4X stainless steel junction box for float switch termination prior to pump control panel. Conduit connection from junction box to wet well shall be sealed as required by code to prevent wet well gases from entering junction box. The conduit from the wet well junction box to the pump control panel shall also be sealed as required by code.

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A float-mounting bracket shall be provided with strain reliefs that support and hold the level control cords. Continuous cords are to run from pump(s) and level controls to a control panel or junction box. No splices shall be made in the wiring. The bracket shall be fabricated from steel, coated for corrosion resistance, and attached to the access frame with 300 series stainless steel fasteners. A dielectric spacer should be installed when bolting to an aluminum access frame.

The controls shall automatically alternate the pumps on successive starts, automatically start the standby pump in the event of pump failure, and start both pumps if the level in the wetwell continues to rise. Time delay relays shall be provided to prohibit simultaneous starting of the pumps. HAND-OFF-AUTO pump mode selector switches shall be connected to allow manual start or stop of each pump and to select automatic operation of each pump under control of the level control system. Pump alternator shall be capable of being manually selected to alternate between pumps or individually select a pump to perform pumping duty in response to the level switch contacts of the level control system. A high alarm float shall be provided that operates separate and apart from the control circuitry that engages the autodialer when a high level condition occurs.

Each pump unit shall be provided with a seal leakage and high temperature detection and alarm systems in the control cabinet for protection of each individual pump motor. A moisture-sensing device shall be provided in the stator housing for seal-leakage protection and, if necessary, a monitoring module shall also be provided within the control panel for alarm transmittal and motor shutdown. This monitoring unit shall be provided with necessary auxiliary relays and terminals for wiring of sensor leads and external alarm/control functions. Operating voltage power supply requirements required to interrogate the moisture sensing device within each motor shall be provided as necessary within the control panel enclosure.

Each three-phase motor shall be protected by a microprocessor-based motor protection relay. The relay shall protect against phase loss, phase reversal, voltage unbalance, and low voltage on any one or more phases, causing a shutdown of the pump if any such abnormality is detected. The relay shall re-activate after power line conditions return to an acceptable level. Trip and reset delays shall prevent nuisance tripping due to rapidly fluctuating power line conditions. Motor protection relay shutdown alarm shall be connected to a separate detection indicator light on the control panel.

The mercury switch shall be cushioned, mounted approximately at 65 degrees inclination from the enclosure main axis and connected to a special three-

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conductor cable. The cable shall be insulated and heavily sheathed with PVC for resistance to immersion, corrosion, and abrasion. The cable length shall be sufficient to extend into the handhole or junction box outside the pumping station and to allow the float to be set within 2 feet of the bottom of the pumping station.

Levels and alarms shall be as follows:

- a. All pumps OFF.
- b. Lead pump ON.
- c. Lag pump ON.
- d. High-water level alarm

Contact interrogation voltage across the level sensing switches within the wetwell shall be 24 volts maximum to ensure compliance with intrinsically safe, explosion-proof requirements. The control power transformer with 24-volt secondary voltage shall be furnished and installed within the control cabinet as necessary to interface with the level sensing switches. Each control panel shall be equipped with heavy-duty, oil-tight pilot lights, reset buttons, common alarm acknowledge push button and selector switches as required, and mounted on an interior hinged panel door within the control panel enclosure. All operating controls and instruments shall be securely mounted in a logical manner and arrangement and such that any standard options offered by submersible pump manufacturer may be added in the field. All controls, pilot lights, selector switches shall be clearly labeled to indicate function. Six digit elapsed time meters (re-settable type) shall be provided to indicate running time of each pump in "hours" and "tenths of hours". Green "Pump Running" indicator lights and elapsed time meters for each pump shall be mounted on the face of the interior hinged panel door. Individual red alarm lights mounted on the hinged interior deadfront panel within the control panel shall be provided for the following alarms:

Pump No. 1 Overload  
Pump No. 2 Overload  
Pump No. 1 Moisture Detected  
Pump No. 2 Moisture Detected  
Pump No. 1 Over Temperature  
Pump No. 2 Over Temperature  
Pump No. 1 Phase Protection Trip  
Pump No. 2 Phase Protection Trip  
Wetwell High-Water Level

Any of the above alarms shall close a single-pole, double-throw relay with a dry, 120-volt ac rated resistive contact, wired to terminals for connection by others, for

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remote indication. In addition, any alarm will illuminate a flashing red vapor-tight alarm beacon and alarm horn. The alarm beacon shall be furnished with a minimum 60-watt lamp, located on the top of the control panel so as to be readily visible from the main road/street. The alarm horn shall be side mounted to the control panel enclosure and shall have minimum 103 dB at 10 feet distance from the panel.

The pump supplier shall provide an autodialer with contacts for remote monitoring of the alarms. The dialer shall be a Verbatim model VSS-4C or equivalent. All telemetry lines to be surge protected and shall be hard telephone line; no cellular phones will be allowed.

## 2.10 ELECTRICAL

1. Motor rated voltage shall be as follows unless indicated otherwise on the drawings:
  - a. All pumps 5 horsepower or less shall be single phase, rated for 240 volts electric power. The motors shall be designed in such a way as to be able to operate with voltage levels 10 percent above or 10 percent below the nameplate rating indicated above.
  - b. All pumps greater than 5 horsepower shall be three-phase, rated 277/480 volts from a three-phase external electric power supply. The motors shall be designed to be operational over a power supply voltage range of plus or minus 10 percent of the nominal voltage.
  - c. Solid state reduced voltage starters shall be provided for all motors 5 HP and greater. At both single- and three-phase service poles, a surge arrester shall be furnished and installed within the service disconnect enclosure and connected to the incoming service conductors for surge protection.
  - d. Adequate site lighting shall be furnished and installed on a new pole. An area light, minimum 100-watt, HPS lamp, with multi-tap ballast, shall be furnished and installed on a new pole with a minimum clear mounting height (ground to fixture) of 15 feet. Location of the pole shall be approved by the City. The area light branch power supply shall originate within the pump control panel and shall be switch operated from the pump control panel. Conduit and branch power circuit conductors shall be routed from the pump control panel underground to a riser conduit along the exterior of the wood pole.



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## 2.11 EMERGENCY GENERATOR

1. Wastewater lift stations shall be provided with a diesel powered emergency generator to meet NCDWQ requirements for power reliability unless otherwise approved by the Director of Public Works. The generator shall be installed on a reinforced concrete pad, sized by the engineer in relation to the size and weight of the generator. The top of the pad shall be a minimum of 4-inches above grade with chamfered edges.

The generator shall meet the following specifications:

Provide auxiliary diesel fired automatically activated stand-by power generator source with automatic reset, auxiliary emergency switchgear placed on site. Pump manufacturer to provide power demand/ratings to Contractor before ordering pump and the power demand appropriately marked on the pump shop drawings. Generator shall have the capacity sufficient to sequentially start and run all pumps in the pump station. The Contractor shall provide a complete engine driven generator set. The generator set shall consist of four-cycle, radiator-cooled, engine direct connected to an alternating current generator, a unit-mounted control panel, all mounted on a common sub-base. The control panel shall be complete with engine controls and instruments, safety controls and panel lights including the following:

- a. The generation unit shall be capable of powering the pump motors starting current, electrical systems, instrumentation /controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station. The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads.
- b. The generator shall be capable of starting, and simultaneously running, both pumps installed in the lift station.
- c. The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry if a damaging operating condition develops.
- d. The generation unit shall be protected from damage when restoration of power supply occurs.

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- e. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under voltage, over voltage, power loss, phase reversal, or phase loss. Transfer switch shall have a field-adjustable time delay in center position.
- f. The control panel shall be complete with run-stop-remote switch; remote start-stop terminals; cranking limit; battery charge rate ammeter, oil pressure gauge, temperature gauge; low oil pressure shutdown; high engine temperature shutdown; over speed shutdown; AC voltmeter; voltage adjustment; frequency meter; and running time meter.
- g. Circuit breakers shall be provided with a built in control panel. Provide generator output circuit breaker rated in accordance with the National Electrical Code.
- h. Provide manufacturer's recommended anti-freeze, engine heaters, and suitable trickle battery charger. All accessories shall be enginemounted and within the weatherproof sound attenuated housing.
- i. The manufacturer of the unit shall completely assemble and test the unit before shipment. He shall be one who is regularly engaged in the production of such equipment, and who has spare parts and service facilities. He must also provide 1 complete set of filters.
- j. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes.
- k. The automatic transfer switches must have a disconnect on the utility service main side.
- l. The generator shall comply with the following minimum requirements:
  - i. Engine: Four-cycle, radiator cooled, at 1800 RPM. Starting shall be from batteries, with capability to start the unit at 32 degrees temperature.
  - ii. Generator: Rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.=
  - iii. Voltage & KW rated to match facility needs.
  - iv. Engine shall be equipped with a mechanical governor.

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- v. Frequency regulation shall be less than 3-cycles from no load to full load.
  
- m. All accessories needed for the proper installation of the system shall be furnished. Included should be batteries, battery cables, exhaust piping, mufflers, vibration mounting, and three bound sets of detailed operation and maintenance manuals with parts list. Batteries should be lead acid.
  
- n. The generator set shall be enclosed with a factory-installed weatherprotective housing (sound abating enclosure to 68 db @ 23 ft.) Housing shall provide easy access to the engine-generator and instrument panel. Muffler to be designed so exhaust is not blown or sucked across the set by cooling air.
  
- o. Included with the generator shall be a complete fuel system consisting of a fuel tank, fuel gauge, fuel lines, fuel pumps, valves and any and all other items incidental to a first-quality installation.
  
- p. Provide integral sub-base double-walled diesel tank. The tank is to be UL approved closed-top dike type. The tank shall also be fitted with a leak sensor device. The tank must have a capacity to run the generator for a minimum of 48 hours at 1000/0 load.
  
- q. Tank shall consist of the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. Provide a drain plug at one end of the rupture basin. Provide vibration isolators of the type, quantity, and size recommended by the generator manufacturer. Provide fuel low level alarm remote mounted.
  
- r. Provide manufacturer's recommended anti-freeze and engine block heater, per manufacturer's recommendations, with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements, adjustable if possible. Provide suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
  
- s. Provide annunciator panels with visual and audible alarms to monitor and warn of emergency operation conditions affecting line and generator power sources.

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- t. Provide stainless steel super critical grade type exhaust silencer mounted on top of the generator enclosure for corrosion protection.
- u. Provide amp meter, voltmeter, and frequency meters with phase switches.
- v. Provide fuses or circuit breakers for battery charger and engine.
- w. Provide an automatic battery charger, static type, magnetic amplifier control with DC voltmeter, DC ammeter and potentiometer for voltage adjustment. The charger is to be completely automatic and rated for the type of battery use. The charging rate is to be determined by the state of the battery and reducing to milliamp current on fully charged battery. The charger shall be 120 V., singlephase, 60 cycles, AC input with 6-amp maximum output.
- x. Operation and Maintenance instructions. The Contractor shall provide a minimum of 4 continuous hours of operation and maintenance instructions for the City's personnel.
- y. The City of Locust must be furnished with one complete set of air, oil, and fuel filters.

## **PART 3: EXECUTION**

### **3.01 INSTALLATION**

- 1. All equipment and materials shall be installed in strict accordance with the manufacturer's recommendations, by an appropriately licensed contractor, and in strict accordance with all local, state, and federal codes.
- 2. Erosion control measures meeting all NCDENR Division of Land Resources requirements shall be installed and maintained at the site during construction. The Developer shall obtain an erosion and sedimentation control permit for the site when required, and shall comply with all provisions of the permit.

### **3.02 STATION LOT AND ACCESS REQUIREMENTS**

- 1. The lift station site shall include chain link fencing and an access gate in accordance with the specifications below. Alternative methods of fencing

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or elimination of the fencing may be approved on a case by case basis by the Director of Public Works.

2. The interior of the fenceline shall be constructed of a minimum 6-inch thick, 4,000 psi concrete slab with a 4-inch minimum washed stone base.

## **A. Chain Link Fencing**

Lots shall be enclosed by a minimum 6-foot tall chain-link security fence (all materials shall be Class I galvanized coated, 9 gauge mesh), topped with three (3) rows of outward facing barbed wire. Fence shall also be equipped with green PVC privacy slats within the fencing. Additional fencing outside of the required fencing may be erected upon approval from the Director of Public Works.

Wire shall be 12-1/2 gauge galvanized line wire with four-point, 14 gauge barbs spaced 5 inches on centers. Bottom tension wire shall be 7-gauge spring coil wire with galvanized coating. End, corner, and pull posts shall be 2-1/2 inch O.D. galvanized coated. Top and line posts shall be 2-inch galvanized coated. All post footings shall be sloped to drain.

Fencing shall include a minimum of either two (2) 6-foot wide or one (1) 12-foot wide hinged locking access gate(s) with latch and hasp assembly. Gate posts shall be 3-inch O.D. galvanized coated. A ground anchor cast in concrete shall be provided. All gates shall be factory fabricated and equipped with gate hold-backs. Panel shall have a horizontal brace center of fabric height.

## **B. Water Service, Yard Hydrant, and Washdown Pad**

A metered potable water source shall be provided to the lift station with a new meter box set outside the fence.

Inside the fence, the lift station shall include a pump washdown pad, and minimum 1-inch potable water connection with frost-proof yard hydrant and 3/4-inch garden hose adapter. The yard hydrant shall supply potable water for washdown capability, and shall be located adjacent to the washdown pad. The service line shall have an RPZ backflow preventer.

The washdown pad shall be sized in relation to the size of the pumps, but in no case shall be less than 2' X 2' square. A 4-inch concrete curb shall be provided around the pad, and a minimum 4-inch drain line with trap and grate cover shall be installed between the washdown pad and the wetwell.

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## **C. Site Access and All Weather Access Road**

Adequate access shall be provided to the lift station by an all-weather access road. All portions of the lot surface and access road to the facility shall be located a minimum of one (1) foot above the 100-year flood (FEMA and local) elevation. Provisions shall be made to protect side slopes from flood erosion and wave action as necessary. Access service road shall have at a minimum a 6-inch compacted layer of ABC stone travel surface 12-feet wide. In the event that any portion of the access road exceeds 8% grade, the entire access road shall be paved. A 10-foot wide all weather access road consisting of 8 inches of ABC is to be provided to the station with a turn-a-round area of sufficient size to accommodate turning of City of Locust vehicle. If the lift station easement does not directly abut a publicly dedicated road, a 30 ft. access easement shall be provided.

A vehicle turnaround area shall be provided at the termination of the site access road. The turning radii used in layout of the area shall be sufficient to accommodate the largest vehicle/equipment expected to access the facility.

## **D. Signs**

The lift station shall be provided with a standard City of Locust reflective sign that indicates the Owner of the lift station, address, and emergency phone numbers. In addition, each side of the fence shall have a sign stating "NO TRESPASSING within 100 feet". Costs for the sign shall be incurred by the Developer.

### **3.03 SPARE PARTS**

1. The Contractor shall furnish one (1) complete set of spare parts as detailed below to the Owner for each pump supplied.

- Wear Ring
- Inspection Plug Washer
- Impeller Bolt
- Impeller Key
- Spare Float

### **3.04 STARTUP OPERATIONS**

- 1 Before a lift station is turned over to the City of Locust for acceptance of ownership and maintenance, a competent representative of the pump

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manufacturer shall be provided to the site to meet with sewer maintenance and inspection personnel to perform system testing and supervise startup operations. Startup shall include pumping under actual pump load conditions and the performance of a draw down test to confirm pump capacity.

- 2 Upon completion of such supervision, the representative shall provide the City with a signed certificate stating that the pumps have been checked, are performing satisfactorily, and that they meet the requirements of the specifications, including pump flow rate and amp draw during pumping. The certificate shall indicate the name of the pump manufacturer, the name of the representative, and the name of the company or firm by which the representative is employed. Certified pump curves shall be included with the Operation and Maintenance manuals, two (2) copies of which shall be provided as part of the project closeout documents.
- 3 Also, a competent representative of the generator/transfer switch manufacturer shall be provided to the site to meet with sewer maintenance and inspection personnel to perform system testing and supervise startup operations, which shall be completed prior to the operation and maintenance instructions outlined above. Startup shall include testing the transfer switch and generator through a simulated power failure, under load conditions, and recording voltages and amp draws. The representative shall provide the City with a signed certificate stating that the equipment has been checked, is performing satisfactorily, and that it meets the requirements of the specifications. The certificate shall indicate the name of the generator/transfer switch manufacturer, the name of the representative, and the name of the company or firm by which the representative is employed. Two (2) copies of Operation and Maintenance manuals shall be provided as part of the project closeout documents.