

Lift Station Specifications

City of Bloomington Utilities

last update: December 2012



City of Bloomington Utilities

Engineering Department

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CITY OF BLOOMINGTON UTILITIES

SUBMERSIBLE LIFT STATION STANDARD SPECIFICATIONS

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LS-1. SCOPE OF WORK.

- A. The Contractor shall furnish all labor, materials, and equipment to construct one fully operational, duplex submersible sewage pumping station. The station shall include but not be limited to such equipment as
1. pumps and motors,
 2. wet well,
 3. valve vault,
 4. electrical controls,
 5. alarms,
 6. piping and valves,
 7. remote monitor package,
 8. hatches,
 9. guide rails,
 10. pump removal components,
 11. control center,
 12. level control switches,
 13. disconnects,
 14. interconnecting electrical wiring,
 15. incoming power supply,
 16. emergency power generation equipment and transfer switch components, unless otherwise stipulated by Utility Engineer. If the requirement for emergency power generation is waived, Contractor shall install a dual interlocked main breaker
 17. any other equipment normally supplied to function as a part of a complete and functional lift station.

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- B. All work is to be performed in accordance with these Standard Specifications, the City of Bloomington Utilities's Construction Specifications, the plans and specifications, 327 IAC 3 and other IDEM requirements and manufacturer's recommendations.

LS-2. GENERAL REQUIREMENTS.

- C. All of the mechanical and electrical equipment shall be furnished by one coordinating supplier who shall be responsible for the preparation of shop drawings, schematics, interconnecting diagrams, panel layouts, and other data required for complete system description. The manufacturer shall verify that all system components are compatible with each other and that all the necessary equipment has been furnished to provide for a properly operating system.

- D. The system shall be manufactured by Hydromatic Pumps or Flygt Corporation.

<u>Hydromatic Supplier:</u>	<u>Flygt Supplier:</u>	<u>Gorman Rupp</u>
BBC Pump & Equipment	Henry P. Thompson Co.	Covalen
P.O. Box 22098	6525 E. 82 nd St., Suite 208	6939 Brookville Rd.
1125W. 16th Street	Indianapolis, IN 46250	Indianapolis, IN 46239
Indianapolis, IN 46202	Phone: 800-597-5099	Phone: 317-308-6300
Phone: 317-636-1111	Fax: 317-576-6569	Fax:
Fax: 317-636-5467		

- E. Exceptions to these specifications shall be submitted in writing and clearly stated and shall be approved by the City Utilities Engineer in writing 10 days prior to the bid date.

LS-2.1. Detail Drawings.

Detail drawings must be submitted to the Utilities Engineer for the wet well, valve vault, concrete pad, hard surface access road and any other site related features that are necessary to review the proposed construction. The details must show all elevations and geometrics of the proposed lift station, including a location map. Drawings shall include average and peak flow used to design the lift station, total dynamic head calculations, a map showing the area to be served by the proposed lift station, and the location and elevation of the force main discharge.

Drawings shall be submitted in digital format as well as on full size paper prints.

LS-2.2. Shop Drawings.

The Contractor shall submit a minimum of five (5) copies of shop drawings to the City Utilities Engineer for review and approval. If the Contractor wants more than 2 copies returned, Contractor shall submit additional copies. Shop drawings shall contain detailed specifications, performance data, and warranty information for all of the equipment proposed to be installed at this lift station. The City Utilities Engineer will review the documents and return a written approval to the Contractor. Without written approval, the work performed may not be accepted.

LS-2.3. Contractor's Responsibility.

The City Utilities Engineer's review of the shop drawings and related documents does not relieve the Contractor from responsibility for errors, omissions, deviations, or compliance with the Contract documents.

LS-2.4. Exceptions.

Any exceptions to these specifications must be identified clearly on the submittals and must be approved by the City Utilities Engineer prior to proceeding with the work. If submittals are marked "RETURNED FOR CORRECTION", then five (5) copies must be resubmitted by the Contractor for approval. If submittals are marked "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", OR "RECORD COPY", resubmittals are not necessary.

LS-2.5. Materials.

All equipment and system components which will be installed outdoors or within the wet well basin must be manufactured from non-corrosive materials such that additional protective coatings will not be necessary and that will require minimum maintenance throughout the expected life of the lift station. Non-corrosive materials shall include but not be limited to stainless steel, fiberglass reinforced plastic, or PVC (ultraviolet stabilized).

LS-2.6. Power Requirements.

Lift stations shall be equipped with 3 phase power for all installations greater than 5 horsepower. Exceptions may be granted if request is made in writing to the Utilities Engineer at the time of design.

LS-2.8. Concrete Pad.

The area surrounding the wet well and valve vault shall have a 6-inch reinforced rectangular poured-in-place concrete pad. The pad shall extend 2-feet outside the largest structure and shall have a 12-inch wide and 12-inch deep turn down section at all edges. Reinforcing shall be W2.0 x W2.0 WWF.

LS-2.9. Station Piping.

- A. All station piping shall be flanged, ductile iron pipe with calcium aluminate cement or ceramic epoxy lining. Pipe and flanges shall meet all requirements of ANSI/AWWA C115/A21.15 and C151/A21.51 standards. Pipe shall have a pressure rating of 250 psi.
- B. All fittings shall be flanged, ductile iron with aluminate cement or ceramic epoxy lining. Pipe and flanges shall meet all requirements of ANSI/AWWA C110/A21.10 and C111/A21.11 standards. Fitting flanges shall be adequate for water pressure of 250 psi with the body of the fitting being suited for 150 psi or 250 psi.
- C. All reducers shall be eccentric.

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- D. Piping between the valve vault and wet well shall be mechanical joint with Mega-Lug restraints or Uniflange restraints.
- E. All connections between flanged piping and plain end pipe shall be restrained with Mega-Lug or Uniflange devices.

LS- 3 ACCESS.

All lift station structures and components shall remain accessible and operable during a 25-year flood. The lift station and all components shall be protected from the 100- year flood.

LS-3.1. Access Road.

Each lift station shall be accessible by a hard-surfaced all-weather road (either blacktop or concrete) for use by City maintenance vehicles. The road shall be at least 14-feet wide and shall include a turn-around for the maintenance vehicles. The minimum requirements shall be 8 inches of compacted #53 stone and 4 inches of asphalt. Access shall remain above the 100-year floodplain.

LS-3.2 Fencing.

The lift stations shall be secured with 6-foot high chain link fence. The fence shall have a 12-foot wide gate for vehicular access into the lift station area. The gate shall have a hasp for a padlock, which will be supplied by Owner.

LS-4. OPERATING CONDITIONS.

At least two identical pumps of equal size and pumping characteristics shall be provided and shall be capable of individually pumping the peak hourly flow. The pump shall be selected to operate near the best efficiency point of the pump/impeller combination. Each pump shall be capable of operating under the following conditions:

Pump:

_____ gallons per minute @ _____ feet TDH _____ RPM

Motor:

_____ RPM _____ Volts _____ Phase

_____ Horsepower _____ Cycles per second

Approved Pumps:

Hydromatic Model _____ with a _____ inch impeller.

Flygt Model _____ with a _____ impeller.

LS-5. PUMPING EQUIPMENT.

The pumps furnished under this section shall be of the submersible type capable of continuous operation at a depth of at least 65' without loss of watertight integrity. The pumps shall be capable of handling a 3" solid sphere, fibrous material, heavy sludge, and any other constituents normally found in raw, unscreened sewage.

LS-5.1. Major Components.

All major components, such as the stator casing, volute, oil casing, sliding bracket, and impeller shall be of high-quality gray cast iron. All surfaces coming in contact with raw sewage shall be protected by a coating resistant to sewage. All nuts, bolts, and fasteners shall be of 304 stainless steel.

LS-5.2 Impeller And Volute.

The impeller shall be the non-clog type slip fit or taper fit with key to securely lock the impeller to the driving shaft. The pump volute shall be fit with a replaceable wear ring installed between the volute and impeller to help achieve longer balanced operating life.

LS-5.3 Seals.

The seals shall be provided by the pump manufacturer and be either carbon-ceramic or tungsten-carbide.

LS-5.4 Seal Failure Sensor Probe.

The seal chamber shall be equipped with a seal failure sensor probe which will sense water intrusion through the lower seal. This sensor is to be connected to an alarm light in the control panel to indicate lower seal failure.

LS-5.5 O-Ring Seals.

All mating surfaces of major parts shall be machined and fitted with nitrile o-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and o-ring contact made on four surfaces, without the requirement of specific torque limits.

LS-5.6 Pump Motor.

The pump motor shall be housed in an oil-filled or air-filled watertight casing and shall have moisture resistant Class F insulation with maximum temperature capability of 155 degrees Celsius. The motor shall be NEMA Design B and designed for continuous duty. The motor shall be provided with heat sensing units attached to the motor windings which shall be wired in the control panel to shut down the pump and activate the alarm light should overheating occur. There is a 5 HP minimum for pumps that are to be maintained by CBU following construction.

LS-5.7 Pump Motor and Sensor Cables.

Pump motor cable and heat sensor/seal failure sensor cable shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Cable of the proper length shall be provided to eliminate need for splices or junction boxes between pump and the control panel. The cable shall enter the motor through a cord cap assembly which is double-sealed allowing disassembly and disconnect of the wires at the motor and still not damage the sealed characteristics of the motor housing.

LS-5.8 Thermal Sensors.

All units of 100 HP or more shall have thermal sensors monitoring bearing temperatures in addition to the motor thermal sensors described above. Bearing thermal monitors shall be independent of the motor sensors and available at the control panel circuitry to affect alarm and/or shut down functions.

LS-5.9 Guide Bracket, Rails And Discharge Flange.

A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices. The rails and rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. Installation of the pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by fiberglass reinforced plastic or 304 stainless steel rails suitable for the pumps installed. No other motion of the pump unit, such as tilting or rotating, shall be required. The system shall not require a person to enter the wet well to remove the pump and motor assembly. Sealing of the discharge interface shall be a metal-to-metal or diaphragm-type contact of the pump discharge flange and mating discharge connection. No portion of the pump unit shall bear directly on the floor of the wet well. There shall be no more than one 90-degree bend between the volute discharge flange and station piping. The guide rails for each pump shall be positioned and supported by the pump mounting base at the bottom and by the frame of the access hatch at the top. The guide rails shall be aligned vertically and one intermediate support must be installed for each 15 feet of FRP and each 20 feet of 304 stainless steel guide rail length. A stainless steel lifting chain or Flygt lift and grip eye system of adequate length for the specific installation shall be provided for each pump.

LS-5.10 Warranty

The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form, apply to all similar units, and shall cover the units regardless of ownership after installation. A copy of the warranty documents shall be submitted with the submittals and shop drawings.

LS-6. WET WELL.

The wet well shall be positioned as shown on the plans and detail drawings. The wet well shall be sized according to the recommendations and requirements of the supplier and may be sized larger if the design dictates for peak flow volume storage.

LS-6.1. Minimum Dimensions.

The minimum diameter for the wet well shall be 6'-0". The minimum dimension for the depth of the wet well shall be determined by the standards listed in LS-12.1, but in no case shall the wet well be less than 10 feet from surface to bottom of pit, nor less than 6 feet from lowest inflow invert to bottom of pit.

LS-6.2. Materials

The wet well barrel and top shall be constructed of pre-cast reinforced concrete conforming to ASTM C-478 and City of Bloomington Utilities Specifications section 4.4.2.2 (manholes).

LS-6.3 Wet Well Table.

A concrete or brick and mortar table shall be installed along the perimeter of the base of the wet well. The dimensions shall be 8 inch high by 8 inch wide with a 45-degree angle slope.

LS-6.4 Wet Well Vent.

A 4-inch downward pointing PVC vent pipe shall be installed in the top with a screened inlet opening.

LS-6.5 Wet Well Access Doors.

A locking double door aluminum access hatch shall be installed in the top of the wet well so that each pump can be removed from service. The frame of the access cover shall support the guide rails. The doors shall be furnished with recessed locking hardware, have a non-skid finish, support 300 psf loading, and be manufactured by either Bilco or American Foundry, or pre-approved equal. 304 stainless steel cable holders shall be mounted to the wet well access doorframe.

LS-7. VALVE VAULT.

The valve vault shall be located adjacent to the wet well as shown on the plans.

LS-7.1. Minimum Dimensions.

The minimum diameter for the valve vault shall be 5'-0". The minimum depth of the valve vault shall be 5 feet from surface to bottom of pit. The bottom of the valves and/or piping shall be a minimum of 12-inches above the bottom of the valve vault. A minimum of 12-inches shall be provided between the sides of the valve vault and any bolted flanges.

LS-7.2. Materials

The valve vault shall be constructed of pre-cast reinforced concrete manhole sections conforming to ASTM C-478, or poured-in-place concrete, or concrete block. The valve vault shall be water proofed in accordance with City of Bloomington Utilities Specifications section 4.4.2.2. for manholes.

LS-7.3 Valve Vault Access Door.

A 36" X 48" locking aluminum access hatch shall be installed in the top of the valve vault. The aluminum hatch shall be similar to the one described above for the wet well. The hatch shall be positioned so the valves may be operated from the surface, portable pump connection made from the surface, and allowing man-entry into the vault.

LS-7.4 Valve Vault Drain.

The valve vault shall contain a 3-inch PVC drain pipe installed such that the floor of the valve vault can be drained to the wet well. A duckbill check valve shall be installed on the wet well end of the drain pipe to prevent sewage from backing up into the valve vault from the wet well.

LS-7.5 Valve Vault Bypass Pumping Connection.

The fitting where the two pump's discharge piping comes together shall be made with a flanged ductile iron cross. The back side of the cross shall be fitted with a plug valve, a long radius 90 degree upward bend, and a quick disconnect fitting for connection to an emergency pump. Alternative piping arrangements incorporating these concepts may be addressed through submittals.

LS-8. VALVES.

- A. The valve vault shall contain one outside swing-arm check valve and one-quarter turn eccentric plug valve on the discharge piping for each pump.
- B. The valves shall be designed for use in a sanitary sewer system.
- C. All valves shall be operable from the surface by use of hand wheels or shall have 2" square nut fittings to be operated by a "T" handle.

LS-8.1 Plug Valves

LS-8.2 Swing Check Valves

Contractor shall install a guard to protect workers from sudden movement of the outside lever.

LS-8.3 Duckbill Check Valves

LS-10. ELECTRICAL CONTROLS

LS10-1 Control Panel

The Contractor shall furnish and install a control panel suitable for the horsepower and voltage specified for the lift station. The panel shall be located so that the wet well and valve vault hatches and the panel door can be open at the same time. The panel shall be a minimum of 48-inches from any opening in the wet well or valve vault. The panel stand shall be large enough to also mount the disconnect switch, the meter base, and remote monitor.

- A. The panel shall be a rain-tight, kevlar or stainless steel NEMA 4X panel.
- B. The panel shall be supported on aluminum (for kevlar) or stainless steel (for stainless steel panels) supports.
- C. The door shall be hinged and have a blank face with provisions for locking with a padlock.
- D. The electrical components, switches, relays, timers, and other circuitry shall be located inside the control panel.
- E. The panel shall be UL listed.
- F. Terminal boards for connection of power, pumps, alarms and level sensors shall be provided.
- G. All controls shall be located above ground.
- H. A transformer to provide 120 volt, 24 volt and/or 4-20 milliamp power for control panel pilot circuitry, control and alarms circuits shall be provided and installed.
- I. Install magnetic contacts on main control cabinet to signal entry into the station.

LS-10.2. Disconnect Switch.

The Contractor shall furnish and install a fused, main disconnect switch adequately sized for the equipment within the lift station. The disconnect switch shall be located adjacent to the control panel within a NEMA 4X stainless steel panel with provisions for locking the switch in either the open or closed position.

LS-10.3. Motor Controls

Each pump motor control shall include the following:

- A. Combination circuit breaker/overload unit providing overload protection, short-circuit protection, reset and disconnect for all phases.

- B. Across-the-line magnetic contactors.
- C. Hand/off/automatic pump operations selector switch with a green run light.

LS-10.4. Automatic Alternation

The panel shall include an automatic electric alternator for two pumps providing alternating operation of pumps under normal conditions, or in cases of high level, allowing both pumps to operate simultaneously.

LS-10.5. Heat Sensors.

The motor heat sensors shall be connected within the control panel such that the starter shall be disconnected once a high temperature signal is received and shall be automatically reset when the high temperature condition is corrected. The sensors shall be factory set for conditions to be expected during normal operation of the lift station. The alarm shall be connected to the remote monitor.

LS-10.6 Seal Failure.

Each pump shall have a seal failure alarm light installed within the control panel. The seal failure alarm, indicating a failure of the lower mechanical seal, shall be an indication only and will not shut down the pump. The alarm shall be connected to the remote monitor.

LS-10.7 Elapsed Time Meter.

Each pump shall have an elapsed time meter installed within the control panel to indicate and totalize the pump motor running time. The timer shall also be connected to the remote monitor.

LS-10.8 High Water Alarm.

The control panel shall have a high water alarm built in and made a part of the panel. The alarm shall consist of a horn mounted on the side of the control panel and a flashing red light mounted on the top of the control panel, protected by a metal guard, and visible from all directions. Controls shall be provided on the side of the control cabinet to test the horn and the light and to silence the horn. The alarm shall be connected to the remote monitor.

LS-10.9. Condensate Heater.

The control panel shall include a condensate heater to protect against condensation buildup inside the cabinet.

LS-10.10 Time Delay Relay.

An adjustable time delay relay shall be provided to delay start of second pump should a power outage occur.

LS-10.11. ALLEN BRADLEY COMPONENTS.

All of the major components of the control panel such as circuit breakers, relays, switches and overload protection shall be manufactured by Allen Bradley and be available from local electrical supply sources.

LS-10.12 Lightning Protection.

The control panel shall include lightning protection.

LS-10.13 Phase Monitor Relay.

The control panel shall include a phase monitor relay to shut down the power supply and control circuit and protect the equipment due to loss of phase or phase reversal.

LS-10.14 Security Light.

- A. Contractor shall provide and install a _____ (type) security light located _____(where) to provide illumination at _____(how many) foot-candles at the surface.
- B. The light shall be installed on _____ (type) pole.
- C. The control panel shall include a switch controlled, inside security light (fluorescent) with a circuit breaker. The switch shall be located inside the control panel.

LS-10.15 Connections For Remote Monitor Package.

The control panel shall incorporate the remote monitor package, as described in section LS-11, inside the control panel. Terminal strips shall be installed to provide connection of the various alarms and signals to the remote monitor package.

LS-10.16. Written Confirmation From Pump Manufacturer.

In order to maintain unit responsibility and warranty on the pumping equipment and control panel, the control panel must be accepted in writing by the pump manufacturer as suitable for operation with the pumping equipment.

LS-10.17. Conduit.

A minimum of 4 - 2.5-inch schedule 40 conduit shall be installed from the wet well to the control panel such that control cables, wiring, sensor cables, and alarm cables can be pulled through without difficulty. Each pump cable shall be pulled through one conduit. The remaining conduits shall be used for signal cables (and/or spare). The conduit shall be sealed at the control panel and inside the wet well to avoid the entrance of sewer gases into the control panel. A slip coupling shall be mounted to the bottom of the control panel to permit settling of the concrete pad without separating the conduit from the panel.

LS-10.18 AUXILIARY POWER OUTLET.

A minimum 15 amp ground fault receptacle shall be installed on the inside face of the control panel.

LS-11. PUMP START/STOP CONTROL

- A. Contractor shall provide one of the following types of pump control devices.
1. Sealed float type mercury switches
 - a) Shall control the operation of the pumps and high water alarm.
 - b) The float shall be coated with polyurethane or polypropylene for corrosion and shock resistance.
 - c) The float shall be supported by its power cable from a support bar suspended from the wet well top and shall be adjustable from outside the wet well.
 2. Hydrostatic pressure sensor
 - a) The hydrostatic pressure sensor shall provide a two-wire, loop-powered, 4-20 mA signal proportional to the hydrostatic head of the liquid. In addition to the analog signal, the transmitter shall also provide a simultaneous digital signal superimposed on the analog output, but shall not affect this analog value. The digital signal shall utilize the HART protocol. The unit shall operate with 11.5 to 30 VDC in non-hazardous and FM approved installations.
 - b) The sensor shall be constructed with a Hastelloy C diaphragm and 316 SST body. It shall be available in compact threaded or flanged versions for bottom or side mounting and shall have the option to be mounted via a cable or rod probe (threaded, flanged, or clamp) for top mounted installations. This sensor design shall eliminate the need for diaphragm seal assemblies. The rod probe version shall be constructed of 316 SST material, while the cable shall be polyethylene (PE) or fluoroethylenepropylene (FEP) material. There shall also be versions, which mount via Tri-Clamp fittings or weld spud fittings, which meet 3-A Sanitary Standards.
 - c) The sensor shall incorporate a polysilicon resistive measuring element and shall be of an all welded construction and hermetically sealed from outside influences such as moisture, dirt, etc. The device shall incorporate multiple integral moisture Gortex filters to prevent condensation from forming in the atmospheric reference tube. This filter mechanism shall not require use of any desiccant devices, which need to be routinely replaced. The transmitter shall have plastic, aluminum, or 304 SST housing options available. The unit shall also be capable of remote mounting the housing and electronics. With this

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remote electronics option, the sensor measuring point shall be completely submersible.

- d) The sensor accuracy shall be 0.2% of calibrated span over a 10:1 turndown. The unit shall be capable of ranges as low as 0-15 inH₂O and as high as 0-60 PSIG (0-1660 inH₂O). This accuracy shall include the effects of linearity, hysteresis, and repeatability. The sensor shall incorporate temperature compensation directly at the sensor to reduce the inherent effects of temperature changes on the sensor output. The temperature effects shall be less than 0.006% per °F product temperature change. The sensor shall also be capable of withstanding an overload pressure of up to twenty (20) times the measuring range without performance degradation.
- e) The transmitter shall incorporate all of the sensor calibration and characterization data on a DAT module so as to be completely replaceable and interchangeable without the need for recalibration. The 0.2% accuracy shall be maintained on an interchanged sensor. The electronics shall also be replaceable without the need for recalibration on the sensor. The calibration shall be via non-interactive digital push buttons, which will allow the transmitter to be rearranged without the need for any pressure source or other external handheld devices. The electronics module shall incorporate level linear, level horizontal cylinders, and other linearization functions so as to be configurable in process engineering units. The unit shall also implement a density factor field which can be modified via the local display or via the HART signal to account manually for changing product densities. In addition, there shall be capability to supply a system, which continuously or at a discrete point calculates product density and recalculates the product level automatically based on this new density value.
- f) The transmitter shall have an optional digital display with any of the housings showing both the digital value and a 0-100 % bar graph. The display shall be universal to all ranges and incorporate a plug-in modular design to allow field retrofit without the need for software or electronics modification. The display shall also be capable of accessing the entire configuration matrix to program the transmitter locally without the need for other external HART devices.
- g) The transmitter shall be Factory Mutual (FM) Approved Intrinsically Safe Class I, II, and III, Division 1, Groups A through G with appropriate barriers and FM approved Non-Incendive Class I and II, Division 2 without the need for barriers. All the housing options shall be rated NEMA-6P.
- h) The unit shall be Endress + Hauser or approved equal.

LS-12. SYSTEM OPERATION.

- A. As the wet well level rises, the lowest control point (float or hydrostatic pressure setting) will energize.
- B. As the wet well level continues to rise, the second control switch will then energize and start the lead pump.
- C. If the wet well level drops, then the lowest control point will stop the lead pump and activate an alternator so that the lag pump will be the lead pump on the next sequence.
- D. If the wet well level does not drop during the operation of the lead pump, then the third control point will activate the lag pump and both pumps will operate simultaneously until the lowest control point is activated to stop both pumps.
- E. If the wet well level continues to rise during the operation of both pumps, then the fourth control point will activate the high water alarm.

LS-12.1. Control Point Elevations

The elevations of the control point settings shall be determined by using the following standards:

- A. 4 foot minimum cover on gravity and pressure sanitary sewers.
- B. 2 foot minimum from lowest inflow invert to high water alarm.
- C. 1 foot minimum from high water alarm float to lag pump on control point.
- D. 2 foot minimum from lag pump on float to lead pump on control point.
- E. 15 minute full developed average flow volume from lead pump on to pump off control point.
- F. 1 foot minimum from pump off control point to bottom of wet well.
- G. Average detention time not greater than 30 minutes.

LS-13. REMOTE MONITOR PACKAGE.

The station shall be equipped with a Remote Monitor Package (RMP) capable of monitoring the status of the lift station and communicating either to the Service Control Center via cellular calls (omni-site.net) or with the existing OMNI alarm system at the Service Control Center.

LS-13.1. RMP Operation.

The Remote Monitor Package shall monitor:

1. High water in wet well.

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2. High water in dry well (if a dry well station).
3. Seal failure, high temperature, and bearing failure if these signals are available in the pump control.
4. Pump ON/OFF - for cycle time studies - to be activated on an as needed basis.
5. Pump run time
5. Pump breaker tripped - each pump.
6. Low backup battery voltage.
7. AC power failure.
8. Pump Call (start) failure.
8. Station entry

LS-13.2. RMP Installation.

The Contractor shall coordinate installation of the RMP and connection to pump control equipment that is equipped to provide contact closure signals for all monitored conditions described above that are applicable to the type of station. The RMP shall be installed in complete conformance to the manufacturer's installation specifications, with special attention given to proper electrical grounding. The contractor shall coordinate installation of a telephone line (if needed) to the RMP and coordinate testing to assure that the RMP communicates properly with the central receiving location.

LS-13.3. Alarm Bypass Switches

Each circuit shall use two relays. Each relay shall be wired to an individual pump to remove the shock hazard. Bypass switches shall be installed for each relay so that when a pump is removed for service, the circuit can be bypassed to allow monitoring the status of the remaining pump. Switches will be labeled PUMP 1 ALARM BYPASS and PUMP 2 ALARM BYPASS.

LS-13.4 Covert Alarm System

No longer used.

LS-13.5 Omni-Site.net Cellular Autodialer

LS-13.5.1 General

- A. The contractor shall furnish, install and place into operation a comprehensive monitoring system for the lift station as described herein. All equipment is to be completely factory assembled, wired and tested prior to shipment. The system shall be Omni-site.net XR-50 Series as manufactured by Logical Concepts, Inc. The local representative for this equipment is BBC Pump & Equipment Company

- B. The naming of manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a standard of excellence for the material used, and to indicate a principle of operation desired.
- C. The equipment provided shall be a completely integrated automatic monitoring system consisting of the required power equipment (circuit breakers, transformers etc.), automation and alarm monitoring equipment in a factory wired and tested assembly. The automatic control and alarm/monitoring system components shall be standard, cataloged, stocked products of the system supplier to assure one source responsibility, immediately available spare/replacement parts, proper system interconnections and reliable long term operation.
- D. Shop Drawings shall be submitted for approval for all equipment herein specified. The Shop Drawing Submittal shall include a Document List. An Order Specification shall be included which shall describe in detail all equipment provided. Each panel shall be provided job-specific wiring diagrams, parts list, enclosure door layout and enclosure dimension drawing. The wiring diagram requirement applies to all field mounted instruments, control and telemetry equipment as well as all required interfacing to the power panel. Interconnection details shall be shown for all field-mounted instrumentation. A description of Operation shall be provided detailing the operation of the complete system, including the telemetry, control and alarm handling.
- E. Provide Record Drawings and Instruction Manuals. These manuals shall include corrected Shop Drawings. In addition, a detailed Programming and Operations Manual for the Microprocessor-based Controller Unit shall be included. The manual shall include all information as detailed for the Shop Drawing Submittals above.

LS-13.5.2 Communications Network

- A. The cellular modems shall be Omni-site.net #XR-40 Radios, operating in the AMPS Spectrum at a full 3-watt rating
- B. Each radio shall be designed for internal/external mounting, housed in a die-cast aluminum enclosure, provided with an external 12 Volt DC rechargeable battery. The system shall accept 120 Volt AC power, and shall be provided with all accessories required, which shall include, but not be limited to, the following:
 - 1. All interconnecting cables.
 - 2. Antenna as required for the most reliable operation.
 - 3. All required surge protection.
 - 4. All mounting hardware

LS-13.5.3 Antennas

- A. The antenna for each location shall be selected based on the results of the cellular survey.
- B. All antennas shall be provided and installed by the CONTRACTOR as per recommendations from the manufacturer, the antenna manufacturer.
- C. The Systems supplier shall be responsible for installation, set-up, adjustment and tuning of the antenna to provide optimal communications for the system.
- D. The antenna installation shall be external to the enclosure and shall be outdoors. The antenna shall be a phantom style.
- E. The Systems supplier shall utilize the XR-50 built-in Radio Frequency signal meter during antenna installation to ensure that the antenna are installed for optimum signal reception.

LS-13.5.4 System Installation

- A. The Contractor shall ensure that the cellular Network system work is properly interfaced with equipment and other work not furnished by the Systems supplier.
- B. The Systems supplier shall install, make final connections to, adjust, test, and start-up the complete cellular Radio Network.

LS-13.5.5 General Equipment Requirements

- A. All wiring shall be minimum 600-volt UL type MTW or AWM and have a current-carrying capacity of not less than 125% of the full load current. The conductors shall be in complete conformity with the national electric codes, state, local and NEMA electrical standards. For ease of servicing and maintenance, all wiring shall be color-coded. The wire color code shall be clearly shown on the drawings, with each wire's color indicated.
- B. All control wiring shall be contained within plastic/PVC wiring duct covers. Where dimensional constraints prevent the use of wiring duct, wires shall be trained to panel components in groupings. The wire groupings shall be bundled and tied not less than every 3 inches with nylon self-locking cable ties as manufactured by Panduit or equal.
- C. Every other cable tie shall be fastened to the enclosure door or inner device panel with a cable tie mounting plate with pressure tape. Where wiring crosses hinged areas such as when trained from the inner device panel to the enclosure door, spiral wrap shall be used.

LS-13.5.6 Nameplates

All major components and sub-assemblies shall be identified as to function with laminated nameplates.

LS-13.5.7 Products

A. The Overall System Shall perform the following:

1. Transmit Flow Meter Data
2. Monitor High Water Alarm
3. Monitor Pump 1 Call Failure
4. Monitor Pump 2 Call Failure
5. Monitor Pump 1 Shaft Seal Failure
6. Monitor Pump 2 Shaft Seal Failure
7. Monitor Power Failure

B. Products to Include:

1. Weatherproof 4X enclosure.
2. Surge Arrestor.
3. XR-50 MicroRTU Remote Telemetry Unit.
4. Power supply, charger, battery and filter.
5. Transient Protector.
6. XR-40 Cellular Modem.
7. 12VDC power supply

LS-13.5.8 Incoming Service and Light Arrestor

A. The incoming service for the control system shall be 120 volt, 1 phase, 2 wire, 60 Hertz. A single phase lightning arrestor shall be supplied in the control system and connected to each line of the incoming side of the power input terminals. The arrestor shall protect the control system against damage as the result of transient voltage surges caused by lightning interference, switching loads and power line interference's. It shall begin shunting to ground at 500 volts maximum.

- B. All metering shall be done ahead of the main disconnect and control panel. The meter shall be supplied and installed by the Contractor in accordance with local power company requirements.
- C. The electrical service shall be provided by the OWNER. Electric meter base shall be provided by the OWNER and installed in accordance with the requirements of Lawrenceburg Municipal Utilities. A UL rated main disconnect switch, circuit breaker panel, conduit and wiring between the power company termination and the control panel shall be furnished and installed by the contractor. The power supply to the control panels shall be 120 volts, one phase, three wire, 60 Hertz.

LS-13.5.9 12 VDC Power Supply

- A. A regulated 12 VDC power supply shall be provided for the radios and other monitoring system components as required. The power supply shall include a terminal block for incoming AC, output DC and ground connections. The power supply shall be powered from a 120 VAC and include tapered charge type battery charging circuitry to maximize battery life. The power supply shall be rated at minimum of 2.0A @ 12 VDC.
- B. The power supply system shall include (1) 12 Volt battery sized to allow for 36 hours continued system operation during a power outage.

LS-13.5.10 Signal Transient Protection

- A. Transient protection shall be provided with all equipment to protect all instrumentation and telemetry devices either receiving or sending signals.
- B. The transient protectors shall be 4000V optical isolators which shall effectively arrest most transients encountered in an instrumentation environment.

LS-13.5.11 Enclosure

- a. All of the seams shall be continuously welded and ground smooth with one hole knockout.
- b. Door and body stiffeners shall be provided for extra rigidity.
- c. Captive door screws thread into sealed well.
- d. Oil resistant gasket and adhesive.
- e. NEMA 4x epoxy powder coated aluminum enclosure. Size = 4"W x 4"H x 2"D

LS-13.5.12 Microprocessor Based Controller

- A. A Microprocessor-based Controller Unit shall be provided for monitoring of the Lift Station based on alarm contact closures.
- B. The Microprocessor-based monitor shall be a standard, catalogued product of a water and wastewater pumping automation equipment manufacturer regularly engaged in the design and manufacture of such equipment. The pump/alarm monitor shall be specifically designed for water and wastewater pumping automation utilizing standard

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- hardware and software. "One of a kind" systems using custom software with a generic programmable controller will not be acceptable. The controller shall be Omni-site.net XR-50 as mfg. by Logical Concepts, Inc.
- C. The controller shall accept (10) DI in its base form. It shall have Phoenix type removable terminal blocks for easy field wiring.

Automatic Dialing and Voice Annunciation Software for Omni-site.net XR-50

MicroRTU(s)

General

1. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available alphanumeric pager systems.
2. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available numeric pager systems.
3. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available voice pagers.
4. Upon Alarm condition: facilitate the compilation and transmission of alarm information over standard telephone lines to residential or commercial sites, or cellular phones, provide for verbalization of alarm information and allow for the password secured remote acknowledgment of such alarms.
5. Allows for Voice Dial-in Connection via telephone line to facilitate the Acknowledgment of active alarms.
6. Allows for Voice Dial-in Connection via telephone line to facilitate the inquiry of and the alteration of values of digital tags.
7. Both Voice Dial-in and Voice Dial-out access modes shall be protected by mandatory redundant password entry system.

Software

Configuration Software

- A. Shall allow for the configuration of unique alphanumeric pager transmission formats.
- B. Shall be configurable to be compatible with 110, 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 BAUD Paging Systems and shall adhere to the TAP protocol standard. It shall be configurable to be compatible with most major brands of data modem by allowing individual configuration of baud rate, modem initialization string, dialing prefix, dialing suffix and modem hang-up strings and accommodate paging systems requiring "passwords".
- C. The omni-site software supplies the unique ability of text-to-speech conversion of typed-in alarm messages so that sound files do not have to be manually recorded. This saves

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much time and programming complexity. Systems that do not employ advanced text-to-speech conversion will not be considered.

- D. Shall allow for the configuration and maintenance of a set of "global" voice data files used in the construction of voice output messages.
- E. Shall allow for the creation and maintenance of a "phone book" of destinations for alarm transmissions. The quantity of eligibility entries in the phone book shall be unlimited.
- F. Shall have the ability to archive collected data and export this data to common Microsoft packages and SCADA systems supporting Windows DDE.
- G. Shall provide for the creation of "Groups" consisting of selected entries from the Phone Book. A "Group" may be considered to be a logical grouping of alarms, based upon the type of transmission desired as a result of any alarm condition. Group configuration shall allow for:
 - 1. Allow for selection of recipient list for alarm transmissions along with recipient priority determination.
 - 2. Allow for creation of user configurable delays prior to commencement of alarm transmissions.
 - 3. Allow for user selection of "single pass" or "continuous loop" modes through recipient list until alarms are acknowledged.
 - 4. Allow for user enable/disable of: data logging to disk file, automatic acknowledgment upon return to normal of alarm condition, mandatory user acknowledgment of alarms.
- H. Shall provide for Digital Alarm handling and allow a textual description field and voice verbalization files for each Digital Alarm. Standard alarm acknowledgment requires personal involvement. Each alarm can be selected to "acknowledge upon return to normal state", or allow for automatic acknowledgment of any alarm generated
- I. Shall allow for the creation and maintenance of "reports" or organized collections of tags. Such reports may be Voice accessed via telephone line employing a mandatory password protection system. The report feature shall make it possible to inquire and receive a verbalization of the description of the tag requested, along with the current value. This alteration process calls for the pre-configuration of the tag, making it available for inquiry and/or change.

Execution Software

- A. Shall be capable of displaying on screen, current alarm status and alarm history status of a minimum of 65,000 simultaneous alarm tags.
- B. Shall allow for manual transmission of user entered alphanumeric or numeric pages by selection of destination from the phone book and message entry.

- C. Shall be capable of maintaining a group-by-group activity log which may capture: Any alarms that may occur (along with user configurable time and date stamp), any return to normal transactions, any alphanumeric or numeric pages, any voice dial-outs, any voice-dial-ins (including who has accessed the system and who has acknowledged alarms).
- D. No other special hardware is required for system operation.

3. EXECUTION

Field Installation

- A The services of a factory trained, qualified representative shall be provided to install the completed system, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment.

Guarantee

All equipment shall be guaranteed against defects in material and workmanship for a period of one year from the date of Owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the Owner.

LS-14 FLOW MEASUREMENT.

- A. A recording flow measuring device shall be provided for lift stations with pumping capacities in greater than or equal to 1,200 gpm. Flow measurement shall be accomplished by an Endress + Hauser magnetic flow meter. Flow shall be recorded by a continuous strip chart which also records date and time. The flow data shall be capable of being transmitted, in the future, by SCADA system. The output shall be both 4 to 20 mA and frequency/pulse output.
- B. The flow meter shall be installed in a concrete manhole/vault. An aluminum hatch shall be installed to allow access to the meter and removal of the meter without removing the top of the manhole.
- C. The flow meter shall be installed a minimum of 5 pipe diameters downstream of the last elbow, valve, tee, cross, or reducer and a minimum of 2 pipe diameters upstream of similar fittings.
- D. The minimum velocity through the flow meter shall be 1 fps.

LS-15. EMERGENCY POWER REQUIREMENTS.

An emergency electrical generator shall be installed, on-site, to provide uninterrupted and automatic station power in the event of power failure unless otherwise stipulated by the Utility Engineer. Utility Engineer will consider the following factors when determining if a generator is required: size of the pump station, storage time in the wetwell, and other factors. Contractor shall assume the generator will be required.

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If the Utility Engineer waives the requirement for a generator, Contractor shall install a dual interlocked main breaker and generator connection.

LS-151 Single Supplier

All emergency electrical backup equipment, transfer switches, generator enclosure, switches and controls shall be furnished by one coordinating supplier who shall be responsible for the preparation of shop drawings, schematics, interconnecting diagrams, panel layouts, and other data required for complete system description. The manufacturer shall verify that all system components are compatible with each other and the pumping equipment and that all the necessary equipment has been furnished to provide for a properly operating system.

LS-15.2 Manufacturers

The system shall be manufactured by Onan Electric Power Systems or Caterpillar. Exceptions must be submitted in writing and clearly stated and must be approved by the City Utilities Engineer in writing 10 days prior to the bid date.

Onan Supplier
Cummins Mid-States
3762 W Morris Street
Indianapolis, IN 46242
Phone: 317-240-1931
Fax: 317-240-1925

Caterpillar Supplier
MacAllister Machinery Company
7575 East 30th Street
Indianapolis, IN 46219
Phone: 317-860-3326
Fax: 317-860-4433

LS-2.7.2 Contractor shall supply and install an enclosure, with sound attenuation for the generator.

LS-2.7.3 Generator set shall meet the following requirements:

1.01 SECTION INCLUDES

- A. Engine Generator Set
- B. Automatic Transfer Switch.

1.02 REFERENCES

- A. NEMA MG 1 - Motors and Generators
- B. NFPA 37 - Installation and Use of Stationary combustion Engines and Gas Turbines.

C. NFPA 70 - National Electrical Code

1.03 SYSTEM DESCRIPTION

A. The work includes supplying and installing a complete integrated emergency generator system to provide an alternate source of power to the lift station in the event of a utility outage. The system consists of a diesel generator set with related component accessories and automatic transfer switch.

B. The Contractor shall provide a full tank of diesel fuel at the completion of all testing.

1.04 REGULATORY REQUIREMENTS AND CERTIFICATIONS

A. Conform to NFPA 70 and applicable inspection authority.

B. Generator manufactured to NEMA standards.

C. Certification of performance of this electric plant by an independent testing laboratory as to the plant's full power rating, stability and voltage and frequency regulation.

1.05 SUBMITTALS

A. Engine-generator submittals shall include the following information:

1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.
2. Manufacturer's catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex, main circuit breaker, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
4. Weights of all equipment.
5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, remote alarm indications.

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7. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactances and time constants.
10. Generator current decrement curve.
11. Generator motor starting capability.
12. Generator thermal damage curve.
13. Jacket water heater connection diagram.
14. Control panel schematics.
15. Automatic load transfer switch.
16. Oil sampling analysis, laboratory location, and information.
17. Manufacturer's and dealer's written warranty.
18. Emissions data.
19. Automatic transfer switch published specification sheet.

1.06 WARRANTY AND SERVICE

- A. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.
- B. The engine-generator supplier shall have service facilities within 50 miles of the project site and maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the generator set package for this specific project.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Caterpillar Tractor Co.
- B. Kohler Company
- C. Cummins Onan Power, Inc.

2.02 GENERAL REQUIREMENTS

- A. The generator set shall be standby rated to supply the maximum starting (surge) loads and steady-state running loads of the connected load equipment, including radiator fan and all parasitic loads. The Control system shall have an adjustable timer to delay the start of the second pump in the event of a power failure. The Generator shall be sized to start the second pump while the first one is running.
- B. All materials and parts comprising the unit shall be new and unused.

2.03 DIESEL ENGINE

- A. The engine shall be water-cooled inline or vee-type, four-cycle compression ignition diesel. It shall meet specifications when operating on number 2 domestic burner oil. Two cycle engines will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump.
- B. The governor shall be mechanical with hydraulic assist as required. It shall maintain 3% or less speed droop from no load full rated load. Steady state speed regulation shall be +/- 0.33%. The governor shall be equipped with a vernier control and positive locking to allow manual speed adjustment.
- C. The complete engine block shall be machined from one casting. Designs incorporating multiple blocks bolted together are not acceptable.
- D. The engine shall utilize a gear-type, positive displacement, full pressure lubricating oil pump and water-cooled lube oil cooler. Pistons shall be spray-cooled. Provide oil filters, oil pressure gauge, dipstick and oil drain.
- E. Fuel filter and serviceable fuel system components shall be located to prevent fuel from spilling onto gen set batteries.

2.04 GENERATOR

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- A. The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.
- B. The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F (130 °C rise by resistance over 40 C ambient). The excitation system shall be of brushless construction.
- C. The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.
- D. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, overexcitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.
- E. Provide motor starting capability of 394.27 kVA SKVA at 30% instantaneous voltage dip as defined per NEMA MG 1.

2.05 CIRCUIT BREAKER

- A. Provide a generator mounted circuit breaker, molded case or insulated case construction, *** amp trip, * pole, (sized for the load) NEMA 1P22. Breaker shall be Merlin Gerin or equal and utilize a thermal magnetic trip unit and 24 VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.06 CONTROL PANEL

- A. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

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B. Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency

C. Alarm NFPA 110

Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Overcrank
6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto. position

12. Low fuel main tank
 13. Battery charger ac failure
 14. High battery voltage
 15. EPS supplying load
 16. Spare
- D. Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
- E. Provide programmable protective relay functions inside the control panel to include the following:
1. Undervoltage
 2. Overvoltage
 3. Overfrequency
 4. Underfrequency
 5. Reverse power
 6. Overcurrent (phase and total)
 7. KW level (overload)
 8. Three spare LED's
 9. Four spare inputs

2.07 COOLING SYSTEM

- A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110° F ambient air entering the room or enclosure without derating the unit and 50/50 anti-freeze mixture. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction

2.08 FUEL SYSTEM

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- A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
- B. Fuel Piping: All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted
- C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI
- D. A UL listed fuel subbase fuel tank shall be supplied, to provide 48 hours of fuel for the generator set, when operating at full rated load. It shall be equipped with low level and leak detection contacts, vents, gauge, engine supply/return lines, and fill provision. The subbase fuel tank shall be factory installed and delivered to the jobsite as an integral part of the generator set package.

2.09 EXHAUST SYSTEM

- A. A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed in the sound attenuated enclosure. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.
- B. The muffler and all indoor exhaust piping shall be "lagged" by the contractor to maintain a surface temperature not to exceed 150°F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

2.10 STARTING SYSTEM

- A. Starting Motor: A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
- B. Jacket Water Heater: A unit mounted thermal circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 120 volt, single phase, 60 hertz.
- C. A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 172-ampere hours. Necessary cables and clamps shall be provided.

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- D. A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
- E. A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.11 AUTOMATIC TRANSFER SWITCH

- A. The automatic transfer switch shall be *** amps, * pole, *** volt AC, (rated for the load) fully rated enclosed switch which complies to NEMA ICS2-447, NFPA 70, NFPA 99, NFPA 110, and UL 1008. It shall have front access to all control panels and contacts. Main contact material shall consist of silver (87% min) and cadmium. Plexiglas covers shall shield electronic controls and main contact connections. Wiring shall be numbered for easy identification. The Break before Make transfer action shall require no more than 3 cycles, and the mechanism shall incorporate lifetime lubrication within a temperature range of -29 C to 60 C (-20 F to 140 F). It shall incorporate solid state programmable logic, be assembled and tested, and include:

1 - Sheet steel NEMA 1 enclosure with hinged.

1 - Operating transfer switch consisting of single solenoid, electrically operated, mechanically held

1 - Frequency of emergency at transfer, 70 to 90 percent (factory 13% full)

1 - Solderless connectors for normal source cables, emergency source cables, load cable, and solid neutral bar.

1 - No load manual transfer

1 - Remote automatic transfer switch control

1 - High fault withstanding capacity

1 - Voltage monitoring of each phase of normal source (full protection), adjustable 70 to 90 percent

1 - Voltage of emergency at transfer, 70 to 90 percent (factory set 90 percent)

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- 1 - Frequency of emergency at transfer, 70 to 90 percent (factory set 90 percent)
- 1 - Voltage and frequency monitoring of one phase of emergency source.
- 1 - Time delay, engine starting, adjustable 0.1 to 10 seconds, set at 3 seconds.
- 1 - Engine minimum run (5 to 30 minutes) (factory set 20 minutes)
- 1 - Engine cool down timer (1 to 30 minutes) factory set 10 minutes)
- 1- Engine warm-up (5 seconds to 3 minutes), with override switch (factory set 1 minute)
- 1 - Time delay, normal to emergency (0.1 to 10 seconds adjustable)
- 1- Time delay, emergency to normal (1 to 30 minutes (factory set 5 minutes)
- 1 - Time delay neutral (0.1 to 10 seconds) with bypass switch (factory set 5 seconds)
- 1 - In-phase monitor with override to time delay neutral
- 1 - Three position mode selector switch in the face of the enclosure, marked auto, test, and fast test.
- 1 - Fast test mode: resets engine minimum run (to 10 seconds), engine cool down (to 0 seconds), and return to utility (0 to 5 seconds)
- 1 - Self check built-in (at start-up, routine check of ATS circuits, LEDs shall flash to confirm integrity.
- 1 - Exerciser (7 days from initial command)
- 1 - Transfer when exercising (on/off switch)
- 2 - Pilot lights in face of enclosure indicating source to which the ATS is connected.
- 1 - Auxiliary C-form contacts for normal and emergency
- 1 - Neutral lug.
- 1 - Internal cabling, terminal boards, fuses, fuse blocks, nameplates, and miscellaneous hardware as needed.
- 1 - Software consisting of: dimensional drawing, layout drawing, electrical schematic, and parts list.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.02 START-UP AND TESTING

- A. Coordinate all start-up and testing activities with the Engineer and Owner.
- B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:
1. Verify that the equipment is installed properly.
 2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater, remote annunciator, etc.
 3. Test all alarms and safety shutdown devices for proper operation and annunciation.
 4. Check all fluid levels.
 5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
 6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.
 7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.
 8. Perform a 4-hour load bank test at .80 power factor at full nameplate load using a reactive load bank and cables supplied by the local generator dealer. Observe and record the following data at 15-minute intervals:
 - a. Service meter hours
 - b. Volts AC - All phases
 - c. Amps AC - All phases
 - d. Frequency
 - e. Jacket water temperature
 - f. Oil Pressure

- g. Fuel pressure
- h. Ambient temperature

LS-16. TRANSFER SWITCH FOR EMERGENCY POWER.

A manual transfer switch of adequate size to provide power via incoming electrical service or emergency generator power shall be provided. The transfer switch shall be built in the same enclosure as the main control center. An outside receptacle shall be provided to fit the City of Bloomington Utilities portable generator.

LS-17. DOCUMENTATION.

The Contractor shall provide to the City Utilities Engineer three (3) lift station manuals each containing copies of the following information:

1. Operating instructions.
2. Maintenance instructions including lubrication schedules.
3. Recommended spare parts list including parts ordering information.
4. Structural and as-built wiring diagrams.
5. Bill of materials.

LS-18 SPARE PARTS.

The Contractor shall provide a complete set of "*O*" rings and gaskets for the lift station supplied.