

## SECTION VIII. DESIGN CRITERIA FOR SANITARY SEWER LIFT STATIONS

GENERAL: The intent of these criteria is to provide guidance to design engineers regarding minimum requirements of equipment and appurtenances for new construction or upgrades of existing sanitary sewer lift stations **owned and operated by the City of Branson**. Other conditions and requirements for construction will apply including the City of Branson Technical Specifications For Public Works Improvements, National Electrical Code, (latest edition), and City of Branson Planning and Development Department requirements. Design plans and specifications for lift stations must be approved by all applicable City of Branson departments prior to issuance of continuing authority by the Missouri Department of Natural Resources.

All requirements in this document must be described in full detail on the plans and specifications of the lift station. The plans shall include a plan and profile view of all wet wells, drywells, valve vaults, piping and appurtenances. Electrical drawings shall include detailed line diagrams that show all electrical components such as electrical service, motor control center, standby generator, transfer switch, PLC, cell modem, UPS, etc. Also included in the drawings shall be a method of operation for the lift station.

The following requirements are intended to establish a baseline minimum for a standard sanitary sewer lift station owned, operated, and maintained by the City of Branson. Individual lift stations may require site-specific special conditions and/or equipment for proper performance and operation. In such cases design engineers shall coordinate with the required city departments to guarantee proper construction and operation.

### A. SITE IMPROVEMENTS - STATION COMPOUND AND ACCESS ROAD

Minimum requirements include the following:

1. Compound fencing including 6-foot high chain link fence with 3-strand barbed wire top and a 16-foot wide vehicle gate (2 - 8 ft. panels). Vehicle gate shall be located at the access road entrance to the compound providing access to station wet well and dry well. Provide a 3-foot wide man gate next to the vehicle gate.
2. A 12-foot wide (minimum) service road with 6 inches of 0 to 6-inch crushed limestone material for road base and 3 inches of 1-inch limestone base material for road surface. (3-inch thick asphaltic concrete pavement is required on roads having a grade greater exceeding 7 percent.) Roadbeds are to be crowned with necessary ditch lines sloping to storm water crossings for proper storm water drainage.
3. Turn around area at front of lift station large enough to turn pump trucks around. Surfacing shall be the same as for the service road.
4. The ground shall slope away from the wet and dry wells at a slope of 3% in all directions, toward the boundaries of the lift station compound. Interceptor ditches shall be installed, as required, to convey surface drainage away from the lift station compound.
5. Ground cover consisting of 3 inches of 1-inch clean gravel for inside lift station compound.

6. Dusk to dawn area lighting to illuminate entire compound (to be operated and maintained by City of Branson). Lighting to be full cutoff to minimize light spill onto adjacent properties.
7. Potable water to frost-free hydrant within lift station compound (if water is accessible within immediate vicinity).

B. MECHANICAL - PUMPS AND RELATED EQUIPMENT

Minimum requirements include the following:

1. Submersible duplex pumping system manufactured by Flygt, or approved equal. Pumps shall be non-clog type impeller capable of passing 3-inch solids. Mounting and installation shall be per manufacturer's specifications. Any variance to this pump specification must be approved by city staff. Grinder pumps will not be acceptable.
2. Dual rail stainless steel pump slide rail system.
3. Aluminum hatch covers and necessary handrails. Covers to be rated for 300 pounds per square foot live load in areas not subject to vehicular traffic. Spring cylinders to be provided to prevent accidental hatch cover closing. Hardware to be stainless steel. Safety grates to be installed below hatch door.
4. Stainless steel pump lifting chains.
5. Swing arm jib crane and hoist at stations where access is not possible with existing city-owned truck mounted hoist equipment.
6. Concrete wet well with capacity for 2-hour storage during peak flow. (Stations without standby generator)
7. A 4-inch diameter emergency suction pipe (PVC) to extend from 16 inches above top of wet well to within 24 inches of bottom of wet well with male quick coupler (mounted in a horizontal position with cap) at top to match existing City pump truck hoses.
8. Separate concrete dry well valve vault for necessary check and isolation valves. Drywell structure to be a reinforced concrete structure with a minimum height of 60 inches. Actual size and height may be greater to accommodate minimum clearances from piping.
9. Sump pump installed in 24" x 24" x 6" sump in valve vault floor with float control and high water alarm circuit signal back to control panel. Discharge line to wet well to be equipped with check valve and isolation gate valve located inside valve vault. (No gravity drains between lift station dry well and wet well allowed.)
10. Valve vault to be equipped with exhaust fan, incandescent light (on separate switches) and weatherproof ground fault protected outlet for sump pump.
11. Standard swing check valve with spring control exterior lever on each wet well pump discharge line with a gate type valve upstream and downstream of each check valve. Check valve to operate with spring controlled exterior levers. Where the pump station design includes a flow control valve, the check valve shall be installed downstream of the flow control valve.
12. Force main isolation valve to be located at point just before force main exits valve vault.

13. Emergency portable pump force main connection located in force main between force main isolation valve and the point where pump discharge lines combine to the force main. Connection to consist of isolation gate valve connected to tee in force main, horizontal mounted swing check valve with spring control exterior lever, and 6 inch male quick coupler mounted in vertical position with access from hatch in top of valve vault.
14. All discharge piping, valves, and fittings in valve vault to have minimum 24 inch clearance from walls and 12 inches from floor for removal and maintenance.
15. Wet well and dry well to be equipped with hot dipped galvanized vent pipe, with exterior end screened, located as not to cause trip hazards. Vents shall be installed horizontally through the wall as high in the well as possible. Location of these pipes shall be coordinated with the city. Vent discharge to be directed away from all electrical and mechanical equipment.
16. All pump discharge piping in dry well and wet well to be class 53 ductile iron pipe and fittings with stainless steel bolts.

C. ELECTRICAL POWER, CONTROLS AND RELATED EQUIPMENT

Minimum requirements include the following:

1. A lift station exterior control panel shall be provided consisting of a NEMA 4X stainless steel enclosure with gasketed hinged outer door(s) having a single handle operator and an inner hinged panel(s) within door configuration for the mounting of all controls.
2. The control panel shall be arc flash protection compliant with separate compartments for 480 volt power circuits and control circuits. Appropriate labels shall be installed on exterior of panel advising level of required arc flash protection.
3. The control panel must be mounted on a heavy-duty rigid mounting rack in a manner not to allow movement in any direction. The rigid mounting rack must be sized to adequately hold the control panel, main disconnect switches and any additional electrical equipment required for a complete control system.
4. All electrical equipment to be mounted a minimum 30 inches above finished grade.
5. The control panel interior must be sized to house individual pump disconnect switches, motor starters, relays, pump alternator, DC power supply, PLC, level sensor equipment, UPS, cell modem, and all other necessary control equipment.
6. Items to be mounted on interior control panel door to prevent weather damage include the following: hand-off-auto switches for operation and control of each pump, pump alternator selector switch labeled Pump 1 – Alternate – Pump 2, hour meters, reset buttons, indication lamps, digital display of wet well level, etc.

7. Incoming electrical power shall be equipped with lightening surge protection device with field replaceable modules for each phase, integral disconnect switch, redundant receptacle modules, red and green LED indicator lights for power and protection status, audible alarm with silence switch to indicate when protection has failed and one set of dry contacts rated at 5A, 250VAC, for remote monitoring of protection status. Peak surge current rating shall be 160ka per phase. Surge protection shall be installed immediately after main service disconnect.
8. Protection shall be provided for loss of phase or phase imbalance.
9. Variable frequency drives are required for pumps in excess of 1,000 gpm. (if applicable under hydraulic design conditions). A line reactor shall be installed for each VFD and sized according to the total rated amperage of the VFD connected to it.
10. Cost comparisons of VFD and soft start equipment should be performed on smaller stations to determine the best options. If VFD is not applicable, soft start or reduced voltage starters may be required depending on horsepower and head conditions. (Coordination with city electrical department is required.)
11. The control panel shall be furnished with a Chromalox 150 watt type S strip heater and a Chromalox WR-90 thermostat wired to a power supply terminal block through a 5A-cartridge fuse.
12. The control panel shall be provided with 120-volt single-phase service receptacle minimum 20-amp capacity mounted on exterior with weatherproof box cover.
13. The control panel shall be equipped with a UPS system of sufficient size and capacity to operate the PLC, cell modem, level sensor, and local alarm strobe and buzzer for a minimum of 2 hours in the event of a power outage. (10 min UPS required for stations with standby generator.)
14. A supervision relay (miniCAS or equivalent) shall be installed to monitor submersible motor leakage sensors and thermal sensors.
15. Wet well pump control shall be accomplished through the use of an Allen Bradley Micro 1100 processor, or approved equal that is compatible with software currently used by the City of Branson (RS LINX & RS LOGICS), both of which are Rockwell software (Note the City will be migrating to Control Logics soon).
16. The PLC shall at a minimum monitor and indicate to the cell modem monitoring system and control panel: pump off, pump run, utility power, run on battery, generator run, force main pressure normal, force main pressure low, pump run hours (indicate and store), wet well level, pump seal failure (when pumps are so equipped).

17. The PLC shall at a minimum indicate alarms for these conditions: low wet well level, high wet well level, wet well level clear, pump fail to run, force main low pressure, power out, power restored, generator fail to start (stations with standby generator only), low battery level, transducer fail.
18. Minimum pump controls of the PLC shall include the following: lead pump on, lag pump on, high wet well alarm, pump off, and analog speed signal with level set points (stations with VFD controls).
19. All operator interfaces shall be processed through the PLC with exception of the redundant high wet well float switch and low wet well level cutout float switch.
20. All operator annunciations shall be processed through the PLC except the redundant high wet well level float switch and the low wet well level cutout float switch.
21. The wet well level sensor shall be a submerged pressure transducer (KPSI Transducer series 750 with digital display model 3019 or approved equal) suitable for the environment that it is located in and shall deliver an analog type signal to the PLC. (Installation in wet well to be within stainless steel restraint rings)
22. Two (2) float switches, independent of the pressure transducer, shall be installed in the stations wet well as backup to the pressure transducer. One at low level set 1 foot below normal pump shut off elevation by pressure transducer, to shut off pumps and indicate computer and local alarm should pressure transducer fail to function. One set at high level 1 foot above normal high level elevation of pressure transducer, to indicate computer and local alarms if transducer fails to function.
23. Redundant float switches shall deliver alarms both locally and to the PLC. The low level redundant float switch shall be wired into the control and alarm circuit as required so that the pumps will shut down regardless of the status of the PLC during a wet well low level situation. The High-level redundant float will deliver a signal to PLC and also deliver a signal directly to the local alarm and activate the local alarm regardless of PLC output.
24. High wet well alarm indication from the level transducer shall be annunciated by means of a PLC output and the use of a local flashing strobe (red in color) and a horn or buzzer that delivers a minimum of 90 db at a radius of 15 feet from the control panel.
25. Pumps shall normally operate in lead/lag configuration.
26. Computer alarm status and station monitoring shall be transmitted via CradlePoint Cell modem. Cell modem antennas are typically mounted inside the control cabinet, however, an external mounting on the control cabinet might be required. Configuration of the modem will be coordinated with the Utilities and IT departments.

27. The contractor shall obtain required IP addresses from the Utilities Department.
28. Zetron SentriVoice 1516 paging radio shall be installed in a NEMA 3R enclosure at each site. The paging radio is totally independent of the cell communications system and is activated by the high water float. Operating frequency is 465.56250 MHz. Power supply shall be 12 VDC with sealed lead acid battery for backup.
29. Force main pressure sensing shall be incorporated on the force main down line of the pump discharge isolation valves and prior to the force main isolation valve to monitor line pressure. The switch shall be non-intrusive pressure type with an adjustable pressure point setting. Isolation valves shall be installed to provide the ability to flush, exercise and check proper operation.
30. Low force main pressure that exists longer than one minute shall cause the PLC to shut down pumps while in automatic mode should a force main break occur. A time delay relay shall be provided to latch all pumps off and require a manual reset in order to restart the pumps. A push button reset shall be installed on the control panel interior door to allow reset of the low-pressure alarm and time delay relay.
31. Hour meters for each pump shall be wired to an output of the PLC in conjunction with the hour counters within the program of the PLC for each respective pump. Hour meters displaying tenths of hours will be sufficient.
32. All lights, switches, buzzers etc. used in the assembly of lift station shall be labeled and identified as to its purpose with minimum  $\frac{3}{4}$  inch lettering.
33. All electrical wiring shall be identified on each end where terminated with suitable identification making each wire unique among all other wires.
34. All electrical equipment used in the construction of lift station shall be properly marked and identified with equipment name, voltage applied and current or fuse size for that piece of equipment and/or circuit number where applicable. Lettering shall be 2 inches, of reflective material and visible on outside of panel.
35. Standby generator with automatic transfer switch is required at higher flow stations (to be determined by city staff) and stations which receive flow from another lift station. Generator to be sized to start and run all lift station pumps and equipment at a maximum starting current for each pump no higher than 350% of nameplate for a duration of no more than 2 seconds. Generator to be equipped with manual gages displaying oil pressure, volts, amps, temperature, and run hours.
36. Stations without standby generation will be equipped with manual double throw transfer switch and quick coupler connections for portable generator operation.

37. Indication lamps shall be mounted in exterior of transfer switch to indicate utility power is available to each incoming phase.
38. The quick coupler connection equipment shall be Meltric Corp brand type DS2/ metal Cat #37-28043 with additional boot cover to match existing city equipment.

D. ADDITIONAL ELECTRICAL REQUIREMENTS

Minimum requirements include the following:

1. All electrical work shall comply with the currently adopted edition of the NEC.
2. Contractor shall arrange for all permits required. Contractor is responsible for coordination with electric supplier for proper installation of meter loop, buried service conduits, and service connections. Coordinate the exact requirements with the control provider. Verify location of all existing utilities prior to excavation. Contractor shall field determine exact routing of conduit etc.
3. All wiring shall be in conduit. Exterior conduit shall be (IMC) Intermediate Metallic Conduit or (RGS) Rigid Metallic Conduit. Size all conduits per N.E.C.
4. Individual conduit shall be provided for each of the following: submersible motor lead power/control cable, level transducer cable, and backup float switch cables, with entrance into wet well that provides accessibility without wet well entry for cable removal.
5. Power/control cable hangers and strain relief cable grips shall be stainless steel.
6. No splices or plug connections in motor lead power/control cables, level transducer cable, or backup float switch cables, between internal unit connections and control panel. In locations where the wet well is unusually deep or distant from the control panel, a junction box may be required within the conduit run. This junction box shall be stainless steel, located just outside of the wet well and installed with proper conduit seals as described in the NEC for hazardous locations. Wire connections shall be made on terminal block style connectors with a corrosion-retarding compound applied.
7. All connections to the control panel must have watertight fittings entering the enclosure.
8. The grounding electrode conductor shall be continuous with connections and/or splices being made at equipment ground bar or with irreversible splices or exothermic welds acceptable by N.E.C. Buried metallic force mains shall be bonded to the station grounding system per NEC requirements. The use of the force main is considered another grounding electrode.

9. An equipment-grounding conductor shall be installed in the same conduit as all circuit conductors. The equipment-grounding conductor shall have green insulation and be sized per N.E.C. Table 250.66.
10. All conductors shall be copper. Branch circuit wiring shall be minimum #12 stranded copper, 600V THHN/THWN insulation. Feeder conductors shall be copper, stranded, 600V THHN/THWN insulation.
11. When contractor chooses to pull more than three current-carrying conductors in a single raceway, the conductor allowable amp capacities shall be reduced, in accordance with N.E.C.
12. Contractor shall increase the size of the branch circuit conductors for loads that are greater than 75 feet from the panel at least one size and shall increase the grounding conductor size proportionally.
13. All devices shall be equal to the following:
  - Duplex Receptacle: 'Hubble' CR5362 Series or approved equal.
  - GFCI Duplex Receptacle: 'Hubble' GF5352 Series or approved equal.
  - Other Devices: Hubble, Leviton, Pass & Seymour, or approved equal.
  - Panelboards: Square D, Seimens, Cutler Hammer, or approved equal.
  - Transfer Switches & Disconnects: Square D, Seimens, Cutler Hammer, or approved equal.
  - Soft Starter: Square D, Cutler Hammer, Allen Bradley, or approved equal.
  - Variable Frequency Drives: Yaskawa, or approved equal.
14. The wet well shall be treated as Hazardous Class 1, Division 2. Devices mounted inside the wet well shall be explosion proof. Conduits containing power or control wiring that are routed between the wet well and the control power panel shall be RMC. All entries into wet well or into valve vault by conduits and/or cables shall comply with N.E.C. 501.5 and be sealed by means of a sealing fitting located near the control panel or as noted earlier with junction box by wet well in order to prevent the migration of sewer gases beyond the boundaries of the wet well or valve vault. An approved duct sealant shall be used and installed firmly in seal fitting to provide a gas tight seal.
15. Electrical service transformer and meter shall be located outside of the lift station compound per electrical company requirements.
16. Contractor shall provide typed circuit directory for all panels.
17. Electrical contractor shall provide a minimum of three as-built drawings and documents listing all parts, specs and electrical schematics in the construction of the lift station to be presented to the city in the form of a loose-leaf binder.

18. Electrical contractor shall provide no less than 2 hard copies including labels and descriptions in loose-leaf binder and 2 electronic copies including labels and descriptions of the lift station PLC programming.

E. WARRANTY

The General Contractor shall provide a two (2) year warranty on all parts and labor.