

CITY of NORTH LIBERTY PUMP CONTROL PANEL AND CONTROL EQUIPMENT STANDARDS

PART 1- GENERAL

DATE: June 2014

1.01 SUMMARY:

Engineer shall design and specify sewage pump station in accordance with these standards and shall be reviewed and approved by the City of North Liberty.

A complete duplex motor control panel shall be furnished. The control panel shall be designed to provide level controls and pump protections for the specific pumps being utilized. All electrical controls shall be contained in a common enclosure. Controls shall be as described in these specifications and accompanying drawings. The control panel shall consist of (but not be limited to), the following:

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| 1. Insulated Enclosure | |
| 2. Inner Door | |
| 3. Cabinet Heater with Thermostat | |
| 4. Line Terminal Block | |
| 5. Motor Circuit Breakers | |
| 6. Utility Power/Generator Power
Circuit Breaker | |
| 7. Generator Receptacle | |
| 8. Motor Starters with bypass
contactors | |
| 9. Transformer Primary Circuit
Breaker | |
| 10. Control Power Transformer | |
| 11. Auxiliary Power Circuit | |
| 12. Convenience Receptacle | |
| 13. Control Fusing | |
| 14. Duplex Pump Controller | |
| | 15. Intrinsically Safe Barrier For Pump
Controller And Level Transducer |
| | 16. Level Transducer and redundant
transducer |
| | 17. Backup Redundant Control System |
| | 18. Redundant Hand-Off-Automatic
switches |
| | 19. Redundant seal failure and over-
temp protection |
| | 20. Run Time Meters |
| | 21. Red Lexan Alarm Light (Mtd Top
of Enclosure) |
| | 22. Horn w/ Silence P.B. |
| | 23. Control Relays |
| | 24. Control Terminal Block |
| | 25. Ground Lug |

To match the existing Lift Stations, the duplex pump control described in item 14 is a Contegra Station Master 702C with a SLX Pressure Transducer as supplied by Jetco, Inc., Altoona, IA ph#515-967-5874.

1.02 WORKMANSHIP AND EXPERIENCE:

- A. The control panel shall be the product of a supplier who has been actively engaged in research, development and has supplied proven field installations of complete sewage pumping systems for not less than five (5) years. A list of ten (10) separate sewage pumping systems shall be provided on request.

1.03 UL LISTING:

- A. The control panel unit shall be the product of a manufacturer that is authorized by Underwriters Laboratories, Inc. to build products in compliance with UL Standard 698A (Enclosed Industrial Control Panel – Enclosure in Non-Hazardous area with extensions into hazardous area). A UL label shall be affixed to the completed control panel.

PART 2 – PRODUCTS

2.01 INSULATED ENCLOSURE:

- A. Enclosure shall be a NEMA type 3R and be of suitable size to house all components. Enclosure shall be fabricated from 14-gauge type 304 stainless steel material. The top of the enclosure shall serve as a drip shield. Inner panel shall be made of 12-gauge steel and shall be painted white.
- B. This weatherproof, insulated, rain-tight enclosure shall be designed specifically for mounting in an unprotected outdoor location. It shall have a gasketed, hinged, front weather door with a locking hasp in addition to latches. Exterior door(s) shall have rod(s) to hold the door(s) open 90 degrees from closed position.
- C. The control enclosure shall be equipped with a hinged inner door with latching device. Main circuit breakers, lights, displays, keys and switches required to control pump(s) shall be mounted on or through the inner door so that all the components normally actuated by Operating Personnel are accessible without opening the inner door. Inner door material shall be corrosion resistant 0.090 aluminum.
- D. The enclosure shall be mounted on a concrete pad with minimum dimensions shown on the plans.
- E. Generator receptacle, main disconnect, and meter box shall be mounted on the side or rear of the main enclosure.
- F. Main enclosure shall be equipped with vents, fans, heaters and/or other equipment to maintain normal operating temperatures and humidity controlled conditions for all interior equipment.

2.02 UTILITY POWER / GENERATOR POWER CIRCUIT BREAKERS:

- A. A thermal magnetic circuit breaker shall be provided for panel short circuit protection on the incoming power supply from the utility and from the emergency generator. (2-pole for single phase / 3-pole for three phase) circuit breakers shall be supplied and shall be properly sized per latest revision of N.E.C. Breakers shall have a minimum interrupt rating of 10,000 RMS symmetrical AMPS. Breakers shall be mounted in the circuit breaker panel and shall be interlocked so that both breakers may not be closed simultaneously.

2.03 GENERATOR RECEPTACLE:

- A. A pin and sleeve, male inlet generator receptacle shall be mounted to the exterior wall of the building structure, and factory wired to the generator power circuit breaker. The generator receptacle shall be Meltric Model 33-98043 with angle adapter to match the other installations at North Liberty.

2.04 LINE TERMINAL BLOCK:

- A. A 3 pole line terminal block rated for 600 volt use shall be provided. Block shall be constructed of nylon and have insulating walls on all sides of the lug. Blocks must be UL recognized.

2.05 LIGHTNING PROTECTION:

- A. A lightning protection unit shall be installed at the point of connection for incoming power to the control panel. All units shall be rated at a minimum of 100,000 amps (maximum current) / 3000 joules per pole. The unit shall be capable of withstanding an unlimited number of surges. There shall be no leak current at double the rated voltage. Housing shall be made of PVC and shall attach through the wall of the control panel enclosure by means of a water-tight connection. Three phase units shall be rated at 600VAC, three phase, 4 wire. Single phase 200-240 VAC units shall be rated at 250VAC, single phase, 3 wire.

2.06 PHASE FAILURE/UNDERVOLTAGE PUMP PROTECTION:

- A. Independent power monitors shall be provided on the load side of the pump disconnects to monitor incoming voltage and provide protection to the motors. These power monitors shall detect incoming service abnormalities including phase-loss, unbalance, reversal, over voltage, under-voltage and rapid cycling protection and provide automatic cutout of pumps and provide local alarm. Upon detection that incoming power has returned to normal, the unit will restore pump operation and discontinue alarm. This device shall have a nominal 2-4 second dropout delay and (2-300 second) adjustable restoration time delay.
- B. The unit shall protect itself from voltage spikes and transients with internal transient protection meeting IEEE 587 standards.
- C. The power monitor system shall also include a stagger time delay function providing time delay between lead and lag pump start to eliminate simultaneous starting of motors upon return of system power. This feature shall be operation in all modes of pump operation. The monitors will be SYMCON 460 VBM

2.07 MOTOR CIRCUIT BREAKER:

- A. A 3 pole circuit breaker shall be supplied for each pump motor and be of adequate size to allow starting of the motor without nuisance tripping, but provide short circuit and branch circuit protection. Breaker shall have a minimum interrupt rating of 18,000 RMS symmetrical AMPS at 460 volts. Breaker shall have line and load lugs and be attached to sub-panel.

2.08 MOTOR STARTERS:

- A. Pump breakers shall be motor control rated for solid state reduced voltage motor starters. Provide Allen Bradley 150 SMC-3 Smart Motor Controllers with automatic bypass contactors.

2.09 TRANSFORMER PRIMARY CIRCUIT BREAKER:

- A. A properly sized two-pole circuit breaker with a minimum interrupt rating of 10,000 RMS symmetrical AMPS shall be supplied.

2.10 CONTROL POWER TRANSFORMER:

- A. A control power transformer shall be furnished to provide sufficient power to the control and alarm circuits. Transformer shall be protected per latest revision of N.E.C.

2.11 AUXILIARY POWER CIRCUIT BREAKER:

- A. A fifteen amp, one pole circuit breaker with a minimum interrupt rating of 10,000 RMS symmetrical AMPS at 240 volts shall be supplied for the convenience receptacle. Breaker shall have line and load lugs and be attached to sub-panel.

2.12 CONVENIENCE RECEPTACLE:

- A. An inner door mounted duplex GFCI, 15A, 115 VAC convenience receptacle shall be furnished. The receptacle shall be protected by a separate 15 amp circuit breaker.

2.13 CONTROL FUSING:

- A. Control, alarm, and cabinet heater circuits, wiring shall be protected by use of properly sized fuses mounted on the secondary side of the transformer. Fuses shall be applied and sized in accordance with latest revision of N.E.C.

2.14 DUPLEX PUMP CONTROLLER:

- A. This specification covers a complete and operational automatic duplex pump control and alarm system responding to the wet well level as shown on the plan drawings.
- B. The controller shall accept a single analog input signal over a user definable, field configurable range.
- C. To reduce exposure to corrosive environments and ensure the control system's reliable, long-term operation, the controller shall have a sealed, user-friendly, graphical interface. The interface shall be comprised of a rotary knob, switches and five columns of ultra-bright, daylight-viewable red LEDs. Four 40-segment, 4" columns of LEDs shall show the process tank level, the pump on and off control bands, and the high and low alarm setpoint bands. All LEDs within a control band shall be illuminated when operating under normal power. A fifth LED column shall indicate the controller's configuration, status, and active alarms. Alarms shall consist of high alarm, low alarm and input signal out of range.
- D. Monitor functions shall include control power and normal system operation. The controller shall contain an internal annunciator and an external alarm driver that activate on an alarm condition. The controller shall contain an integral 'silence' key and an external silence input. Discrete LEDs shall show the activation of the differential pump control stages.
- E. The controller shall provide easy, convenient indication and adjustment of the operating setpoints and controller configuration without the need for tools. For ease of operation and configuration, multiple indicating columns are required. Controllers that provide fewer columns, thus limiting the viewing of relevant and necessary station information, are specifically precluded by this specification.
- F. The control circuits shall be forced OFF by activation of the external inhibit input or upon power loss. Upon power restoration, or removal of the inhibit input, the controller shall enable its outputs in an adjustable time-step sequence as required to meet the demand.

- G. The controller shall continuously indicate the status of the selected alternation sequence, pumping direction, and control modes. The controller shall provide 1st On/1st Off, Fixed, and Auto Rotate alternation sequences and selectable Pump-Up or Pump-Down programming.
- H. Integral span, offset, and damping adjustments shall be easily adjustable. The controller shall have the ability to select from 1 to 40 seconds of input signal averaging/damping.
- I. The controller shall have a configurable security lockout feature.
- J. The controller shall be powered by 12-30 VDC. When operating on main power, the controller shall charge an optional, external electrolyte gel-cell battery. Upon loss of power, and when provided with the battery, the controller shall revert to a low-power mode. When applied as an RTU and operating on battery backup, the controller shall continue to provide communication with the host controller.
- K. The controller shall contain a level simulation function that allows manual manipulation of the displayed process variable. When simulating, the controller shall display both the actual process level and the simulated level.
- L. The controller shall provide isolated 5 and 24 VDC for direct power/excitation of a compatible level sensing transducer. The controller shall contain a galvanically isolated analog input, two optically isolated digital inputs, and five digital outputs. The analog input shall accept a nominal 4-20 mADC signal. Three digital outputs shall be individually fused solid-state switches with zero-voltage turn-on and zero-current turn-off. Two discrete outputs shall be provided for common alarm and controller monitor. The controller shall contain an RS-232 communication port and have capabilities for connection to a SCADA (Supervisory Control And Data Acquisition) system. The complete assembly shall be designed for use in UL508 Industrial Control Panels. All job connections shall be at drop-cage type removable terminals.
- M. It is the specific intention of this functional requirement that a standard controller shall be provided with features as described herein. Additionally, this controller shall be a fully-integrated assembly. That is, the furnishing of similar functions using multiple setpoint modules, a custom-configured programmable logic controller (PLC) or extensive relay/timer logic to accomplish control sequences, etc., is specifically precluded by this specification and is not acceptable.
- N. The controller shall be a Contegra STATION MASTER 702C with design specified range or pre-approved equal by the City.

2.15 LEVEL SENSING EQUIPMENT:

- A. Water level in the wet well shall be measured by a submersible water level transducer. The transducer shall transmit a 4-20 mA DC signal to the pump controller. The pumps shall normally be automatically controlled by the controller and water level. One primary and one secondary transducers required.
- B. Provide Contegra Model SLX 130 4-20 mA submersible transducer or pre-approved equal by the City.
- C. The transducers shall be hung by its signal cable from a stainless steel cable hanger. Provide signal cable length as required to run unspliced to the controller.

2.16 INTRINSICALLY SAFE BARRIER FOR PUMP CONTROLLER AND LEVEL SENSORS:

- A. Provide hazardous location protective device (intrinsically safe barrier). The device shall be panel mounted and designed to protect the pump controller and level sensors. The barrier shall be certified intrinsically safe in installations up to and including Class 1 Zone O. The intrinsically safe barrier shall have screw terminals for wire connections. The intrinsically safe barrier shall be protected and current limited according to the requirements of UL Class I (Groups A, B, C & D), Class II (Groups E, F, & G) and Class III certification. The intrinsically safe barrier shall allow for a maximum short circuit current of 10 ma.

2.17 PUMP SEAL FAILURE DETECTION:

- A. Adjustable pump seal detection shall be provided to indicate a pump inner seal failure and disable a pump when a seal fault is present. The seal fault function shall be user selectable to assign a seal leakage condition to a display only fault, critical (lockout) fault or non-critical (auto reset) fault. While a fault condition is present, the seal failure light shall blink rapidly. When the seal fault condition is cleared, the seal failure light shall blink slowly until the reset button is pressed on the control unit keypad.
- B. Pump seal moisture sensors to be supplied by pump manufacturer to panel manufacturer for installation by panel manufacturer.

2.18 OVER-TEMPERATURE PROTECTION:

- A. Provide a shut-off relay to shut down and lock out each pump when high temperature is indicated. Allow operator to manually reset and start the pump with a pump reset push button.
- B. Pump over-temperature sensors to be supplied by pump manufacturer to panel manufacturer for installation by panel manufacturer.

2.19 SEAL FAILURE PROTECTION:

- A. A seal failure relay shall be provided for each pump. The relay shall protect the pump from damage that might otherwise occur from moisture in the motor housing.

2.20 HAND-OFF-AUTO SWITCH:

- A. Switch shall be 22mm oil-tight design, rated NEMA 4X. When in the auto position the level controls shall control the operation of the pump. When in the hand position all safeties shall be by passed except overload protection.

2.21 REDUNDANT CONTROL SYSTEM:

- A. A simple, redundant, intrinsically safe pump control system shall be provided for the lift station which includes only water level float switches and a selector switch. This system shall provide backup control of pumps in the event of failure of the normal automatic level control system for any reason.

- B. Pump 1-Off-Pump 2 selector switch shall be used to choose which pump will operate under the redundant control system.
- C. A high level float switch for pump turn on shall be above the normal high water automatic turn on point yet below the high-high water level alarm point. A low level float for pump turn off shall be below the normal turn off level. Redundant control system will be Contegra CD-2RC.

2.22 REDUNDANT FLOAT SWITCHES:

- A. The liquid level shall be sensed by (2) two direct acting float switches. Each float shall have molded polyethylene body, internal redundant polyurethane foam flotation, potted switch and cable connections and fine-stranded AWG #18 cable with heavy-duty synthetic rubber jacket in lengths as required to run unspliced to the redundant control system.
- B. The floats shall be hung by their signal cables from a stainless steel cable hanger. This hanger may be a multiple hook hanger for both the transducer and floats. Provide signal cable length as required to run unspliced to the redundant control system.

2.23 RUN TIME METERS:

- A. A six (6) digit, non-resettable time meter shall be connected to each motor starter to record the total running time of each pump motor in hours and tenths of hours. An additional identical meter shall be connected to record the total time that both pumps run simultaneously. Meter(s) shall NEMA 4 rated and shall be U.L. recognized.

2.24 LEVEL CONTROL OPERATION:

- A. The panel shall include provisions for normal pump down operation using the duplex pump controller. The operation sequence shall be as follows:
 1. Level 1 - All pumps off
 2. Level 2 - Lead pump on
 3. Level 3 - Lag pump on
 4. Level 4 – High wet well level alarm / Backup Pump Start
 5. Float Switch Off – Redundant Off / Low level alarm / Backup Pump Stop
 6. Float Switch ON – Redundant On/ high wet well level alarm

2.25 CONTROL RELAYS:

- A. Required 120 VAC and 12 VDC, 2PDT, 3PDT, 4PDT, plug-in control relays shall be provided. Relays shall be equipped with silver cadmium oxide contacts, rated at 10 amps and a dust cover. Relays shall be U.L. recognized.

2.26 CONTROL TERMINAL BLOCK:

- A. Control terminals shall be provided for connecting level control switch leads. Terminal blocks shall be rated for 600 volt use and accept a wire range of #22-8. Block shall be constructed of nylon and have insulating walls on all sides of the lug. Blocks shall be UL recognized.

2.27 GROUND LUG(S):

- A. Required equipment ground lugs shall be provided for grounding the enclosure. The ground lug

shall be suitable for the service provided to the enclosure sized per table 250-95 of the N.E.C. In all cases the enclosure must be adequately grounded per article 250 of N.E.C.

2.28 CONSTRUCTION STANDARDS:

- A. Sub-panel shall be drilled and tapped to accept machine thread bolts (self tapping screws are not acceptable). All control wiring shall be 16 AWG machine tool wire, Carol type 76512 or equal. All control wire shall be numbered in accordance with JIC standards. Power (motor) wiring shall be in accordance with the National Electrical Code. Major groups of wires shall be contained in plastic wiring trough equal to Panduit type E.

2.29 ALARM AND COMMUNICATIONS SYSTEM:

- A. Provide an AC line/DC battery-powered local alarm system in the pump station control center cabinet. The system shall be normally powered by 120 VAC commercial power.
- B. The alarm shall indicate high level, control power failure, pump overtemp lockout, generator running, backup float system active, seal-fail and pump #1 and #2 fail to run. The main alarm shall trigger the appropriate message for broadcast by a communications system.
- C. The alarm system shall be provided with a complete set of instructions on installation, system checkout, and operation with a trouble shooting guide.
- D. A flashing high water alarm light shall be mounted on the top of the control enclosure. The lens shall be made of red lexan. The lens shall be mounted, with screws, from the inside of the control panel enclosure and shall be water tight. The bulb shall be easily replaced from within the control enclosure.
- E. An alarm horn or buzzer shall be mounted on the control enclosure. The horn or buzzer shall operate on 115 VAC and shall have a minimum decibel rating of 85. A pushbutton, mounted on the exterior of the control enclosure, shall be furnished to silence the audible when an alarm condition exists. Horn or buzzer shall be U.L. listed.
- F. Provide remote alarm communications capability and connections via an advanced environmental monitoring system combined with digital speech recording technology. The auto-dialer shall contact the North Liberty Wastewater Department's phone during normal business hours and shall contact the on-call operator's phone evenings, nights and weekends. The alarm auto-dialer shall also contact the Superintendent's work phone, Assistant Superintendent's phone, and wastewater plant if the phoned alarm is not confirmed by the recipient. The communications system shall be housed inside the controls enclosure. Provide Omni-Site XR50 cellular telephone dialer system. City of North Liberty will establish Omni-Site service contract for the lift station site.
- G. Provide a Wilson Cellular 800MHz/1900MHz Dual-Band Direct Connection Amplifier with a SMA/M to FME/M Adapter.
- H. A battery back-up system shall be provided to supply power for the alarm circuits and remote communications system in case of power failure. If the A.C. power fails, the system shall automatically switch to the batteries and shall provide enough stand-by power for at least 24-hours. When A.C. power is restored, the batteries shall be automatically recharged.

- I. Provide telephone service entrance into enclosure.

2.30 NAMEPLATES:

- A. All major components and sub-assemblies shall be identified as to function with laminated, engraved bakelite nameplates, or similar approved means. Install nameplates on all devices or pieces of equipment for which use or identification is not readily apparent. Ensure position of nameplate is readable after equipment installation. Prior to manufacturing of nameplates, submit list-indicating designations to Engineer and City for approval.
- B. Identify pumps as related components as No.1 – North/East and No.2 – South/West.
- C. All wiring shall be numbered and control panel components labeled in all panels and shall be recorded on all electrical drawings.

PART 3 – EXECUTION

3.01 INSTALLATION, TESTING AND START-UP:

- A. It shall be the installing contractor's responsibility to secure from the station manufacturer station installation instructions at least one (1) week prior to the scheduled shipment of the station to the job site. The contractor shall study the instructions and direct any questions he has to the station manufacturer representative for answers before proceeding with the station installation. The contractor shall then install the station in complete conformance with the manufacturer's recommendations.
- B. Devices requiring field calibration or testing shall be calibrated in presence of Owner's representative and documented.
- C. Supplier shall provide skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place entire system into satisfactory operation; engineer or technician shall make necessary inspection of completed installation, make necessary final field adjustments and make program revisions as required for start-up.
- D. Supplier shall demonstrate proper operation of all system features and functions to City of North Liberty, Owner and Engineer. Submit a written report summarizing results of the field tests to the Engineer for final approval.
- E. Coordinate installation, testing and start-up scheduling with City of North Liberty, Utility Service Provider and Engineer.
- F. All equipment will have a 100% parts and labor 24 month warranty that starts after final startup and accepted by the City.