**CITY OF BILOXI**

**SPECIAL PROVISION NO. 907-650-1 CODE: (SP)**

**DATE: 07/03/2017**

**SECTION 650 – DUPLEX / TRIPLEX PUMP CONTROL PANEL**

**650.01 - Description.** The work covered by this section consists of furnishing all labor, equipment and materials and performing all operations in connection with the installation of a duplex/triplex pump control panel, control floats and elevated platform (if applicable) as specified herein and/or shown on the Drawings.

**650.01.1 - Manufacturer's Experience.** It is the intention of this Specification to cover minimum acceptable quality equipment for a complete installation. These Plans and Specifications were developed based upon a submersible solids handling sewage pump duplex controller as manufactured by Control Systems, Inc. The intent of the Plans and Specifications is to describe the required features, functions, and performance of the pumping system to be supplied. Bidder and pump system supplier shall familiarize themselves with the requirements of the project and the particulars of this installation. Any and all modifications or adjustments of any kind to any siting, foundation, piping, valving, electrical, controls, instrumentation and/or appurtenances of any nature that may be required to accommodate the particular sewage pump system manufacturer as proposed in any Bidder’s Bid Proposal shall be included in the price bid therein. No additional compensation shall be paid for any accommodation of any particular sewage pump system supplier.

The Equipment Manufacturer shall have not less than 10 years successful experience in the design, construction and operation of electrical control equipment of the type specified. The City Engineer may require and Bidder shall provide certified documentation, satisfactory to the City Engineer, from the owner/operator of the equipment installations cited above to substantiate any claims concerning the ability of the proposed sewage pumping equipment to perform as required.

**650.01.2 - Supplier's/Manufacturer's Services**. The manufacturer of the pump controller package shall be a UL 508A Certified facility. Proof of label availability shall be provided with submittals.

The pump controller package shall be designed, constructed and tested in accordance with NEMA, NEC, IEC and UL 508A standards.

Prior to shipment, the pump controller package shall be functionally tested at the factory, as an assembled unit with motors connected to ensure proper sequencing and operation. All pilot devices and controls shall be tested to verify proper operation. Temperature tests shall be conducted to assure that internal enclosure temperatures are suitable for the installed components operating in the site environment. Documentation of the tests shall be furnished at the engineer's request.

**650.02 - Materials.**

**650.02.1 – General Requirements.** Enclosure shall be constructed of a minimum 14 gauge, type 304 stainless steel.  Seams shall be continuously welded and ground smooth.  Provide a seamless form-in-place gasket to assure water tight and dust tight seal.  Provide a rolled lip around three sides of door and all sides of enclosure opening to exclude liquids and contaminants.  Provide an internal 3-point latch and type 316L stainless steel padlocking “power glide” handle to assure security and a water-tight seal while still allowing convenient access.  Door shall be removable by pulling a stainless steel continuous hinge pin.  Enclosure shall be painted inside and out with white polyester powder to reduce absorption of solar radiation to keep internal components cool. The enclosure shall be rated NEMA 4X and be manufactured by Hoffman or approved equal. All operator devices including selector switches, pilot lights and meters shall be mounted on an interior deadfront panel. The deadfront panel shall be constructed of anodized aluminum with a continuous aluminum hinge to swing outward and allow access to the back panel. Provide a thermostatically controlled heater in the enclosure to reduce condensation in the enclosure. Also, provide a stainless steel automatic breather drain in the lowest part of the enclosure. The manufacturer shall size the enclosure to provide minimum wire bending spaces per N.E.C. requirements.

All power and control wires shall be stranded copper type MTW. All wiring bundles shall be in covered plastic wireway.

All points necessary for external connection in the controller, whether power or control shall be wired to a terminal strip located at the bottom of the enclosure. The terminal strip shall be permanently marked with the same designation as the wire connected to it. Provide neutral and grounding terminals.

All power and control wires shall be marked at both ends using self-adhering wire markers. No two wires having different functions within the control panel shall have the same markings.

All circuit breakers, starters, and other control devices mounted within the controller panel shall be labeled for identification both within the panel and on the wiring schematic with corresponding designations.

Control power shall be 120 volts and shall be protected by a correctly sized circuit breaker. If required, provide a properly sized control power transformer with primary over current protection.

Each starter shall be provided with overload protection in all three phases and each individual starter shall have phase failure protection.

All circuit breakers, selector switches, pilot lights and control devices shall be visible and operable from an interior dead-front panel. The dead-front panel shall be constructed of anodized aluminum and shall have a continuous aluminum hinge.

Provide a 15A, 120V duplex receptacle surface mounted in a metal outlet box on the back panel in the enclosure.

All drawings shall be prepared per J.I.C. standards and submitted prior to any fabrication of control equipment. The Controller shall be produced by a UL 508 listed shop. Proof of label availability shall be submitted with above drawing.

Provide enclosure with a properly sized main breaker. The breaker shall include a door mounted operator mounted on the deadfront panel. The operator shall prevent the deadfront panel from being opened with the breaker in the on position.

**650.02.2 - Surge Protection Device (SPD).** Provide a properly sized SPD to protect the components in the enclosure.The SPD shall be UL 1449 listed subject to IEEE C62.41 test standards for all category locations surge current rating of 100kA per phase and 50kA per mode minimum. Provide diagnostic indicator lights for each phase and a 20 amp, 240 or 480 volt (as required to match service entrance voltage) circuit breaker for disconnecting means.

**650.02.2.1 – Motor Controllers with Across-the-line Starter.** Provide a properly sized circuit breaker combination NEMA rated motor starter with NEMA Class 10, ambient compensated overload protection and individual phase failure protection. Across the line starters shall be required on 240V AC station with motors less than 15 horsepower and 480V AC station with motors less than 20 horsepower.

Overload relays shall be solid state Allen Bradley type E1 Plus or approved equal.

For UL listed combination starters, circuit breaker shall be a motor circuit protector type with instantaneous trip only.

Minimum NEMA rated starter size shall be Size 1.

**650.02.2.2 – Motor Controllers with Solid State Starters.** Provide a solid state starter for each pump motor. The solid state starter shall come complete with a shorting contactor and overload protection. Solid state starters shall be required on 240V AC stations with motors 15 horsepower and larger and 480V AC stations with motors 20 horsepower and larger.

The solid state starter shall be provided with a pump control option, and other features as found in the Allen Bradley SMC Flex soft starter or approved equal.

1. **– Duplex Pump Controller Module Features and Functions.** Provide a Duplex Pump Controller Module to control two single speed pumps with features and function of the Model DC201B made by Control Systems, Inc., Jackson, MS including the following features:
   1. – Operators and Front Panel Indicators (for each pump)

Manual-Off-Automatic selector switch

Green “Pump Running” pilot light

Red “Pump Failure” pilot light

Red “Pump Seal Failure” pilot light

* 1. – A Pump NO.1 LEAD – ALTERNATE – Pump NO.2 LEAD sequence selector switch to select either pump as lead pump or to select that the pumps alternate as lead pump on each call for cycle.
  2. – Signal inputs for stop, lead pump start, lag pump start, and high/low alarm. The sensors shall be optically isolated and operate on 24V DC with a maximum current of 16 mA for intrinsic safety.
  3. – Pilot light indicators for each signal input described above, as well as, Pump No.1 and No.2 running inputs.
  4. – The controller shall operate a pump based upon various combinations of signal inputs. Normal operation shall operate pumps in the following automatic sequence:
     1. – With no signal inputs activated and both pumps off, a stop input activation shall not cause a pump to operate. With a stop input activated and a lead start input activated, the controller shall start a single pump that pump shall operate until the lead start and stop inputs are deactivated. With both the stop and lead start inputs activated and one pump operating, a lag start input being activated shall operate the second pump. Both pumps shall operate until the lag start, lead start, and stop inputs are deactivated.
     2. – In the event an input device(s) fails to activate the controller shall operate as follows:
     3. – With a stop input device failure, the controller shall operate a single pump based upon the status of the lead start input and a field adjustable short cycle delay. The short cycle delay shall keep the pump operating after the start input deactivates for the delay time setting. If the stop input device fails to activate, the controller shall operate one pump as described above with the lag start input starting the second pump. Both pumps shall operate until both start inputs are deactivated and the individual pump short cycle delays have expired. In the event both the stop and lead start inputs fail to operate, the controller shall operate both pumps based upon the status of the lag start input and the individual pump short cycle delay timers. Both pumps shall operate until the lag start input is deactivated and the individual pump short cycle delays have expired. If all input devices fail except the high/low alarm input, the controller shall operate both pumps based upon the status of the high/low alarm input and the individual pump short cycle delay timers. Both pumps shall operate until the high/low alarm input is deactivated and the individual pump short cycle delays have expired.
  5. – A field adjustable failure time delay for each pump, in the range of 5 seconds to 6 minutes, to start the lag pump at the lead pump start point if the lead pump fails or if the lead pump selector switch is placed in the off position. If a pump fails, the remaining functional pump shall remain the lead pump on future cycles. The failed pump shall only be called to operate at the lag pump operating point. Normal pump alternation shall resume when the failure condition is corrected and the pump has been reset.
  6. – Soft stop feature to require the pumps to stop three (3) seconds apart during the condition that both pumps are running when signaled to stop. Soft start feature to require the pumps to start three (3) seconds apart during conditions that the lead and lag pumps are called for simultaneously.
  7. – Individual field adjustable time controls to delay starting each pump in the automatic mode after power failure or during initial startup.
  8. – Pump failure, pump seal failure, and high/low alarm red pilot lights shall flash when activated. Provide field selectable controls to allow the seal failure indicator to burn steady when activated.
  9. – Manual override inputs for each pump, which can be used to manually override the duplex controls’, pump outputs when the controls are in the Automatic mode. Inputs shall be provided to start or stop each pump from a remote location.
  10. – Provide a selectable improper sequence alarm to activate the common alarm in the event the control inputs are activated in the wrong order. The proper order shall be Stop, Lead Start, and Lag Start. The High water alarm shall not be included in the improper sequence test. Provide a selectable Lag Stop Level control to allow the lag pump to stop based upon the status of the lead start level input.
  11. – Provide automatic pump alternation on pump failure and seal failure when a failure condition is detected and the pumps are in the automatic mode. The failed pump shall be made the lag pump on future cycles until the failure condition is corrected. Pump failure shall require manual reset to clear the failure condition and the seal failure condition shall clear when the failure condition clears. Provide field selectable controls to allow the seal failure condition to not automatically alternate the pumps.
  12. – An exterior alarm light output that would flash the light brightly during any common alarm condition that includes pump failure, seal failure, improper sequence, and high water alarm. The output shall allow the light to dim glow under normal conditions to indicate that power is on and the lamp is good. A normally open common alarm output contact shall be energized by these alarm conditions. Provide selectable controls to prevent the seal failure input from activating the common alarm output and alarm light.
  13. – Provide an intelligent Lift Station Analyzer with the following features:
      1. – Provide the following additional inputs: an external normal power failure input for use in remote telemetry, three (3) 4-20 mA analog inputs with an input resistance of 100 ohms.
      2. – Provide the following additional outputs: pump no.1 is lead, pump no.2 is lead, pump no.1 selector switch is in the automatic position, and pump no.2 selector switch is in the automatic position.
      3. – Provide front panel status indicators for pump running, pump failure, pump seal failure, high/low alarm and auxiliary input.
      4. – Provide selectable first on/first off control to allow the first pump activated to be the first pump off when both pumps are activated.
      5. – Influent and Effluent flowrate calculation based on floats or portable submersible pressure level transmitter.
      6. – Provide two serial communications ports, one RS-232 and one RS-485 for interfacing with RTU's, PLC's, radio or telephone modems, operator interfaces, and PC's. The ports shall support industry standard communication protocols, such as MODBUStm and BrickNettm at baud rates of 1200, 2400, 4800, and 9600.
      7. – Provide a user selectable unit address from 000 to 999. The switches shall allow the unit address to be set without software or special equipment.
      8. – Provide user selectable cross sectional area switches. The switches shall allow the cross sectional area of the wetwell to be set without software or special equipment.
      9. – Provide user selectable float distance setting switches. The switches shall allow the distance between the stop, lead start and lag start floats to be set without software or special equipment.
      10. – Provide average pump capacity calculation as well as the following other statistics: Pump Runtimes, High/Low and Average Inflow for the last 24 hours, Average flow-capacity loss when more than one pump is running, Estimate Real-Time level based upon current flows and float positions.
      11. – Provide TRUE Volumetric Influent Flow calculation with long-term averaged error not to exceed 0.2% of Full Scale.
      12. – The analyzer shall be capable of operating with float switches or a level controller with dry contact outputs for All-Stop, Lead Start and Lag Start during normal operation and use a portable submersible pressure level transmitter (SPLT) for automatic calibration in determining the level positions of all floats. During the calibration process, the SPLT shall automatically start the calibration procedure when it is plugged into the lift-station analyzer, and stop the procedure when it is unplugged.
      13. – For level control systems using SPLT level sensing, the analyzer shall be capable of using the signal from the SPLT in all calculations.
      14. – The controller shall monitor key lift station functions such as Seal and Pump Failures, Improper Sequence, General Alarm, High Level Alarm, Pump Currents, pump runtimes, and pump duty cycles.
      15. – Data-logging and storage in non-volatile memory.
      16. – Capability for an optional external operator interface hex-keypad for easy entry of floating point numbers, set-points, menu selections and other parameters that need to be entered into the controller.

**650.02.2.3.15**  – The following information shall be transmitted from the (DC201D) Duplex Controller to the Master (CTU) Central Telemetry Unit. Triplex and Quadraplex stations shall be similar with additional information for the third and fourth pumps.

* Wet-well High Level
* Lag Pump Start
* Lead Pump Start
* All Pump(s) Stop
* Auxiliary # 1 Alarm Input
* Pump No. 1 Running
* Pump No. 2 Running
* Pump No. 1 Seal Failure Detected
* Pump No. 2 Seal Failure Detected
* UPS101A Low Battery Input
* Auxiliary # 4 (Spare)
* Auxiliary # 3 (Spare)
* Auxiliary # 2 (Spare)
* Pump No. 1 Set to Lead
* Pump No. 2 Set to Lead
* High Level Enable
* Improper Sequence
* Pump No. 1 in Auto
* Pump No. 1 in Manual
* Pump No. 2 in Auto
* Pump No. 2 in Manual
* Improper Sequence Delay Time
* Common Alarm
* Improper Sequence Alarm
* Pump No. 1 Failure Alarm
* Pump No. 2 Failure Alarm
* Pump No.1 Call For
* Pump No.2 Call For
* All Pumps Have Failed
* UPS101A Battery Failure
* Pump No. 1 Current Input
* Pump No. 2 Current Input
* Level Input
* Pump No. 1 Run Hours
* Pump No. 1 Run Thousand Hours
* Pump No. 2 Run Hours
* Pump No. 2 Run Thousand Hours
* Pump No. 1 Last Cycle Run Time
* Pump No. 2 Last Cycle Run Time
* Pump No. 1 Average Run Time
* Pump No. 2 Average Run Time
* Tank Fill Time
* Tank Pump-Down Time
* Average Tank Fill Time
* Average Tank Pump-Down Time
* Estimated Inflow
* Average Inflow
* Estimated Outflow
* Communications Stat Counter
* Inflow Gallons
* Inflow Thousands of Gallons
* Inflow Millions of Gallons
* Pump No. 1 Capacity
* Pump No. 2 Capacity
* Pumps 1 & 2 Capacity
* Pump No. 1 Average Capacity
* Pump No. 2 Average Capacity
* Pumps 1 & 2 Average Capacity
* Pump Capacity Ratio
* Estimated Tank Level
* P1 Current Cycle Run Time
* P2 Current Cycle Run Time
* 24 Hr. High Inflow
* 24 Hr. Low Inflow
* Cross-Sectional Area
* Improper Sequence Time Delay
* Pump Failure Delay Minutes
* Pump No. 1 Starts (0-999)
* Pump No. 1 Starts (Thousands)
* Pump No. 2 Starts (0-999)
* Pump No. 2 Starts (Thousands)
* Stop Level Tank Capacity
* Lead Level Tank Capacity
* Lag Level Tank Capacity
* Previous 24 Hr. Inflow High

**650.02.2.4 – Float Test Option Module.**  Provide input indicator and test module with improper input sequence indicator and controls of the Model FT101A made by Control Systems, Inc., Jackson, MS. The following controls and equipment shall be supplied:

**650.02.2.4.1 –** Four deadfront panel mounted input pilot light indicators: One for each of the following control points: Stop, Lead Start, Lag Start and High Alarm.

**650.02.2.4.2 –** Four dead-front panel mounted pushbuttons to test each pump control input point.

**650.02.2.4.3 –** Automatic input sequence monitoring, such that if the inputs do not occur in proper order (stop, lead start, lag start), a red pilot light indicator shall be activated.

**650.02.2.4.4 –** If stop input fails, followed by lead input activation, lead pump shall operate and continue until lead pump input is removed and a field adjustable time delay has expired

**650.02.2.4.5 –** If stop input fails, followed by lead and lag input activation, both pumps shall operate and continue until their respective input is removed and an individual field adjustable time delay for each pump has expired.

**650.02.2.4.6 –** If stop, lead and lag inputs fail, followed by high input activation, both pumps shall operate and continue until the high input is removed and a field adjustable time delay for each pump has expired.

**650.02.2.4.7 –** Improper sequence activation shall also activate the common external alarm controls.

**650.02.2.4.8 –** Improper sequence alarm shall require reset button activation to remove the alarm light.

**650.02.2.5 – Triplex Pump Controller Module Features and Functions.** Provide a Triplex Pump Controller Module to control three single speed pumps with features and function of the Model QC101B made by Control Systems, Inc., Jackson, MS including the following features. Refer to Section 650.02.2.15 above for available information to be transmitted to the Master (CTU) Central Telemetry Unit.

**650.02.2.5.1** – Operators and Indicators

Manual-Off-Automatic selector switch

Green “Running” pilot light

Red “Failure” pilot light

Red “Seal Failure” pilot light

Green pump “Start” pilot lights for Lead, Lag 1 and Lag 2

Amber pump “Stop” pilot lights for Lead, Lag 1 and Lag 2

**650.02.2.5.2** – Level Inputs

**650.02.2.5.2.1** – Individual “Start” and “Stop” level control points shall be provided for each pump or field adjustable controls shall be provided to allow the first “Stop” level control point to stop all of the pumps.

**650.02.2.5.2.2** – Provide a High liquid level alarm input sensing point, as required for the application.

**650.02.2.5.2.3** – Provide pilot light indicators for each level input sensing point.

**650.02.2.5.2.4** – Provide manual override inputs for each pump, which can be used to override the triplex controller’s pump call-for outputs when the controls are in the Automatic mode. Inputs shall be provided to start or stop each pump from a remote location.

**650.02.2.5.2.5** – All pump control inputs shall be optically isolated and their power limited to 24 Vdc with a maximum current of 16 mAdc for intrinsic safety.

**650.02.2.5.3** – Pump Sequencing

**650.02.2.5.3.1 –** Automatic pump alternation on lead pump “Call” cycle. Pump alternation shall be field selectable to alternate on a first pump “ON”, first pump “OFF” basis or on a last pump “ON”, first pump “OFF” basis.

**650.02.2.5.3.2 –** The pumps shall also alternate as lead pump, when the lead pump reaches a field adjustable running period, which shall have a time range from 10 minutes to 21 hours.

**650.02.2.5.3.3 –** Provide a field adjustable failure time delay for each pump. If a pump fails to run, or if that pump’s selector switch is placed in the off position, provide controls to start the next pump in the sequence at the failed or disabled pumps operating call-for input setting.

**650.02.2.5.3.4 –** If a pump fails to run, that pump shall automatically become the last called for pump in the operating sequence. Normal pump alternation shall resume when the failure condition is corrected and the failed pump has been reset.

**650.02.2.5.3.5 –** Provide individual field adjustable time controls to delay starting each pump in the automatic mode after power failure or during initial start.

**650.02.2.5.3.6 –** Provide stagger stop feature to require the pumps to stop a minimum of two (2) seconds apart during the condition that two or more pumps are running when signaled to stop. Provide stagger start feature to start the pumps a minimum of three (3) seconds apart during conditions that two are more pumps are called for simultaneously.

**650.02.2.5.3.7 –** Provide controls to remove any pump(s) from the alternating sequence, making the removed pump(s) the last pump(s) to be called for if the input conditions require it.

**650.02.2.5.3.8 –** Pump failure, Seal failure, High-level alarm, and Improper Sequence alarm red pilot lights shall flash when activated.

**650.02.2.5.3.9 –** Provide automatic controls to alternate pumps on Pump Failure, Seal Failure, or when a pump is running in Automatic and is manually turned off.

**650.02.2.5.3.10 –** When pump seal failures are not needed, the seal failure circuitry for each pump shall be able to indicate an auxiliary condition by flashing or steady operation without interfering with the controller operation.

**650.02.2.5.4** –Input Monitoring and Control

**650.02.2.5.4.1 –** The Manual-Off-Automatic switches shall bypass all of the controls and energize their respective pump outputs when placed in the Manual position. In the Manual and Off modes, pump failure alarms shall be disabled.

**650.02.2.5.4.2 –** The Manual-Off-Automatic switches shall be used to reset a pump failure alarm after the failure condition has been cleared, by manually switching the failed pump to the OFF position and back to Automatic.

**650.02.2.5.4.3 –** Provide automatic input sequence monitoring, such that if the first “All Pumps Stop” input fails to activate, and any two start inputs are activated, the lead pump shall start.

**650.02.2.5.4.4 –** If a third start input is activated, start the first lag pump.

**650.02.2.5.4.5 –** If the high-level alarm input is activated, start all pumps.

**650.02.2.5.4.6 –** When operating in a “Last On, First Off” mode, each pump that is started is turned off at the next lower start input setting during the “improper sequence”. That is, the Lag 2 pump will turn off at the Lag 1 Start setting, Lag 1 will turn off at the Lead Start setting, and the Lead pump will run until the Lead Start input turns off.

**650.02.2.5.4.7 –** When operating in a “First On, First Off” mode, the Lead pump will turn off first, followed by the Lag 1 and Lag 2 pumps.

**650.02.2.5.4.8 –** Provide a red pilot light indicator to alarm "Improper Input Sequence" when any of the above-described conditions occurs. Also, provide a manual reset pushbutton switch for clearing the Improper Sequence alarm.

**650.02.2.5.4.9 –** If the “improper sequence” clears itself, the pumps will return to normal operation. The alarm will continue to be energized until manually reset.

**650.02.2.5.5** – Annunciating

**650.02.2.5.5.1 –** Provide individual discrete pump running output contacts for each pump.

**650.02.2.5.5.2 –** Provide individual discrete “Alarm Telemetry” dry contact outputs for the following alarms:

Each Pump Failure

Each Pump Seal Failure (If Required)

High Level Alarm

Improper Level Input Sequence

**650.02.2.5.5.3 –** Provide a Common Alarm discrete output contact that will actuate when any alarm condition occurs.

**650.02.2.5.5.4 –** Provide an exterior alarm light output, which allows the light to dim glow under normal conditions to indicate power on and lamp good. The light shall flash brightly during any alarm condition.

**650.02.2.5.5.5 –** Provide a lamp test feature to light all of the front panel pilot lights.

**650.02.2.6 – Remote Telemetry Unit.** Provide a Remote Telemetry Unit (RTU) to interface with the Pump Controller Module to transmit I/O to and from the Master Computer via the radio modem transceiver, as described below. The RTU shall have the features and functions of a Model RTU103 as made by Control Systems, Inc., Jackson, MS.

**650.02.2.6.1 –** The RTU shall feature an I/O count expandable to twenty (20) digital inputs (DI), twelve (12) digital outputs (DO), eight (8) 4-20 mA analog inputs (AI), two (2) isolated 4-20 mA analog outputs (AO), four (4) RS232 serial ports, one (1) dedicated serial programming port and the capability of “daisy-chaining” another RTU via a serial port for expandability. The unit should be back-plate mounted and 12VDC powered with optional battery backup for operation even under power failure conditions. The programming language shall be ‘C’. The microprocessor shall have 512K of Flash memory, 512K of SRAM memory and a Real-Time-Clock. The microprocessor shall run at a minimum of 29.4 MHz. The SRAM and Real-Time-Clock shall be maintained by a lithium battery. Provide separate LED indicators for all digital I/O, analog outputs and serial ports. Digital inputs shall be dry-contact type with a maximum voltage potential of 12VDC. Digital outputs shall be open-collector NPN Darlington transistor type with a maximum current rating of 150 mA per channel. There shall be provisions to support up to eight (8) 4-20 mA analog inputs using plug-on cards. Provide support for two (2) optional isolated 4-20 mA analog outputs. Four (4) standard 9-pin serial ports, all including Tx, Rx, Rts and Dcd pins, shall be provided for external communications and one dedicated serial port for programming. Provide optional 10/100Base-T Ethernet connectivity. The RTU shall have quick-connect plugs for all I/O points.

**650.02.2.7 – Radio Modem Transceiver.** Provide a Radio Modem Transceiver to transmit duplex and triplex lift station data to the existing Central Terminal Unit (CTU) at the City’s master SCADA location. The radio Modem Transceiver shall provide re-farming compliant high speed data link communication with system security and diagnostic reporting. The RMT shall provide full UHF, VHF, and 900 MHz MAS bands as required by the FCC license. The RMT shall be capable of transmitting MODBUS protocol messages. Built-in radio diagnostics shall be included and shall be capable of reporting specific unit programming, link testing, and radio performance statistics including RSSI, temperature, supply voltage, and additional parameters throughout the radio. Radio diagnostic information shall be capable of on-line communication with each transmission with no interruption in the application, and with minimum overhead. The RMT shall also comply with FCC re-farming and power regulations. Bandwidth shall not exceed 12.5 KHz. To assure communications with the OWNER’s existing resources and to assure compliance with FCC regulations, Radio Modem Transceivers shall be Cal-Amp Model Guardian 100.

**650.02.2.8 – Radio Path Survey.** Provide a radio path survey to measure radio signal strength and to properly design transceivers, antennas, masts and any other equipment necessary for data radio communication between each CTU/RTU site. Contractor shall provide radio repeaters as necessary for this purpose. The Owner’s existing facilities will be made available for installation of this equipment including 120V AC power if already existing. To assure reliable radio data communication, the minimum acceptable signal strength between RMT sites necessary for communication links shall be 85dB. Provide a Radio Path Survey Report to the City Engineer or his authorized representative including all measured field data, survey equipment used, site location including latitude and longitude of all sites, and recommended radio equipment, antennas and antenna masts necessary to achieve the required radio signal strength. This report shall be provided to the City Engineer or his authorized representative for review prior to the installation of any radio equipment. Acceptance of the Radio Path Survey Report shall in no way absolve the Contractor from the responsibility for provision of reliable radio communication system required. Apply for secure and provide FCC license(s) in the Owner’s name for VHF radio frequency as required for data radio communication. All application fees and processing fees for this purpose shall be the responsibility of the Contractor. The Contractor shall be responsible for providing and installing proper antenna masts determined by the radio path survey. The Contractor shall coordinate the installation of each with the project Engineer and Owner.

**650.02.2.9 – Radio Antenna.** Provide an Omni or Yagi type antenna with gain as required for signal proper strength. The antenna shall be connected to the radio modem transceiver with RG/8U low loss coaxial cable. In addition, a coaxial type Antenna Protector shall be provided for connection of coaxial cable to the control panel enclosure. Antenna shall be equal to Cushcraft model CRX-150B (omni) or P154-4 (yagi). Antenna Protector shall be equal to Polyphaser model IS-B50LN-C2.

**650.02.2.10 – Power Supply.** Provide a Power Supply to provide 13.5V DC for the radio modem transceiver and remote telemetry unit on triplex stations.

**650.02.2.10.1 -** Power supplies shall be for 120V AC primary and 13.5V DC secondary and shall have a frequency range of 47-440 Hz with an inrush current of 35A. Secondary adjustment range shall be ±10% minimum. Line and Load regulation shall be ±0.3%. Output ripple shall be no more than 180mV. Voltage Tolerance shall be ±1%. Over voltage protection shall clamp at 115-135% and short circuit protection shall be continuous, self-recovering.

**650.02.2.11 – Uninterruptible Power Supply.** Provide an Uninterruptible Power Supply/12V DC battery charger with 24V DC auxiliary power output option (UPS). In Addition, provide one (1) 12V DC 12 Ah Backup Battery for the UPS in the event of a power failure.

**650.02.2.11.1 –** The uninterruptible power supply shall function as a battery charger for 12V DC Sealed Lead Acid rechargeable batteries with an optional 24V DC isolated output. The maximum battery current charging current is 2.9 amps for a completely dead battery and typically less than 0.4 amps for battery voltages over 10V DC. Trickle charging shall stop at a battery voltage of 13.8V DC. The unit shall operate on 13.8V DC with a current rating of up to 11 amps. Provide an optional, integral battery backed up 24V DC option that is capable of being field mounted onto the unit, for powering external 4-20 mA loops or other instrumentation of up to 1 amp maximum load and shall be isolated from the input power supply if necessary. Provide quick-connect terminal blocks for all connectors. Provide High and Low input power supply voltage.

**650.02.2.12 –** **Dual Current Monitor.** Provide a Dual Current Monitor (CM) and properly sized Current Transformers to monitor the motor current of each pump and provide an analog signal to the duplex controller. Provide a dual 5-amp Current Transformer (CT) input to dual 4-20 ma DC current output converter. The circuitry shall include true Root Means Square (RMS) conversion for the most accuracy. The converter shall be SnapTrack or backplate mounted, as required, and be powered by +12V DC. Provide input contact terminals for a quantity of two 5-amp current transformers and output contact terminals for dual, isolated 4-20 mA outputs. The unit shall supply the +12V DC voltage to power both 4-20 mA outputs. Provide quick-disconnect connectors with capture type terminals for ease of testing. Spring-clip terminals shall not be accepted. Current monitor shall have the following features and functions.

1. External Power Supply Requirements: +12V DC at 120mA
2. Current Transformer Inputs: 0 – 5 amps AC
3. Output Current: Dual, isolated 4 – 20mA DC; maximum 500 ohms load each
4. Humidity: 5 – 95% non-condensing
5. Warranty: 1-year

**650.02.2.12.1 – Current Transformer.** Current transformers insulation class shall be 0.6 KV BIL, 10 KV Full Wave. They shall be manufactured to meet the requirements of UL1244 and have a minimum accuracy of 60Hz of 2%. Current transformers shall be provided with brass stud terminals and mounting bracket.

**650.02.2.13 – Submersible Pressure/Level Transmitter.** Provide a solid-state direct submersible level sensor and transducer designed as pressure sensor for continuous, hydrostatic level measurement in open containers/basins. Transmitter shall have a high resistance to overload and aggressive media with a ceramic diaphragm and enclosed in 316L stainless steel housing. The range of the transmitter shall be as required for the desired application with excitation voltage of 10 - 35V DC. Instrument cable shall be commercially available shielded instrument cable with a minimum of forty-foot (40’) cable length. The transmitter shall be capable of being supported by its own cable. The electronics shall be completely potted and provide an analog output to drive a level meter controller. The output shall be 4 - 20mA. The operating temperature shall be –20 to +70°C (-4 to +158°F) and the accuracy shall be ±0.2% full scale. Pressure overload rating shall be 40 times the adjusted span. Long term drift shall be ±0.1% full scale per year. The transmitter shall be mounted near the bottom of the vessel with support bracket and be cable connected. Transmitter shall have Drinking water approvals: KTW, NSF, and ACS; and approvals by: ATEX, FM, and CSA. Submersible Pressure/Level Transmitter shall be Endress + Hauser Waterpilot Model FMX21, or approved equal.

**650.02.2.14 – Wet-Well Level Indicator.** Provide a Wet Well Level Indicator mounted on the interior deadfront panel to display the pump station wet well level. The indicator shall receive an analog signal from the wet well submersible pressure/level transmitter as described above.

**650.02.2.15 – Float Switches.** In the automatic mode, the Duplex / Triplex Controller shall receive start and stop commands based upon the level in the station wet well as sensed by the float switches.

Provide float switches for: stop, lead pump start, lag pump start, 2nd lag pump start (triplex stations) and high alarm.

The float switches shall be a direct acting switch and contain a single pole mercury switch which activates when the longitudinal axis of the float is horizontal and deactivates when the liquid level falls 1 inch (1”) below the actuation elevation. The float shall have a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed mercury switch and the entire assembly shall be capsulated to from a completely watertight and impact resistant unit. Float shall include a bracket for support pipe mounting.

**650.02.2.16 - Run Time Meters.** Provide run time meters for each pump and the time that both pumps are running. Mount meters on the interior swing out panel.

Unless otherwise shown on the drawings, run time meters shall have the features and functions of a Model T50B2 as manufactured by ENM Company, Chicago, IL or approved equal including the following:

a. Sealed and tamper resistant case

b. Six digit AC hour meter

c. Quartz crystal time base

d. Frequency insensitive

**650.02.2.17 – Common Alarm Light.** Provide a weatherproof exterior common alarm light with red Lexan lens as described below. The exterior alarm light shall be activated during high water level, pump failure, or seal failure.

Alarm light shall be above the fence and visible from the road. Mount the alarm light as shown on the plans. The light shall be PERFECT LINE catalog number B-100/PVG-1R or equal. The alarm light shall burn dim and steady during normal conditions to indicate electrical power "ON" and lamp good. During any alarm condition the alarm light shall flash brightly.

**650.02.2.18 – Control Panel to Wetwell Junction Box.** Provide a weatherproof exterior stainless steel cabinet junction box as shown on the plans. Wiring changes to the pumps and float switches will be made via the conduit to the junction box in lieu of to the control panel.

**650.02.2.19 – Submittals.** Operating and Maintenance manuals, installation instructions, and Shop Drawings shall be submitted in accordance with the General Conditions and these specifications.

Submittal packages including drawings shall be furnished prior to factory assembly of the pump controller package. These packages shall consist of elementary power and control wiring, enclosure outline drawings as well as the complete Bill of Material (BOM). The enclosure drawings shall include front and side views of the enclosures with overall dimensions, and general component arrangement of the sub-plate. Drawings shall be produced using computer aided software compatible with AutoCAD, latest version. Drawing files shall be furnished to the Owner or his authorized representative on compact disk. Standard catalog specification sheets showing applicable ratings shall be furnished as part of the submittal package.

Detailed shop drawings for the elevated platform (if applicable to this particular project) shall also be provided for review and approval prior to construction. The platform shall meet all current code and safety requirements, especially with regard to structural integrity, handrails, stair configuration, clearances at the electrical panel, etc.

**650.02.2.20 - Training.** On-site training of one day per controller shall be provided by a factory trained representative of the manufacturer to plant and/or maintenance personnel.

**650.03 - Construction Requirements.** Install equipment in accordance to manufacturer’s instructions, drawings and recommendations.Provide a factory trained technical representative to inspect the installation, test and start-up the equipment furnished under this specification.

**650.03.1 – Documentation.** All documentation including a copy of the complete schematics, product data sheets, interconnection instructions, inspection and/or certification reports, and any special instructions shall be bundled inside each enclosure.

Provide project closeout documentation in accordance with the General Conditions of the contract.

The supplier shall provide a written warranty with submittal drawings covering all Control materials and parts furnished for a period ending one year after final acceptance of the project. This warranty shall cover all material replacement, all labor, and all travel expenses.

**650.04 - Method of Measurement.** Measurement for Duplex/Triplex Pump Control Panel, Elevated Platform for Controls and Pole to Elevated Controls will be measured complete in place and operational. The cost of all testing and startup shall be included in the measurement for these lump sum items. The removal of any existing control panels and/or poles, new wire and conduit, grounding, aluminum uni-strut, light fixtures, safety switches, service poles and all other items shown on the electrical drawings for the lift station shall be included in the lump sum amount(s).

All equipment testing, setting of new service pole, coordination with electrical service provider, equipment start-up, and training will be considered subsidiary obligations of the Contractor and will not be measured for separate payment.

**650.05 - Basis of Payment.** This work will be paid for at the contract unit prices per unit specified, complete in place, which shall be full compensation for completing the work. Materials or work for which a pay item is not included and are necessary to complete the work under this section shall be furnished or performed and shall be considered incidental to the completed construction.

Payment will be made under:

907-650-A: Duplex / Triplex Pump Control Panel -per lump sum

907-650-B: Elevated Platform for Controls -per lump sum

907-650-C: Pole to Elevated Controls -per lump sum