

# **Integrated Level Monitoring and Lift Station Control System**

## **Part 1.General**

### **1.1 Scope**

- A.** This section describes the requirements for an Integrated Level Monitoring and Lift Station Control System including a multi-purpose, internal ultrasonic level transmitter-controller and ultrasonic transducer with integral temperature compensation.
- B.** Under this item, the contractor shall furnish and install the multi-purpose lift station/ultrasonic control equipment and accessories as indicated on the plans and as herein specified.

### **1.2 Quality Assurance**

The equipment shall be manufactured in an ISO9001 registered facility. The registration shall be by an internationally recognized organization.

### **1.3 Submittals**

- A.** The following information shall be included in the submittal for this section:
  - 1. Data sheets and catalog literature for microprocessor based transmitter-controller, transducer, digital input capability, analog input capability, pump control interlock capability, pump control algorithms available, digital output capability, digital serial communications protocols supported, modular capabilities and accessory modules available.
  - 2. Operating voltages capable and power required.
  - 3. Interconnection, electrical control schematics and wiring diagrams.
  - 4. Panel layout, weight and dimensional drawings.
  - 5. General description including list of materials supplied.
  - 6. Provide Operation and Maintenance data for incorporation in the O & M manuals as specified. Include complete description of operation together with general arrangement and detailed drawings: wiring diagrams for power and control schematics, parts catalog with a list of replacement parts with identifying numbers. Wherever possible, provide information on electronic media, using AutoCAD for drawings and MS Word or Word Perfect for documents, in addition to hard copies.
  - 7. Parts catalog and list of spare parts

## **Part 2. Products**

### **2.1 Multi-Purpose Lift Station Controller**

- A.** The multi-purpose lift station controller shall be a microprocessor based echo-time

measuring type providing an electronic output signal proportional to the level of material, space, volume, flow or differential as may be required. It shall consist of a transmitter and one or two transducers connected by shielded twisted pair cable.

1. The unit will be capable of controlling up to 5 fixed frequency pumps.
2. The unit shall be capable of connecting to a central SCADA or Plant-wide control system.
3. The unit shall be capable of open channel flow monitoring.
4. The unit will also be capable of controlling sluice or penstock gates
5. Unit shall have capability of accepting auxiliary input/output modules to expand the capabilities of the instrument.
6. Unit shall be capable of utilizing 2 transducers to function as 2 independent systems such as pump control and OCM flow for bypass totalization.

**Note to Specifier: Please consult your local Milltronics representative for details regarding available expansion modules.**

**B. Transducer:**

1. Operating principle: Acoustic impulses emitted from an ultrasonic transducer are reflected back from the material surface and are received by the transducer. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the transducer face and material surface.
2. Primary Sensor: The acoustic transducer shall contain a polarized Zirconium crystal with acoustic impedance matching face and transformer. The specifications for the transducer shall be found under separate cover.

**C. Transmitter**

The multi-purpose lift station controller shall be available of in three configurations; Wall mount, Rack mount and Panel mount. It shall be capable of operation in both indoor and outdoor locations.

1. The enclosure shall be Wall Mount polycarbonate with a NEMA 4X; or Rack Mount with 3U/14HP configuration; or Panel Mount with DIN43700, 72 mm W x 144 mm H cutout on 100 mm centers (3" W x 6" H cutout on 4" centers) configuration. Rack and panel mount units shall be equipped with a terminal board that is attached to the 19-inch rack or clip onto the panel mount. The Wall mount configuration shall include the necessary terminal blocks.
2. Power supply shall be a plug in module with a rating of 100 to 230 Vac  $\pm$  15% 50/60 Hz or 12-30 Vdc. The power supply module shall be field replaceable.
3. Operating temperature shall be  $-20$  to  $50$  C ( $-5$  to  $122$  F).

4. Outputs:
  - a. Quantity (4) - Form A, SPST multi-purpose relays rated at 4A /250 Vac non-inductive.
  - b. Quantity (1)- Form B, SPST multi-purpose relay rated at 4A /250 Vac non-inductive.
  - or**
  - c. Quantity (1)- Form C, SPDT multi-purpose relay rated at 4A /250 Vac non-inductive. **(for Wall Mount Version Only )**
  - d. Quantity (2) analog outputs (0-20 or 4-20 mA)
  - e. Quantity (1) RS-485 communications port
  - f. Quantity (2) RS-232 communications ports
  
5. Inputs:
  - a. Quantity (2) transducer inputs. The single point model will have the ability to use a second transducer for differential level control. Optionally dual point available for complete separate functional ability.
  - b. Quantity (8) discrete inputs for control interlocks and/or alarm functions, rated at 10 to 50 Vdc. Minimum on/off times to be 5 ms. If inputs are dry contacts, a 24 Vdc power source shall be available at the terminal blocks. Two of the eight discrete inputs shall be configurable as pulse counter or frequency inputs. Frequency input to be scalable between 1 and 20 kHz. Optional to add a card to increase discrete inputs to 16 discrete same as inputs 1 to 6.
  - c. Quantity (3) analog inputs (0-20 or 4-20 mA) and scalable for use as level, distance, temperature or other analog input signal from an alternative device. Optional to add a card to increase analog inputs to 5.
  - d. All Auxiliary boards to come with RS-485 port.
  
6. Transmitter shall process all echoes from stored memory that is continually updated after echo enhancement.
7. The echoes shall be processed comparing returns for largest area echo and first echo returned. The patented Sonic Intelligence shall compare the various returns and select the echo with the greatest confidence factor.
8. The transmitter will have the capability of storing echo profiles based on various combinations such as: the transducer of interest; location between 2 levels; loss of echo; rising or falling level; and interval between recordings.
9. The transmitter will have a differential input for the best noise immunity possible when used near noise generating devices such as back up generators, variable frequency drives etc.
  
10. Programming
 

The integrated level system shall be programmable using:

Rack and Panel Mount Configurations

  - a. All parameter and commands maybe entered via a removable, non-invasive infrared hand held programmer. Milltronics Dolphin Plus for Windows (95/98) via an RS232 to programming port using Milltronics Dolphin protocol.

#### Wall Mount Configuration

- b. All parameter and commands may be entered via a removable, non-invasive infrared hand held programmer. Milltronics Dolphin Plus for Windows (95/98) via an RS232 to the non-invasive, infrared Converter using Milltronics Dolphin protocol.

#### 11. Communications Protocol

- a. The integrated level transmitter-controller shall include built-in telemetry interfacing capabilities via MODBUS RTU or ASCII protocol for integration with Plant-wide control or SCADA systems over leased line, dial-up or Radio Frequency networks.
- b. The integrated level controller shall have the ability to interface to popular industry standard fieldbus communications protocols such as Profibus DP, DeviceNet, and AB RIO via plug-in modules. The customer shall have the ability to install these modules in the field.

**Note to Specifier: Please consult your local Milltronics representative regarding the availability of other protocols.**

#### **D. Transmitter and Transducer Performance**

1. Minimum and maximum range shall be dependent on transducer selected. The nominal range shall be 1 to 50 feet or 0.3 to 15 m.
2. Accuracy shall be +/- 0.25% of range or 6 mm (0.24" ) , whichever is greater.
3. Resolution shall be 0.1% of range or 0.2 mm (0.08" ) , whichever is greater.
4. Maximum separation between transmitter and transducer shall be 1200 feet using 2 wire twisted pair with continuous shield in separate metal conduit.
5. Integral temperature compensation shall function over a nominal range of -50°C to 150° C or -58° F to 302° F.

#### **E. Operator Interface**

1. The integrated level monitoring and lift station control system shall include a backlit LCD display. The operator interface shall function in program mode and run mode: It shall include or display :
  2. Primary and Auxiliary reading
  3. Engineering Units or % or scale
  4. Operating Mode : Run or Program modes
  5. HiHi, Hi, Lo, LoLo Alarms
  6. Normal and Failsafe Operation mode via graphical icon
  7. Individual Relay and/or Alarm status lights (energized or de-energized) shall be represented via graphical icons.
  8. Displayed value can be level, distance or volume. The filling and emptying mode is also displayed in symbol form.
  9. In the program mode, individual parameter and the corresponding value along with the applicable index values shall be displayed.
  10. A bar graph meter shall also provide a visual representation of the level display.

**F. Equipment**

The multi-purpose level controller shall be a Milltronics EnviroRanger ERS 500 with an EchoMax transducer.

<b>Range</b>	<b>Model</b>
1.0 to 26.0 ft	XRS-5
1.0 to 33.0 ft	XPS-10
1.0 to 50.0 ft	XPS-15

**Part 3. Level System Functions**

**3.1 Control Capabilities**

**A. Pump Control**

The integrated level monitoring and lift station control system shall have the ability to monitor and control 5 pumps using any of the following control strategies:

1. Fixed duty-assist and fixed duty backup
2. Alternate duty assist and alternate duty backup
3. Service ratio duty-assist and service ratio duty backup
4. First on first off duty assist

These pump control strategies shall have the ability for further optimization by utilizing advanced pump control modifiers such as:

1. Pump by inflow rate to reduce pump starts and conserve energy
2. Pump service ratio to balance pump run-time or have one pump run more often
3. Pump run-on to occasionally clear sediment
4. Pump start delay to reduce power surges
5. Pump exercise to run a pump that has been idle for an excessive time
6. Wall cling reduction to eliminate a scum line by automatically adjusting pump setpoints
7. Time-of-day setpoint adjustment to reduce energy or allow surcharging of distribution and collection systems.
8. Control a flush valve to lift sediment in the wet well.

**B. Monitoring Functions**

**Note to Specifier: The total number of discrete inputs shall not exceed sixteen. Please consult your local Milltronics representative for details regarding available expansion modules**

The integrated level monitoring and lift station control system shall monitor pump control interlocks such as: hand/off/auto switch, pump run status, pump overload, low flow, level (float or point level) back-up such as HiHi level switch and/or Lo Lo level switch or pump failure.

**C. Alarms**

**Note to Specifier: The total number of relay outputs shall not exceed five. Please consult your local Milltronics representative for details regarding available expansion modules**

The integrated level monitoring and lift station control system shall use the relay outputs to annunciate alarms such as: High-High, High, Low, Low-Low, Rate of Change, In Bounds, Out of Bounds, Temperature, Loss of Echo, Transducer Fault, Pump Efficiency, Time of Day, Real-Time Clock Fault, Power Failure and Pump Failure. These parameters shall be remotely accessible by the SCADA system via the Modbus RTU/ASCII register map.

#### **D. Pump Performance Logging**

The integrated level monitoring and lift station control system shall log pump and lift station performance parameters such as calculated pump efficiency, pump run-time, pump starts pump runs.

#### **E. Combined Sewer Overflow - Data logging**

In the event of an overflow or underflow condition, caused by storms or other unusual events, the integrated level monitoring and lift station control system shall record parameters such as overflow event dates, the overflow event time and overflow event duration. The overflow date shall include the 20 most recent overflow events. The overflow event times shall also include the 20 most recent overflow events with a 24-hour format (Hours: Minutes: Seconds). The overflow event duration shall be displayed in minutes for the 20 most recent overflow events.

#### **F. Network Analysis for Distribution and Collection Systems**

The integrated level monitoring and lift station control system shall calculate pumped volume with an accuracy of better than 5% for most fixed frequency applications and/or monitor rain gauges or anemometers using the available pulse and frequency inputs.

#### **G. Open Channel Flow**

The integrated level monitoring and control system shall perform open channel flow calculations for standard weir and flume types such as; BS3680 and ISO 1438/1 Thin Plate V Notch weirs; BS3680 and ISO 1438/1 Rectangular Flumes; Palmer Bolus Flumes; H Flumes; Non-standard weir and flume types using an exponential or universal calculation.

#### **H. Other Control Functions:**

The integrated level monitoring and lift station control system shall provide other control functions such as:

1. Control bar screen rakes based on the difference in upstream and downstream level.
2. Control a flow control gate (penstock) to maintain a constant downstream level.
3. Activate a discrete device based on elapsed time.
4. Pulse a relay proportional to volume to control a sampler or increment a totalizer

### **3.2 Security and Set-Up**

#### **A. Parameter security lock**

A security lock function shall be included to prevent unauthorized changes to the parameter database

#### **B. Set-Up**

The unit shall include the ability to use a Quick-start menu to configure the appropriate parameters in an easy and timely manner. The unit shall also incorporate smart scrolling for quick access to altered parameters.

## **Part 4. Execution**

### **4.1 Installation**

- A.** Follow manufacturers recommendation for the minimum separation between the transducer face and the maximum expected material level.
- B.** Mount the transducer to ensure a clear path to the material surface.
- C.** Additional cable for the transducer shall be 2 wire twisted pair with a continuous shield, Belden 8760 or equal. Co-axial cable should not to be used with this transmitter due to the differential input
- D.** Wiring between the transmitter and the transducer(s) shall be routed through grounded metal conduit.

## **Part 5. Warranty**

### **5.1 Terms**

- A.** The manufacturer of the above specified equipment shall guarantee for twenty four (24) months from equipment startup or thirty (30) months from date of shipment, whichever occurs first, that the equipment shall be free from defects in design, workmanship or materials.
- B.** In the event a component fails to perform as specified or is proven defective in service during the warranty period, the manufacturer shall promptly repair or replace the defective part at no cost to the owner.

## **Part 6. Options & Accessories**

### **6.1 Optional Cards and Features**

- A.** Plug in Auxiliary Cards to provide a choice of one of the following:  
8 discrete inputs; 2 analog inputs and 2 analog outputs; 4 analog outputs or 4 analog inputs. each card shall have an RS-485 port included
- B.** Plug in expansion memory for use with Optional data logging feature
- C.** True dual point capability

## **6.2 Related Equipment**

- A.** TS-3 Temperature Sensor for Echomax Transducers to increase speed of response of temperature measurement
- B.** PVC, Aluminum, and Stainless Steel flanges for transducers
- C.** Belden 8760 cable for transducers
- D.** Transducer Submergence Shield
- E.** Overflow or Underflow - Float Back-up Point Level Device

## **Part 7. Spare Parts**

### **7.1 Recommended Spare Parts**

- A.** Box of 5 fuses.
- B.** AC Power Supply Module or DC Power Supply Module