

Suggested Specifications D620i Programmable Logic Controller

MICROPROCESSOR CONTROLLER/TELEMETRY UNIT

- a. A Microprocessor-based Controller/Telemetry Unit shall be provided for control and monitoring of the _____ system based on _____ levels. Voltage regulation and battery charging circuitry shall be on-board. Not less than 4 hours battery backed operation shall be provided for this location to include the level transducer equipment. The controller shall provide up to sixteen-user programmable control stages that shall control the various pumps. Pump and abnormal level alarm setpoint operation shall be determined by an integral user keypad.
- b. The Microprocessor-based controller shall be a standard, catalogued product of a water and wastewater pumping automation equipment manufacturer regularly engaged in the design and manufacture of such equipment. The pump/alarm controller shall be specifically designed for water and wastewater pumping automation utilizing standard hardware and software. "One of a kind" systems using custom software with a generic programmable controller will not be acceptable.
- c. The controller shall accept three (3) analog (1-5 VDC or 4-20 mADC) and twelve (12) digital inputs in its base form. The Controller/Telemetry Unit shall provide two (2) analog and ten (10) digital outputs in its base form. The unit shall incorporate 12-bit analog to digital and digital to analog conversion. Additional analog and digital signal monitoring capability shall be provided as necessary to via I/O expansion modules to accomplish the specified requirements. Additional local analog inputs shall be provided in increments of four (4). Additional local digital inputs or outputs shall be provided in increments of eight (8). Additional analog outputs shall be provided individually.
- d. All job connections shall be made at barriered, wire clamp type UL- recognized plug-in terminals, each accepting one or two AWG 14-22 wires. The DCU shall combine a high performance microprocessor with a powerful event-driven, multi-tasking operating system well suited to communications/process control data manipulation. CMOS construction shall provide a low power requirement and reliable performance under high electrical noise/temperature conditions.
- e. Input signal conditioning shall provide keypad-selectable averaging of the input signals with one reading taken every second and from one to ninety-nine readings being selectable with the controller displaying and providing control based on a moving average of the selected number of samples.
- f. The controller shall include diagnostic capability that allows for indication of input and output status including discrete and analog variables. The analog variable shall be displayed in a percentage of scaled range. Discrete points shall be displayed as on or off. The unit shall include control code diagnostic capability capable of displaying the corrupted or malfunctioning algorithm. The controller shall monitor communications status and provide serial port communications diagnostics in percent of reliability. Diagnostics shall be provided for monitoring of microprocessor utilization including loop frequency and interrupt stack.
- g. The controller shall monitor analog and digital information. Analog variable setpoints shall be provided for the analogs as described elsewhere in this specification. Each analog shall be presented in engineering units. Setpoints based on the analog signals shall be provided for the following:
 - i. High level alarm On/Off
 - ii. Low level alarm On/Off
 - iii. Etc...
- h. The level signal received from the pressure transducers shall be converted to a "feet and tenths" digital display. Keyboard-configurable digital setpoints shall be provided for differential level-type automatic pump operation as well as automatic alternation and manual sequence selection or timing logic and alarm indication as herein described.
- i. An analog simulation software module shall be supplied to provide a wet well normal/simulated signal to test the control system.

j. The controller shall provide ON/OFF operation of the _____ pumps based on the _____ level as sensed by the herein specified level transducers in a pump-down/Up mode of operation. In general, pumping capacity shall be called into operation with a increase/decrease in _____ level. Pumping capacity shall be called for upon a decreasing/increasing _____ level. The controller shall alternate the pumps to equalize the system pumps. Alternator shall have built in time clock function for 8, 16 & 24 hour automatic alternation.

k. The controller shall be field configurable permitting operator adjustments. The changes can be saved to permanent non-volatile memory or can function in working memory only thus allowing the operator to reset the system to previously programmed settings.

l. The controller operating program shall be resident in EEPROM and include full-scale ranging and pump-up/down determination. The controller shall have expansion capability to operate up to eight (8) pumps plus high and low alarms. The ON and OFF adjustments of each pump and alarm setpoint shall be full-range adjustable through use of an authorized operator access code and a keypad. The controller display shall show the operation of each control stage. Review of controller adjustments shall be possible by the operator without use of the access code.

m. The controller shall support up to 4 levels of security in a hierarchical structure allowing different levels of access to the C/TU for differentiation of desired access levels to include Operator level 1, Operator level 2, Maintenance, & Supervisory access levels. Each data viewing/configuration parameter can be assigned a separate level of access.

n. The display shall operate in a manual scrolling menu mode with the various displays shown in sequence as selected by the keypad's up/down arrow keys. The display shall indicate the specific function entered on the keypad to confirm that selection of a particular output or other function from the keypad during adjustment or review routines. When operating a key of the controller the audible alarm shall chirp briefly to confirm that the selected key has operated.

o. The digital controller shall include keypad adjustable on-delay timing logic to provide staggered pump starting following a power failure condition. The controller shall also provide keypad adjustable off delay timing for each pump control stage to provide smooth transition between control stages.

p. In addition to the pump control and abnormal level alarm setpoint capability, the controller shall provide alarm annunciation. The controller display shall show abnormal alarms, signal failure and system monitor/alarm outputs of a watchdog timer. Upon the occurrence of an alarm, an audible device shall operate and the controller display will flash with the alarm description, complete with the time and date of the alarm occurrence. An acknowledge push-button shall be provided to allow silencing of the audible device while the digital display will continue to show the alarm function, complete with time and date information, until the condition has cleared. The controller shall be able to historically store system events with a time and date stamp system. The historical log shall store and make available for operator review events including failures, acknowledgments, return to normal, pump starts and stops, etc.... The historical alarm log shall allow a minimum of 1000 historical events to be stored and displayed. The following alarms shall be provided for:

- i. Wetwell High Level alarm
- ii. Wetwell Low Level alarm-
- iii. Main Controller Power Failure
- iv. Etc...

q. The following additional capabilities shall be available:

- i. Multiple analog inputs with alarm and control setpoint capability for each
- ii. Multiple pump alternators (for varying sized pumps)
- iii. Varying alternation and sequencing schemes (rotary, first-on, first-off, manual, fixed)
- iv. Load cycling/shedding with automatic or manual activation
- v. Automatic pump replacement upon a pump failure input (pump failed/replaced)
- vi. Analog input adder-subtractor-multiply-divide
- vii. Automatic highest/lowest analog signal selector (for basis of control)
- viii. Pump run time/time of day/day of week/external digital input alternator advancement

r. The controller shall include built in site intrusion detection logic that will monitor an external sensor (motion sensor, door switch, etc...) and allow authorized access to the station via controller keypad entry of proper security code or access level. The intrusion system upon detection of entry, will allow a preset amount of time for the operator to go the controller keypad and enter the proper code. When the operator logs out and leaves the facility, the controller shall allow a preset amount of time for the operator to get out before re-arming.

s. A station flow and performance monitoring capability shall be provided within the controller. This capability shall provide the following as a minimum:

- Average Station Inflow Rate Over the Last Filling/Pumpdown/Filling Cycle
- Average Station Outflow Rate Over Each Hour of the Last 5 Days
- Average Station Outflow Rate Over Each of the Last 7 Days
- Daily Station Flow for Each of the Last 35 Days; in Gallons
- Totalized (incrementing) Station Flow; in Gallons; Up to 999,999,999 Gals.
- Average Flow Rate of Pump 1 (while running) Over All Cycles
- Average Flow Rate of Pump 1 (while running) During the Last Three Cycles
- Totalized Flow of Pump 1
- High-Flow-Rate Alarm Setpoint for Pump 1
- Low-Flow-Rate Alarm Setpoint for Pump 1
- Elapsed Running Time of Pump 1
- Number of Operating Cycles of Pump 1
- Maximum Starts-per-Hour (with date and time of occurrence) of Pump No. 1
- Maximum Running-Time (during a pumping cycle) (w/ date/time) of Pump No. 1
- Average Flow Rate of Pump 2 (while running) Over All Cycles
- The Average Flow Rate of Pump 2 (while running) During the Last Three Cycles
- Totalized Flow of Pump 2
- High-Flow-Rate Alarm Setpoint for Pump 2
- Low-Flow-Rate Alarm Setpoint for Pump 2
- Elapsed Running Time of Pump 2
- Number of Operating Cycles of Pump 2
- Maximum Starts-per-Hour (with date and time of occurrence) of Pump No. 2
- Maximum Running-Time (during a pumping cycle) (w/date/time) of Pump No. 2
- Number of Cycles of Pumps 1 and 2 Operating Together
- Elapsed Time of Pumps 1 and 2 Operating Together
- Maximum Running-Time (during a pumping cycle) (with Date and Time) of Pumps 1 and 2 Operating Together.
- Pumps-Running Together Flow Rate Factor; $P1 \text{ Flow} + P2 \text{ Flow} \times \text{"Factor"}/100$
- "Gallons-per-Foot" Value of the Station Wet Well. (Note B)
- Pump-Backflow Time (following each operation); in seconds.
- There are three "internal" data flags which identify the stored/logged station/pump flow information for any hour in which the following conditions have occurred, in that the data might be of doubtful validity; in that the wet well level conditions may have precluded the obtaining of valid data. (a) Wet Well Overflow. (b) Wet Well Rise/Surcharge into a collection facility of unknown volume and/or (c) Abnormally-Low Wet Well Level which could be in a non-linear portion of the wet well "volume/foot" range.

t. The controller digital display/keypad shall be housed in a flush-mounted, environmentally-protected assembly and mounted on the door of the control system.

u. The unit shall employ an operator interface having a 32-character alphanumeric backlit LCD display with character height not less than .3" and with a 16 position keypad operating in menu mode.

v. A watchdog function shall be provided in the controller that observes meaningful microprocessor activity. In the unlikely event of microprocessor stoppage the watchdog shall reset the processor. In addition, it shall transfer Form C contacts provided to job connection terminals.

w. The Controller shall have two (2) RS-232C serial communications ports. One serial port shall be used as a modem interface for communications. The other serial port shall be available as an interface for a microcomputer or other compatible serial device.

x. The controller shall support telemetry communications via phone line or radio communications mediums. The controller can be configured as a master or slave telemetry unit. The unit shall be configurable to support industry standard MODBUS RTU or DF1 communications protocol.

y. It is the specific intention of this specification that a standard Microprocessor-based pump controller be provided, with all of the control features described as a fully-integrated assembly. The Controller shall be a Siemens Water Technologies, Control Systems D620i.