Monitoring and Control of a Lift Station With the SEL-2411 Programmable Automation Controller

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INTRODUCTION

Municipal sanitary and storm water systems often have their lift stations strategically located in the lower elevations of collection systems to convey water to treatment facilities. Most of these lift stations are remotely located and are controlled manually or via remote supervisory control and data acquisition (SCADA).

This application note describes the control functions in the SEL-2411 Programmable Automation Controller that can be used in a duplex lift station with primary SCADA control and a failover to local automatic or manual control.

PROBLEM

Remotely located lift stations require local, automatic control and continuous monitoring.

SOLUTION

The SEL-2411 offers automatic and manual control functions for these types of pumping systems. In addition to local control functions, the SEL-2411 is capable of remote control via several communications protocols. The SEL-2411 can monitor, control, and provide indication of a well's water level. This level is sensed by four sensors (float switches), as shown in Figure 1, indicating low-low, low, high, and high-high level conditions.
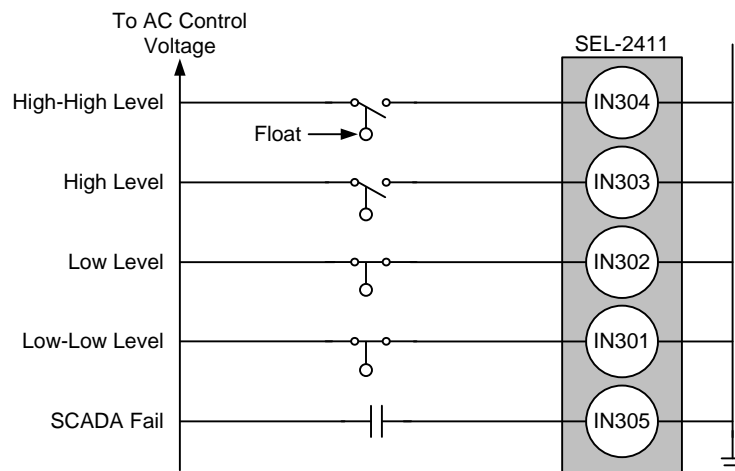

Figure 1   Sensor Connections

During increases in flow due to inflow or infiltration, the controller automatically starts wet well pumps for a high-water condition. The SEL-2411 alarms for a high-high water level and manages the operating duty of the pumps by running in alternation mode. For a low-low level, the controller shuts off automatic mode and allows manual operation from a human-machine interface (HMI). When SCADA is unavailable, IN305 deasserts, allowing the controller to function in local mode.

Front-Panel Operation

The operator interface on the SEL-2411 configurable front panel is customized to user preferences. Figure 2 shows the operator interface functions and indicating LEDs for the example application.
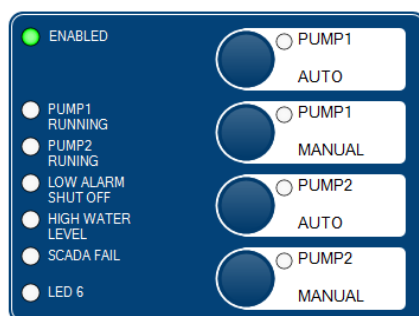

Figure 2   SEL-2411 HMI

Example Settings

SELOGIC® control equations combine Relay Word bits and I/O information to create control and monitoring functions. Table 1, Table 2, and Table 3 show the setting categories, SELOGIC control equation values, and functions used in the example application. Refer to the SEL-2411 Instruction Manual for a more detailed description of the Relay Word bits.

Table 1   Global Settings

Input Debounce	Value	Function
IN301D–IN308D	AC	Sense ac

Table 2   SELOGIC Control Equation Settings

SELOGIC Enables	Value	Function
ELAT	10	Quantity of latch bits enabled
ESV	N	NA
ESC	1	Quantity of SEL counters enabled
EMV	1	Quantity of math variables enabled
Latch Bits	**Value**	**Function**
SET01	MV01 = 1.00 AND LT04 AND IN303 AND LT05 AND NOT LT02 OR MV01 = 2.00 AND IN304	Automatic run and alternation mode for Pump 1

RST01	PB01_PUL AND LT01 OR (NOT IN302) OR (NOT IN301) OR (NOT LT05)	Stop Pump 1 when wet well level falls below low level
SET02	PB02_PUL AND NOT LT02 AND NOT LT01	Manually run Pump 1
RST02	PB02_PUL AND LT02	Manually stop Pump 1
SET03	MV01 = 2.00 AND LT06 AND IN303 AND LT05 AND NOT LT08 OR MV01 = 1.00 AND IN304	Automatic run and alternation mode for Pump 2
RST03	PB03_PUL AND LT03 OR (NOT IN302) OR (NOT IN301) OR (NOT LT05)	Stop Pump 2 when wet well level falls below low level
SET04	PB01_PUL AND NOT LT01	Pump 1 automatic mode
RST04	PB01_PUL AND LT04 OR LT02	Pump 1 stop and manual mode
SET05	IN305	Asserts for SCADA fail input
RST05	NOT IN305	NA
SET06	PB03_PUL AND LT04 OR NOT LT03	Pump 2 automatic mode
RST06	PB03_PUL AND LT06 OR LT08	Pump 2 stop and manual mode
SET07	0	NA
RST07	0	NA
SET08	PB04_PUL AND NOT LT08 AND NOT LT03	Manually run Pump 2
RST08	PB04_PUL AND LT08	Manually stop Pump 2
SELOGIC Counters	**Value**	**Function**
SC01PV	1	Preset value for pump alternation
SC01R	NA	NA
SC01LD	R_TRIG OUT101 AND MV01 = 0.00	Load counter for pump alternation
SC01CU	F_TRIG OUT101	Count up when Pump 1 stops
SC01CD	MV01 = 2.00 AND F_TRIG OUT102	Count down when Pump 2 stops
Math Variables	**Value**	**Function**
MV01	SC01	Store value of Counter 1
Output	**Value**	**Function**
OUT101	LT01 OR LT02	Automatic or manual output to Pump 1
OUT102	LT03 OR LT08	Automatic or manual output to Pump 2
OUT103	NOT (HALARM OR SALARM)	Hardware software alarm
Slot 4 Output	**Value**	**Function**
OUT401	IN301	Low-low level indication
OUT402	IN305	SCADA fail indication

Table 3   Front-Panel Settings

General	Value	Function
EPD	12	Enable display points
ELB	N	NA
FP_TO	15	Front-panel time out
FP_CONT	5	Front-panel contrast
Target LED	**Value**	**Function**
T01_LED	LT01 OR LT02	Pump 1 running
T02_LED	LT03 OR LT08	Pump 2 running
T03_LED	NOT IN301	Low alarm shut off
T04_LED	(LT01 OR LT02) AND (LT03 OR LT08)	High water level
T05_LED	LT05	SCADA failure
T06_LED	0	Spare
PB01_LED	LT01	Pump 1 automatic mode
PB02_LED	LT02	Pump 1 manual mode
PB03_LED	LT03	Pump 2 automatic mode
PB04_LED	LT08	Pump 2 manual mode
Display Points	**Value**	**Function**
DP01	OUT101, "Lead Pump Run"	Lead pump indication
DP02	LT04, "PUMP1", "AUTO"	Pump 1 operate mode
DP03	LT02, "PUMP1", "MANUAL"	Pump 1 operate mode
DP04	LT06, "PUMP2", "AUTO"	Pump 2 operate mode
DP05	LT08, "PUMP2", "MANUAL"	Pump 2 operate mode

CONCLUSION

In the example application described in this application note, the SEL-2411 configuration had a minimum I/O requirement (Part Number 0241101A3A2X0X0X0130). The SEL-2411 modular design and flexible SELOGIC control equations provide an ideal retrofit solution for wet well controls requiring multiple operating modes. The SEL-2411 communications options can be interfaced to an existing SCADA system to provide continuous monitoring and remote control.

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