PLC Test Station Proposal

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February 14, 2019

The detector and magnet control systems of the Physics Division's experimental halls (B, C, and D) use Allen Bradley Programmable Logic Controllers (PLCs). A PLC test station is proposed to run automatic or manual tests on a faulty module. Such a test station will aid in determining the problem with the module and help in reducing downtime.

Two types of PLCs, ControlLogix (Fig. 1) for large control systems and CompactLogix (Fig. 2) for small control systems, are used in the halls.

FIG. 1. ControlLogix PLC Test Station.

FIG. 2. CompactLogix PLC Test Station.

Table I lists the types of PLCs, hall systems where they are used, and quantities on-hand. Table II shows the 42 different types of modules in use in the experimental halls (B, C and D).

Ideally, for the proposed test station there should be at least one spare for each type of module (Table II), which could be used for testing and, if needed, as a replacement. However, currently all types of modules are not available to replicate the actual PLC control systems. Table III shows what modules are currently available for test stations.

The development of the PLC test station requires the implementation of hardware and the generation of software.

Hardware implementation requires setting up the test station with controller, modules, backplanes, chassis terminal blocks, power supplies, and with high precision instruments such as multi-meters and voltage/current sources.

Software generation requires writing code for the controllers to test each type of module, and the development and implementation of HMI screens for the operation of the test station and for showing progress and results in real time.

Code development for the tests depends on the module type. ADC output/input modules' code will be developed to test accuracy, offset error, gain error, differential nonlinearity, integral nonlinearity, and missing codes.

For communication modules, the software developed will check data transmission speeds, communication, use of available protocols, and synchronization with controller.

Digital input/output modules and TTL modules will be analyzed for their accuracy and voltage outputs.

The tests for relay modules will check contact responses for opening and closing.

Data translation of motion to amplitudes and frequencies will be tested for counter/encoder modules.

Finally, for SOE modules, timestamp-records and accuracy of response times will be tested.

Results of each test will be archived in an Excel spreadsheet to enable data analysis and comparison with vendor specifications.

The proposed test station will reduce downtime because the problems associated with the modules will be identified/ solved sooner, rather than having to wait for the vendor to receive the module, determine its issues, and then making the decision to repair or replace.

Controller	Controller type	Hall systems	Qty in systems	Qty spare/dev	Qty total
AB 1756-L72	ControlLogix	B: Solenoid, Torus, DBX	3	0	3
AB 1756-L62	ControlLogix	C: SHMS, HMS, D: Solenoid	5	0	5
AB-1769- L35E	CompactLogix	D: BCAL, FCAL, FDC/CDC	5	0	5

TABLE I. PLC types and hall system where used.

Module	Module type	Hall system(s)	Qty in systems	Qty spare/ dev	Qty total
1756-EWEB	Web	B-Torus, Solenoid; D-Solenoid	3	0	3
1756-EN2T/D	EtherNet Network	B-Torus, Solenoid; D-Solenoid	7	0	7
1756-EN2T/C	EtherNet Network	C-SHMS; D-Solenoid	3	0	3
1756-ENBT/A	EtherNet Network	C-SHMS	1	0	1
1756-EN2T/B	EtherNet Network	C-SHMS; D-Solenoid	4	0	4
1756-CN2/B	ControlNet Network	C-SHMS; D-Solenoid	7	0	7
1756-CNB/D	ControlNet Network	C-HMS	5	0	5
1756-CN2/C	ControlNet Network	C-HMS	2	0	2
1756-RM2/A	redundancy	C-SHMS, HMS	4	0	4
1756-OF8/A	analog voltage/current output	B-Solenoid, Torus, DBX	6	0	6
1756-IF16/A	analog voltage/current input	B-Solenoid, Torus, DBX; C-SHMS, HMS; D-Solenoid	67	0	67
1756-OW16I/A	isolated relay output	B-Solenoid, Torus, DBX; C-SHMS, HMS; D-Solenoid	31	0	31
1756-IV32/A	DC sourcing input	B-Solenoid, Torus	4	0	4
1756-IB32/B	DC voltage input	B-Solenoid, Torus	3	0	3
1756-IB16ISOE/A	sequence of events input	B-Solenoid, Torus; D-Solenoid	4	0	4
1756-IV16/A	VDC voltage input	C-SHMS, HMS; D-Solenoid	10	0	10
1756-IB16D	VDC voltage diagnostic input	C-HMS, D-Solenoid	7	0	7
1756-OB16D/A	VDC voltage diagnostic output	C-HMS	2	0	2
1756-OF6VI/A	analog voltage loop output	C-HMS	4	0	4
1756-OF4/A	analog voltage/current output	C-SHMS	5	0	5
1756-HSC/A	high speed counter	C-HMS	1	0	1
1794-ACN15/C	ControlNet FlexI/O adapter	C-HMS, SHMS	4	0	4
1769-IR6	RTD/direct resistance input	D-BCAL	16	0	16
1769-OV16	24 VDC sink output	D-BCAL	3	0	3
1769-OG16	TTL output	D-BCAL, FCAL, Target	3	0	3
1769-OW16/A	AC/DC relay output	D-FCAL, FDC	4	0	4
1769-IQ16	24 VDC sink/source input	D-FCAL	1	0	1
1769-IF8	analog voltage/current input	D-FCAL, Target	8	0	8
1769-HSC	high speed counter	D-FCAL	1	0	1
1769-IF4	voltage/current analog input	D-FDC/CDC	1	0	1
1769-IT6	thermocouple/mV input	D-FDC/CDC, Target	4	0	4
1769-OB8	24 VDC source, high current output	D-Target	1	0	1
1734-IE2V	analog voltage input	B-Torus; HD-BCAL, Solenoid	18	0	18
1734-IB4	24 VDC sink input	B-Torus	1	0	1
1734-IE2C	analog current input	B-Torus; D-FCAL	2	0	2
1734-OE2C	analog current output	B-Torus	1	0	1
1734-OW4	AC/DC relay output	B-Torus; D-FDC/CDC	3	0	3
1734-IK/C	encoder/counter	D-BCAL	2	0	2
1734-IT2I	thermocouple cold-conjuction input	D-FCAL, FDC/CDC	5	0	5
1734-IE8C	analog current input	D-FDC/CDC	1	0	1
1734-OE4C	analog current output	D-FDC/CDC, Solenoid	3	0	3
1734-IB8	24 VDC sink input	D-Solenoid	1	0	1

TABLE II. 262 PLC modules used in Halls B, C, and D.

Controller	# of Chassis	Module	Module type	# of Channels	# of Modules
AB 1769 L35E CompactLogix	1	1769-IF8/A	analog current/voltage input	8	1
		1769-OW16/A	AC/DC relay output	16	1
		1769-IR6/A	RTD resistance analog input	6	1
		1769-OF4	analog current/voltage output	4	1
AB 1756-L72 ControlLogix	1	1756-EN2T/D	Ethernet Network	N/A	1
		1756-IB16D	VDC voltage diagnostic input	16	1
		1756-IF16/A	analog voltage/current input	16/8	1

TABLE III. Details of PLC test stations.