Outcomes: Troubleshoot a Process Automation System

Course goal

According to the statement of purpose, the goal of the Troubleshoot a Process Automation System course is that each exiting technician will be able to produce an automation system that is operating again after a problem, while making no unnecessary diagnostic checks and replacing zero parts that didn't need replacing.

Course hierarchy

The course is laid out in modules and units:

- **Module**: a behavioral process a person does to produce the course outcome
- **Unit**: specific skills, knowledge, and information a person uses to do the behavioral process

Modules and module outcomes

The modules in the course are organized around the guiding strategy a master technician uses when troubleshooting, called the split-halves search. In a split-halves search, the technician splits the system or sub-system in half to determine which half is likely to have the problem. By repeating the process on each successive half, they can pinpoint the problem without wasting time making unnecessary checks or replacing parts that are OK in the first place.

Each module in this course represents a part of the system the technician would initially isolate the problem to. Given that initial decision, each module teaches how to continue isolating and diagnosing a problem with that part of the system. The only exception is the first module, which teaches fundamental skills a technician uses no matter what part of the system they are troubleshooting.

The course is divided into these modules:

Module		Outcome
1	Find and trace signals through function blocks	Determination of states of output signals and conditions or inputs causing them based on the blocks running in the controller
2	Troubleshoot discrete device alarms	Determination of cause of problem with discrete device
3	Troubleshoot I/O faults	Determination of cause of I/O fault
4	Troubleshoot non-alarm problems	Determination of cause of non-alarm problem
5	Troubleshoot switchovers and operator workstation problems	Determination of cause of switchover or operator workstation problem

Units and unit outcomes

Building on the concept of the split-halves search, each module takes the technician through a series of checks that further pinpoint the problem. Because this is a branching process, some units represent possible branches off the initial decision about where the problem is. Other units represent sub-skills a technician may use on a variety of branches.

Each module is divided into these units:

Module	Unit		Outcome
1	1.1	Prepare equipment for restart	Process running again and clear of alarms related to the problem just resolved
	1.2	Find data online	Find the data in the controller for a device shown on the operator workstation
	1.3	Trace through a function block diagram	Find input data from devices and output data to devices by tracing data flow through function blocks
	1.4	Find I/O chassis, slot, and terminals for device	Determination of which I/O card and terminals a discrete device is wired to

Module	Unit		Outcome
2	2.1	Isolate alarm condition	Decision about next steps given initial alarm indication
	2.2	Isolate problem with field device	Decision about where to continue troubleshooting: permissives and interlocks or specific type of device, such as discrete input, discrete output, etc.
	2.3	Diagnose problem with discrete output device	Determination of cause of problem with discrete output device
	2.4	Diagnose problem with discrete input device	Determination of cause of problem with discrete input device
3	3.1	Isolate I/O fault	Decision about which of these is causing problem: I/O module, I/O channel, communication module, or EtherNet/IP network
	3.2	Find I/O channel data	Determination of which I/O card and terminals an analog device is wired to
	3.3	Diagnose problem with analog input device	Determination of problem with analog input signal
	3.4	Diagnose problem with analog output device	Determination of problem with analog output signal
	3.5	Diagnose module problem	Good communication with comm. and I/O cards again
	3.6	Diagnose EtherNet/IP problem	Ethernet switch working again
4	4.1	Isolate non-alarm problem	Decision about where to continue troubleshooting: permissives and interlocks, mode of device, or field device
	4.2	Diagnose permissives and interlocks	Determination of interlock or permissive causing problem
	4.3	Diagnose device mode problem	Device back in required mode
	4.4	Bypass devices	Equipment able to run because it is bypassing a permissive, interlock, or other required condition
5	5.1	Diagnose switchover	Determination of cause of switchover to secondary controller
	5.2	Isolate operator workstation problem	Decision about which of these is causing problem: controller fault, EtherNet/IP switch, or server-client
	5.3	Check server status	Decision that there is/isn't good communication with primary and secondary servers
	5.4	Ping servers and workstations	Test results indicating whether or not a workstation or server can communicate with device over an EtherNet/IP network
	5.5	Isolate server problem	Restored communication between operator workstation client and server