PLC Upgrade for the Power Supply Control System of Hall A Dipoles

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After selecting and receiving the Allen-Bradley CompactLogix series of PLC [1] for the power control system of the Hall A dipoles, the next step in replacing the previous SLC 500 series was to upgrade the software that runs on the PLC. The upgrade is discussed in this note.

The PLC upgrade of the Hall A dipoles' power supply control system is shown in Table I.

Setup	Old	New
PLC controller	SLC 500	CompactLogix
Software	RSLogix 500	Studio 5000

TABLE I. Comparison of old setup with new setup.

To convert RSLogix 500 files to Studio 5000 (vrs. 28), Rockwell Automation offers a Project Migrator Wizard [2]. Proceeding as per the instructions in the documentation resulted in the same 124-rung ladder logic for the new system (CompactLogix) as for the old system (SLC 500), with two exceptions.

- The DC input module 1746-IV16 did not have a direct replacement; hence, it was changed to 1769-IQ16, which can do both sinking or sourcing input, while the old module is sourcing only.
- Lack of status file in a CompactLogix PLC. In the SLC 500, the status file is used as a free-running counter.

Resolving the first issue, converting the DC input module, was straightforward. With regards to the second issue, investigation of the hardware revealed that the counter was connected (in the PLC code) to an output channel, but the output channel was not wired to a component, so this part of the PLC code was removed.

While the project migrator provided the correct code, the code was difficult to follow as most of the logic went to a single Boolean array. Therefore, to make the ladder logic easier to follow, without having to constantly cross-reference where each element of the Boolean array was being used, the Boolean array was converted to individual Boolean tags, e.g. *B3[1].14* became *Reset_Interlocks*.

To make reading the code easier, the single RSLogix 500 routine was broken up into three separate routines: Input, Output, and Main. Input and Output routines are self-explanatory. The Main routine handles additional logic, e.g. combining multiple inputs into a single fault.

Prior to swapping the hardware, the PLC logic was checked using the original test procedure produced by Dynapower [3]. Testing was done using the I/O Forces feature enabling logic testing without having anything connected.

The PLCs were swapped and a simplified checkout was done to ensure that the power supply could be turned on/off and that a fault would turn off the supply. After a detailed checkout, it was found that some hardware had been previously miswired. Corrections enabled activation of additional protections on the power supply, e.g. quench alarms.

In conclusion, the new CompactLogix controller is running with nearly identical functionality as the previous, SLC 500 controller. Implementing additional functionality offered by the CompactLogix will be explored in the future.

[1]B. Eng, et al. *Proposal for the Power Supply Control System of Hall A Dipoles,* DSG Note 2019-13, 2019.

[2]Rockwell Automation Publication 1756-RM085D-EN-P.

[3]https://hallaweb.jlab.org/tech/Detectors/public_html/hall_a/magnets/high_resolution_spectrometers/dipole/dynapower/of_historical_interest_only/dynapower_test_procedure_and_results_original.pdf .