



Upgrading existing power supply controls for Mu2e

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SIST program

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Overview

- Where I worked
- What I was assigned and what was it for
- Why was it done?
- What did I use?
- What does it look?
- What have I learned?

Where did they put me?



-Accelerator Division Electrical / Electronics support

-Power Supply Room at MC2

What was I assigned?

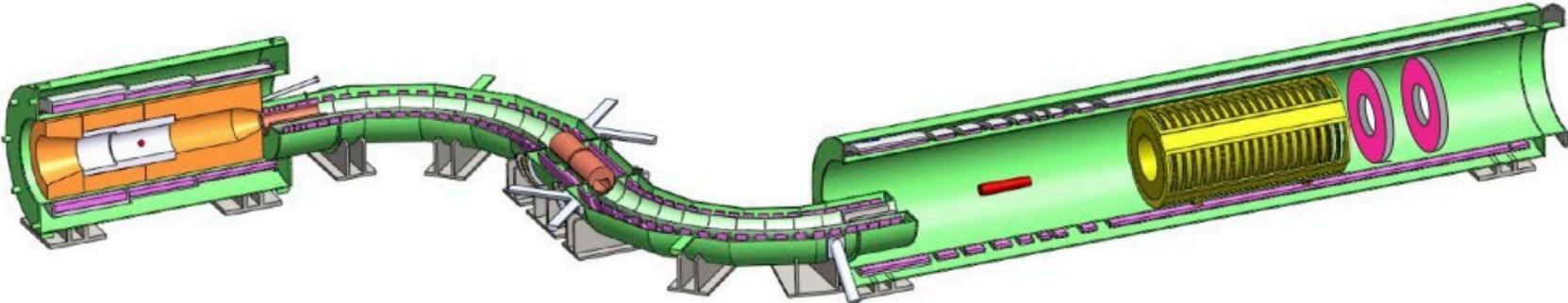
Layout and design control system to improve existing power supplies using a Programmable Logic Controller.

- Layout
- construct
- code a PLC
- perform a low level test.

The PLC will be used to manage:

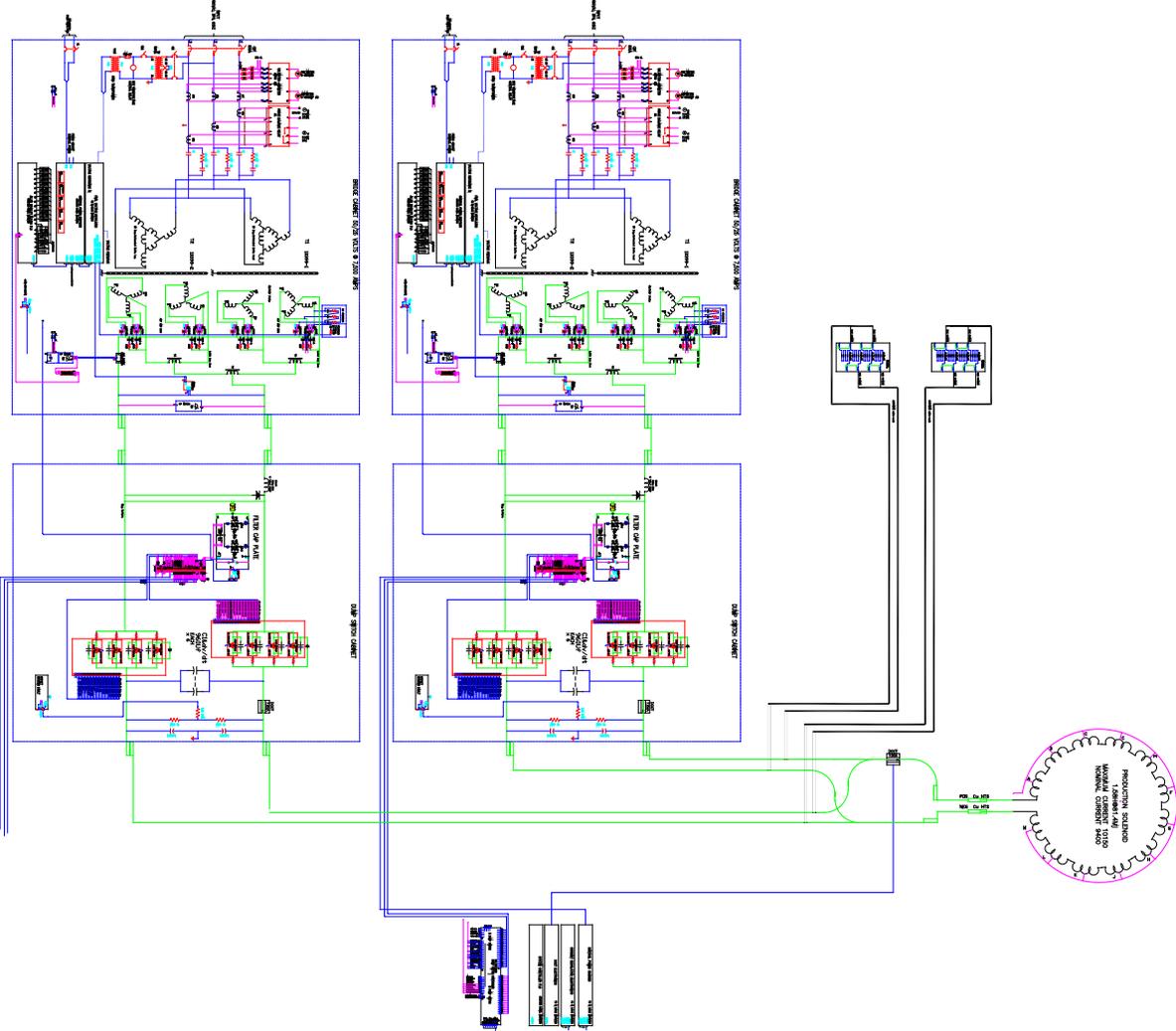
- Low level protection circuits switches
- Relay control
- Relay status
- Simple ADC/DAC (AC to DC converter) in place of existing discrete hardware.

What is this for?



Production Solenoid –	Uses 2 TeV Low Beta	375kW	 15000 Amp
Detection Solenoid –	Uses 1 Low Beta	375kW	 7500Amp

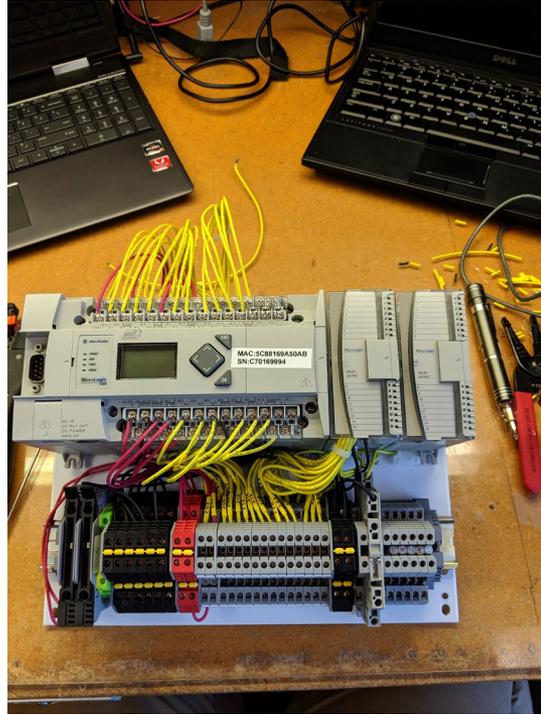
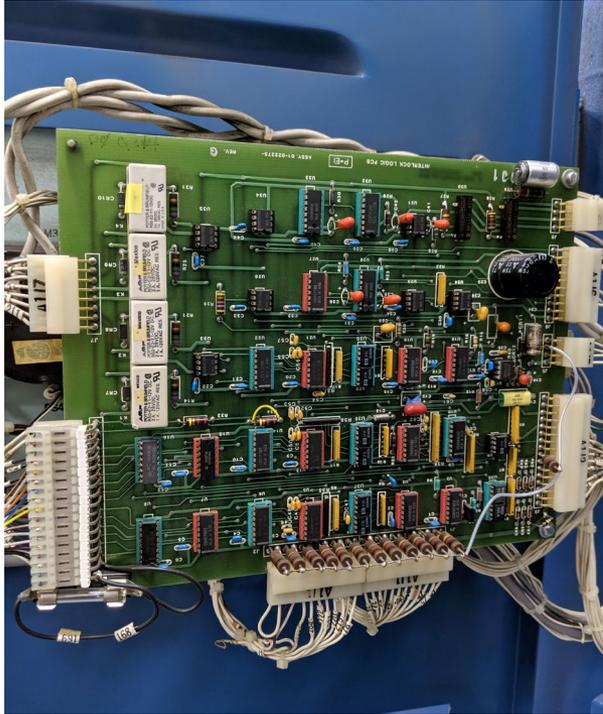
What is this for?



Each power supply converts 480VAC 25VDC at 7,500 amps

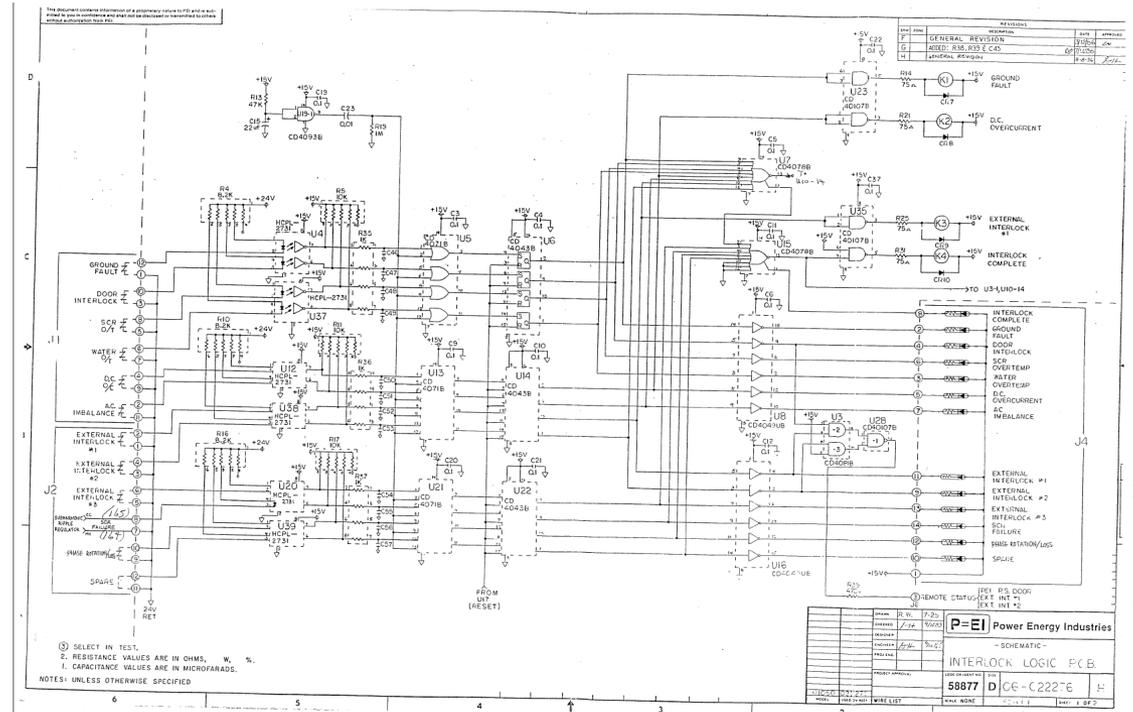
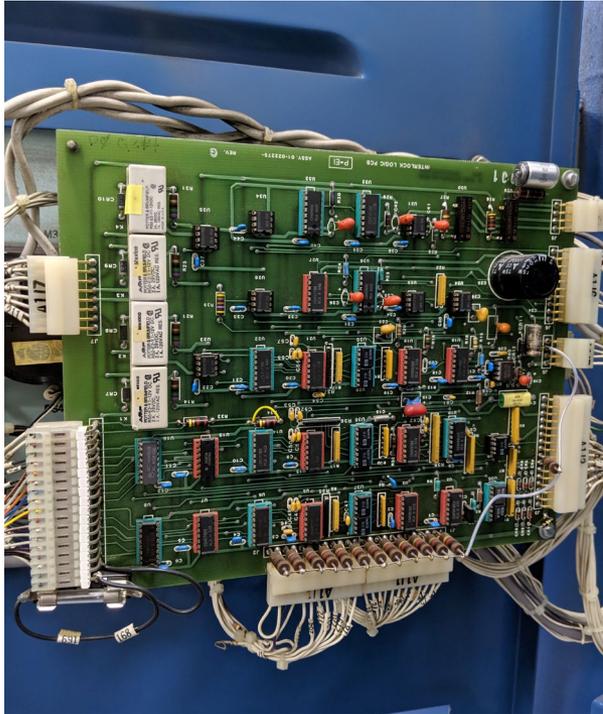


What have I done?



Replacing existing hardware with a PLC to provide more versatile functionality such as adding this power supply to the Industrial Internet of Things. This also allows for quickly and easily changing the behavior of the power supply.

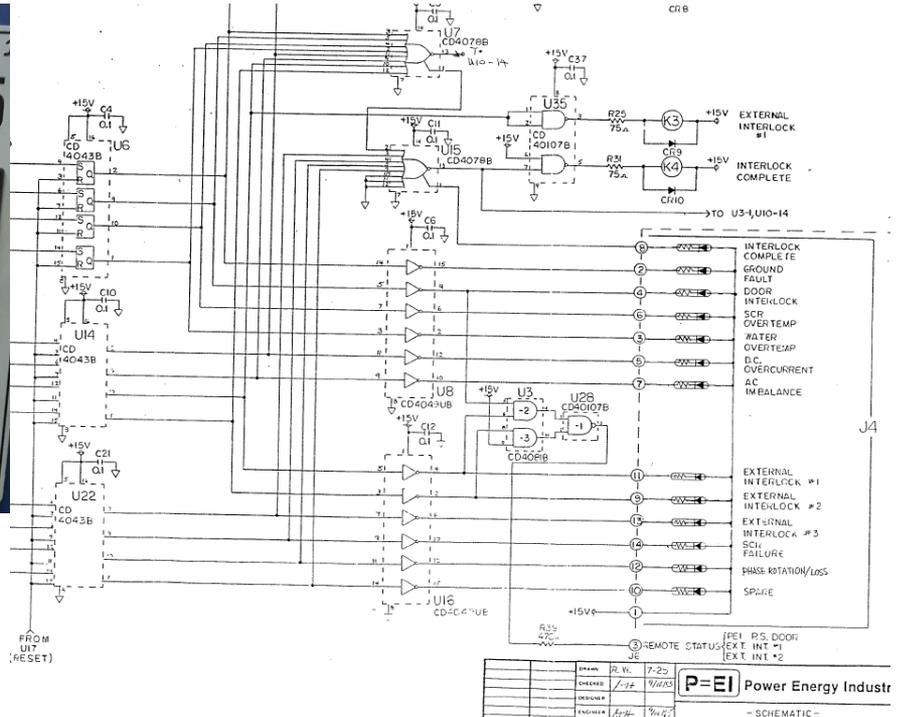
But why?



Printed circuit boards and the integrated circuits are nearing the end of their lifetime

The ethernet port allows this to be added to the Industrial Internet of Things

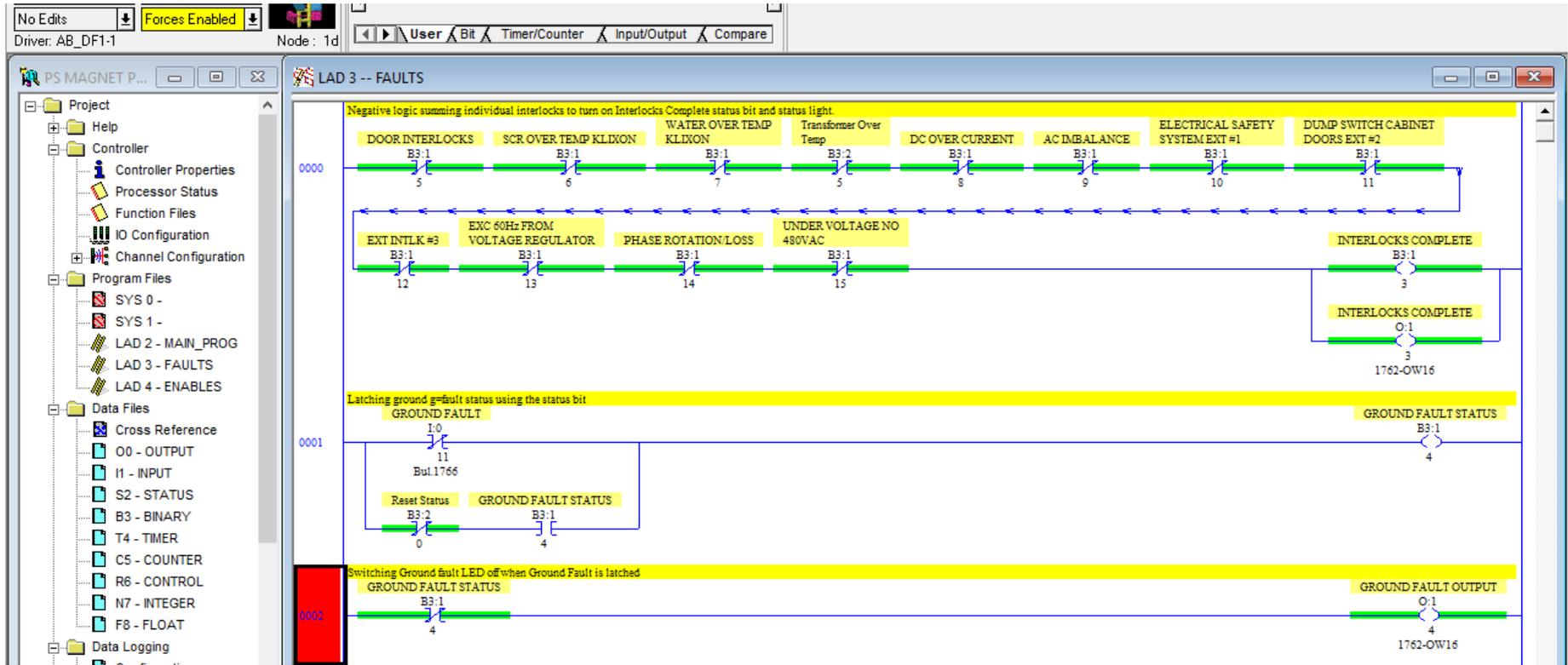
But why?



- Ground Fault
- Door Interlocks
- SCR Klixon Over Temperature
- Water Klixon Over Temperature
- DC Over Current
- AC Imbalance

- External Interlocks #1
- External Interlocks #2
- External Interlocks #3
- SCR Failure
- Phase Rotation Loss
- Spare

What did I use?

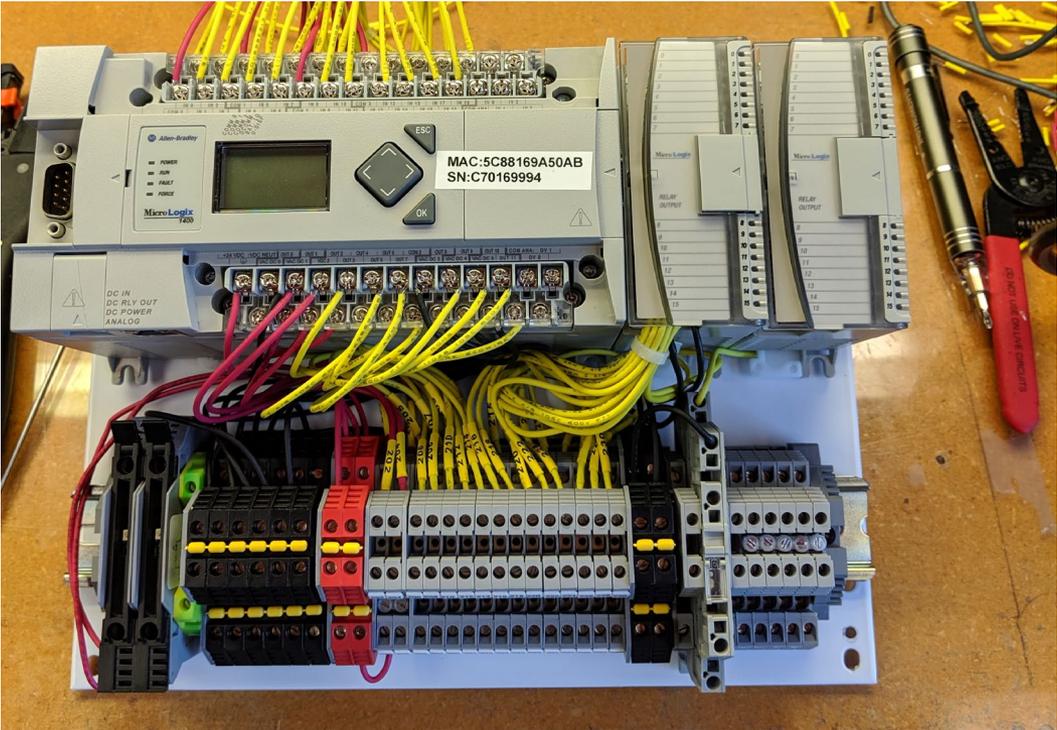


RS Logix 500 was used to program the PLC in ladder logic.

Ladder logic is a visual programming language that uses glue logic and uses iconography from relay design.

O:1/4 refers to Outputs, column 1, bit 4

What did I use?



Programmable Logic Controller

Din rail, Terminal Blocks, wires, steel plates, nuts and bolts, machining tools

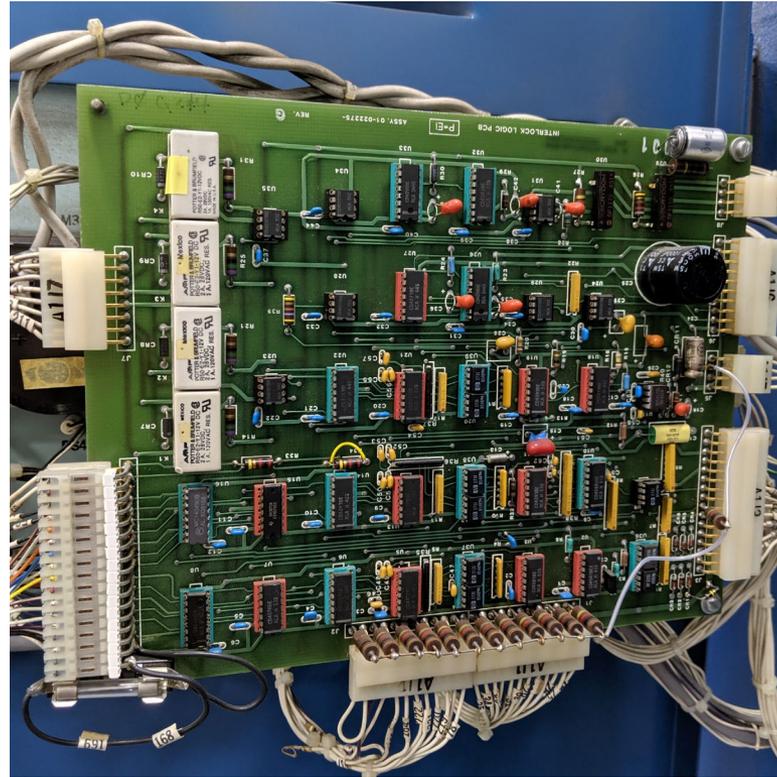
Red - 24V

Black - Common/neutral

Yellow - Signal

Green - Ground

What did it look like?



Lessons learned the hard way:

- This power supply is 25-30 years old and wires have become brittle
- There have been changes made to the wiring from what was done in the original documentation
- Take pictures and keep a reference for how it was originally wired

What does it look like now?



Lessons learned the hard way:

- Every wire used on the old board doesn't need to be used for the PLC
- It's super easy to accidentally use the wrong terminal when wiring
- Tracing wires through the cabinet is "fun" so bring a friend.
- Spreadsheets are your friend

Lessons learned

- This is the first time I have worked with PLCs and power supplies.
- This is one of the best work environments I've had to privilege to work in.
- This has caused me to switch my major from Computer Engineering to Electrical Engineering.
- I have discovered that design is what I really enjoy working with.
- There are huge and complex machines here that are amazing and inspiring to see.

