Dresden Full Core Display Replacement
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Dresden Simulator History

- Simulator originally build and owned by GE (1960’s)
- Purchased by Exelon (Commonwealth Edison) in the early 90’s and moved to the Dresden site
- Original I/O was NOT distributed, all components were wired back to one central I/O cabinet
- Late 90’s Dresden installed full back panels and upgraded the I/O system to RTP. This required major rewiring of the bulk of the simulator.
- In 2010 replaced the RTP G2 controllers with TMI Corp. Ethernet controllers.
Full Core Display Issues

- The age and history of the I/O wiring made diagnostics and fixes difficult.
- Wires are old and brittle and components are densely packed, attempts to fix issues would break other components.
- Many different hardware techs had attempted to make things better over the years.
- Issues with the cabling causing inconsistent light intensity of rod position displays.
- Heat load from incandescent bulbs is a nuisance.
Solution

- Contracted with TMI Corp. to develop a full replacement of the full core display
- Not using the same lamp holders (Eaton lamps are really expensive).
- New design will use LED bulbs (different from control room)
- All components will be modular and can be replaced from the front panel
- Replacement included new metal panel, painted and with all panel mimics
- Used existing lens covers to maintain look and feel
- Simplified wiring with Ethernet interface to the simulator
Full Core Display Components – Power Supply

Independent circuit breaker connection for each of the 15 columns on the full core. (one spare)
Full Core Display Components – Controller

Ethernet based controller with 15 – 50 pin ribbon connectors to the full core display, RJ-45 network connector to simulator network and RS232 connection for diagnostics.
Full Core Display Components – Backplane

Backplane supports up to 5 rod display modules. Daisy chained together to create a full column of the display.
Full Core Display Components – Display Module

Contains 4 LEDs and the rod position digital display for a single rod. All components are socket mounted and can be maintained from the front of the display.
To accommodate the removal of the old panel section (~500 lbs. of steel with 684 Eaton SS light housings), a special “scaffold” was built to conform with the sloping section of the panel and support the panel before removal/installation.
Over 300 lbs. of wiring was removed - with more to go when opportunity arises.
Measure Twice, Cut Once...
There was only one issue with the fit, requiring minor removal of the panel support for clearance of the uppermost display modules near centerline.
We identified one issue with the switch LED bulbs. The blue LPRM LO lights need to be dimmed to minimize eye strain... a light or two was fine, but they all come in when the reactor scrams, the panel was difficult to look at.
Results

- Removed 1630 DO points
- 74 DO cards retired, new spare stockpile.
- 4 chassis removed
- 1 Ethernet controller retired
- 15 unnecessary power supplies removed
- Between the power supplies and the light bulbs removed, temps at the top/inside of the 902-5 panel dropped 8-10 degrees

- Special thanks to Joe Rodriguez the Hardware Technician who executed all the hardware prep, old panel removal, and new panel installation and testing
De”Bugging” an I/O issue
2016 Dresden I/O issue

• Thursday prior to Labor Day 2016, group of common panels on the Dresden simulator stop responding.
• Started checking the usual suspects
  • Power cycling components
  • Replacing controller cards
  • Testing power supplies
  • Etc.
• By Friday, called in the Braidwood hardware Tech, who had experience w/ Dresden’s IO, and still no luck
• Mike Colavito from TMI Corp. arrived on Saturday morning, reviewed what had been tested and identified the issue in a matter of a couple hours.
• WHAT DID WE MISS??
Chassis Layout

- Chassis C33, is the head chassis, containing an ethernet I/O connected back to the simulator network via CAT6 cable.
- The chassis are daisy chained using 50 pin ribbon cables.
- The cable between C33 and C35 is about 25’ and runs through a cable tray that is difficult to access.
Troubleshooting Steps

• During trouble shooting, it was found that you could remove one or more chassis from the chain and the rest of the I/O would start working.

• Started down the path of some sort of grounding issue or maybe a flaky power supply or maybe a bad chassis backplane.

• Because of this, the cable between C33 and C35 was ruled out (also it was hard to get to and we didn’t have a spare cable long enough to replace it anyway)

• Luckily, Mike brought a spare 25’ cable with him, replaced the cable and we were back in business

• The old cable was pulled out and examined.....
The Culprit
Turns Out, Our Bug Was a Mouse

We were unable to apprehend the mouse in question so he could be taped to the SWR
The Moral of the Story

• Don’t dismiss testing of components because it’s time consuming. Follow the logical flow of the failure.
• Having a fresh set of eyes look at a problem can give you a different perspective.
• Take a closer look at single points of failure. Could a single cable failure take your simulator down for days?
Questions???