Test Jumpers For Nuclear Power— Improving Human Performance

Pomona two-part jumpers and color-coded connectors help a nuclear power plant maintain the highest level of safety

Our thanks to Pomona Electronics for allowing us to reprint the following article.

When the cost of a human error can easily cost your company millions of dollars or more in lost revenue, minimizing errors is critical. When it also happens to be a nuclear power plant, the stakes are even higher.

Test and test again

One key to the success of testing programs is maintaining configuration and control of the test being performed. Technicians at the plant test the systems daily to ensure their consistent performance. “We have to prove the reliability of the equipment, that it will work like it’s supposed to work,” said a first line supervisor for a nuclear plant. “Because test leads are used so much, they are required to be replaced on a given frequency or when inspection reveals signs of becoming degraded or defective.”

Core to the testing process is minimizing errors due to human performance. There are several methods to achieve human performance improvements, but the common philosophy behind them is to create consistent ways of doing things so no matter what system a technician works on, they use the same tools and procedures with which they are familiar.

When testing control panels where there are multiple terminals that appear very similar to each other, peer checking is one method to ensure that the two-part jumper cables (used to block out other systems, so only one can be tested) are attached to the correct locations before making the connection. The procedure is methodical and reliable:

1. Pre-install test banana receptacles to the desired jumper locations
2. Check Test Jumpers for continuity
3. Install each jumper end to the appropriate test jumper location without actually connecting the jumper
4. The peer, who has the same set of documentation, verifies that the connection points are correct
5. Once verified, the center connection points on the jumper cables are connected to complete the circuit
6. After the required testing is completed, the jumper is removed and the removal is independently verified

Figure 1 - Control panels

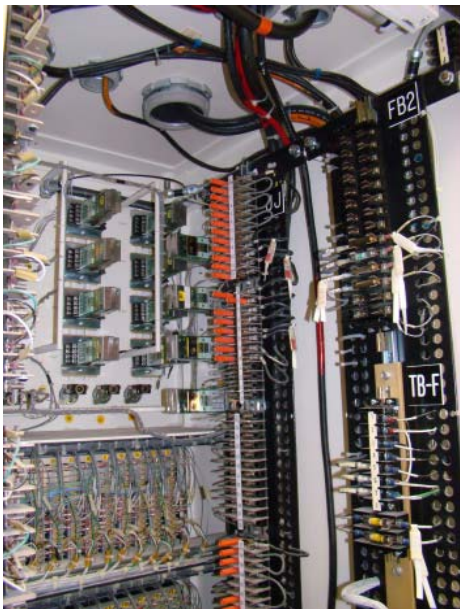

Figure 2 - Inside control panels

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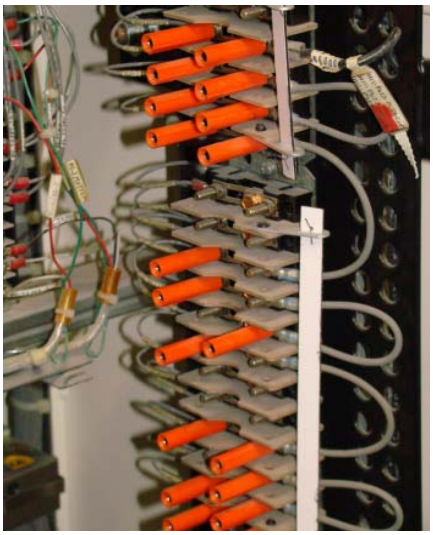

Figure 3 - Terminal strip inside the control panels with pre-installed terminal jacks

While the procedure may seem tedious, the consequences of connecting the cables to the wrong location are costly. “Human performance tools help us to not make a mistake, which could lead to tripping a unit or disabling the safety system,” the first line supervisor said. “If it happens, you can shut down the reactor and lose power. An average 900 megawatt unit being down can be expensive due to loss of electricity. Sometimes its takes three or four days to get the system back up, so at a rate of millions of dollars a day in lost revenue, depending on the market, you could be looking at huge losses.”

“As required by site procedures, surveillance tests are conducted to verify the systems work as designed and are quickly repaired if any deficiencies are found during testing,” the supervisor said.

Color coding connectors

Another area where the nuclear power plant—in collaboration with Pomona Electronics—has made human performance improvements is in the manufacturing of two-part jumper cables and color coding the connectors. Plant technicians had experience using Pomona products and trusted their quality.

Prior to working with Pomona on the new generation of connectors, jumper cables were fabricated by plant technicians and color coding—when there was any—was applied by painting the parts. Sometimes paper labels were used to designate functions. The results were inconsistent, less reliable connectors that had the potential to cause serious problems.

“There are so many things like this that cause problems due to improperly fabricated, homemade jumpers,” the supervisor said. “They were costing us about $100 each to make and there were operational events where the jumper fell off, shorted out, caused a trip or the jumper was not made correctly. That’s why we wanted to go to a manufactured, consistent method of fabrication.”

Because of the daily testing regime, test jacks are often left attached so they can be used for the next set of tests. Color coding the two-part jumpers and connectors provides an immediate indication of what function is being tested. Pomona now produces three sets of color-coded jumpers/connectors for the plant:

• Red connectors with white jumper wires are for maintenance use and surveillances

• Blue connectors with white jumper wires are for operations normal use and surveillances

• Yellow connectors with white jumper wires are used for operations and emergency operating procedures.

The color coding not only reduces the risk of human error during normal operations, it becomes extraordinarily important during emergency situations when time is of the essence.

“There are emergency operating boxes throughout the plant,” the supervisor said. “If you have access to a box during an emergency, the color coding tells the technician where to put the leads.”

Size was also an issue for the connectors. Most of the terminal strips are very tight on space, so bulky connectors or paper labels made a difficult situation worse. The Pomona connectors provide a compact, easy-to-connect terminal jack that simplifies testing.

Consistency improves human performance

Pomona two-part jumpers and connectors are helping nuclear power plants streamline testing procedures and improve human performance by providing a higher-level of quality, reliability and utility than what they were using before. By integrating a common set of connectors and a consistent color scheme into their procedures and peer check processes, plant technicians reduce the risk of placing jumpers on the wrong terminals and causing an event that could shut the plant down.

“By lessening human performance errors made by technicians and electricians, you don’t challenge the safety systems of a nuclear plant,” the first line supervisor said.

Pomona Jumper Test Leads (model 73087)

Pomona Terminal Jacks (models 73084, 73085, 73086, 73088)

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