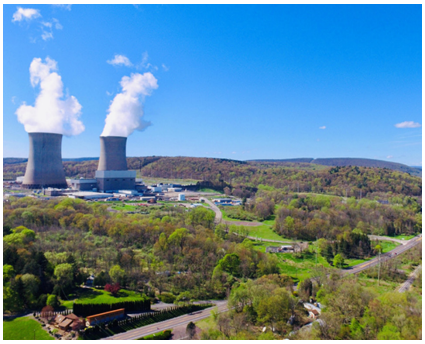
CURTISS-WRIGHT

Reverse Engineering Annunciator Relays at Susquehanna



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Organization: Talen Energy is an independent power producer founded in 2015. Its Susquehanna plant produces 63 million kilowatt hours per day and has been in operation since 1983.

Challenge: Obsolescence is a pressing problem at today's nuclear power plants. In many cases, original analog parts such as the Panalarm 70-X11 relay are in limited supply, or may no longer be available from surplus vendors.

Solution: Curtiss-Wright reverse-engineered a replacement relay known as the NUS-70-X11, which replicates the basic function of the Panalarm 70-X11 while significantly improving the longevity and maintainability of the unit.

Results: Reverse engineering the old relays rather than installing new annunciator panels and brand new relays has the potential to save Talen Energy an estimated $9.5 million.

TEAM SUSQUEHANNA a division of Talen Energy

The Susquehanna Steam Electric Station in Luzerne County, Pennsylvania, produces 63 million kilowatt hours per day. As one of Talen Energy's leading generating affiliates, the dual-unit boiling water reactor plant has been in operation since 1983.

When procurement engineers at Talen Energy's Susquehanna nuclear power plant needed to replace obsolete relays in the station's annunciator systems, they asked Curtiss-Wright to reverse-engineer dozens of custom relays to keep their critical systems online.

"It was becoming increasingly difficult to buy surplus Panalarm 70X11 relays, which meant we would either have to replace the entire annunciator panels, or reverse engineer these failing relay components," recalls Darin Hock, supply chain supervisor at the Susquehanna plant. "Completely replacing the annunciator panels would have been prohibitively expensive, so we asked Curtiss-Wright to develop like-for-like replacements."

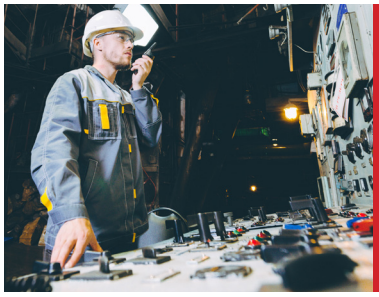
With a 40-year history in supporting obsolete systems in commercial nuclear power plants, Curtiss-Wright's Instrumentation and Controls (I&C) team has developed a highly refined reverse-engineering process that has been accepted during audits by the NRC, DOE, and several other suppliers to the commercial nuclear industry. These components can be installed under 10CFR50.59, and can greatly extend the useful life of a plant's essential systems.

In this instance, instead of replacing the entire annunciator system, duplicating these aging relays would allow Susquehanna to keep the major components of these systems in place.

Sizing Up the Problem

Annunciators collect information from critical systems and components such as safety relief valves, steam generators, pumps, turbines, and fire protection systems. The information is combined logically to alert operators of any remedial actions that may be required. Relays are electric switches within the annunciator panels that convey audio/visual warning signals of potential faults or mishaps in control systems and equipment.

"Whether it's a temperature reading or a pressure reading or dozens of other events and variables, our annunciators keep operators in the control room apprised of equipment status, which is very important," explains Bill Frey, a procurement engineer focused on obsolescence issues at Susquehanna plant. "Relays such as the Panalarm



70-X11 provide immediate visual and audio feedback of plant systems and equipment. When a relay receives a signal, it will flash a warning or sound an alarm."

Unfortunately, Susquehanna was starting to see a high failure rate in its Panalarm 70-X11 relays, due in part to the age of the equipment. With 150 of these units installed throughout the plant, Frey and his team needed to come up with a long-term solution.

Engineering a Custom Solution

Curtiss-Wright's experienced I&C workforce is highly skilled at engineering, production, testing, qualification testing, and both repair and refurbishment work. Team members are adept at creating new components that maintain the same certified form, fit and function as the original equipment, as well as complying with all pertinent industrial and regulatory requirements.

Frey sent two Panalarm 70X-11 relays to the Idaho Falls facility, along with documentation, schematics, and information on plant methods. In response, Curtiss-Wright designed, tested, and manufactured an initial set of 10 new relays, dubbed NUS-70-X11. They also supplied an engineering change package that included documentation on how to implement the new units.

"Curtiss-Wright had experience with similar relays, and their price was competitive," Frey says. "The team in Idaho is very good, and they have good, open communication."

Leveraging A Superior Design

Curtiss-Wright's NUS-70-X11 relay is an enhanced version of the Panalarm 70-X11 relay. It retains the basic function of the original module, yet also improves it in key ways.

To replicate the form of the Panalarm 70-X11, the NUS-70-X11 front plate subassembly includes a mounting tab and a fold-down handle, as well as a 12-pin connector on the rear plate subassembly.

The fit of the re-engineered NUS-70-X11 differs from the Panalarm model only in the width of the relay. The additional width is needed to accommodate the interchangeability of the identical PC boards, which prevent corruption of other integral parts within the unit (see Figure 1).

The original Panalarm unit is completely sealed, so replacement is the only option if a unit fails. To overcome this limitation, Curtiss-Wright engineered removable side panels to allow maintenance technicians to open the box and perform necessary repairs.

Another improvement to the NUS-70-X11 was the use of aluminum polymer capacitors rather than electrolytic capacitors, which extend the shelf life of each relay to as long as 40 years.

"Electrolytic capacitors only have a shelf life of 72 months," confirms Frey. "The new relays that Curtiss-Wright produced don't have that limitation, so we can maintain them in inventory for much longer."

Computing a Significant ROI

Curtiss-Wright's I&C team has designed relays for about half a dozen nuclear power plants. They used that experience to help Susquehanna develop a cost-effective solution that will save millions of dollars in time and equipment over the life of this project.

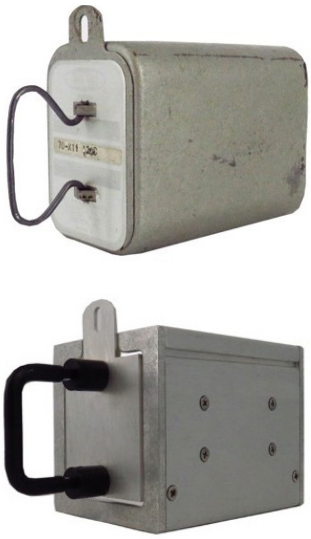
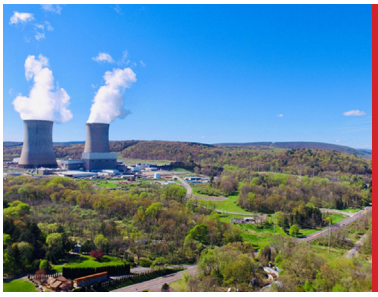


Figure 1:
The original Panalarm 70-X11 relay (top), alongside its new NUS-70-X11 replacement (bottom).



If Susquehanna's procurement team had opted to replace the old annunciator panels and install brand new relays, it would have cost significantly more than Curtiss-Wright's reengineered solutions. "I figured we would have to spend about $100,000 to perform each modification, and $75,000 to replace and install new equipment—which are very conservative numbers," Frey says. "Multiplied by 150 units, we would have to spend $11.3 million if we followed this approach."

The total cost of the Curtiss-Wright relays, once fully implemented, will be much less. Other Talen Energy plants use similar relays, and will likely need to address this same problem in the future, which will further compound these returns.

"The initiative has been a success and we are satisfied with the results to date," Hock states. "In fact, we are considering hiring Curtiss-Wright to reverse engineer another type of relay that we use in our power supplies."

While these are basically "like for like" replacements, Frey notes the obvious gains in reliability and shelf life, which make the reverse engineered relays more valuable to the plant. "Once we swap in these new relays, we can count on steady operation for quite a long time," he adds.

Sharing Insight with Other Plants

According to Frey, obsolescence problems are widespread at today's nuclear power plants, and the industry can learn from Susquehanna's experience.

"Many analog parts are either obsolete or becoming obsolete, and most plants don't have the time, knowledge, or bandwidth to reverse engineer components such as this," he concludes. "Reverse engineering parts is often significantly cheaper than trying to change out parts. From a cost savings standpoint, this is what plants need to do to stay competitive."

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— Bill Frey,
Procurement Engineer

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