Southern Nuclear's "second" simulator project

The nuclear arm of Southern Company commissioned additional full-scope simulators for its entire reactor fleet to enhance plant safety and operator performance.

Several years ago, the leadership team at Southern Nuclear—a Southern Company subsidiary and operator of six nuclear power units for Alabama Power and Georgia Power at the Farley plant near Dothan, Ala., the Hatch plant near Baxley, Ga., and the Vogtle plant near Waynesboro, Ga.—recognized an opportunity to modernize, optimize, and expand the fleet's licensed operator training program. With plant safety at the center of the discussion, the company made plans to develop and construct additional—or "second"—control room simulators at each of its three operating plants. This project, according to Southern Nuclear, would become the largest single nuclear simulator project in the United States in the past 30 years.

"This investment in our replica simulators was made to support our strategic objective of developing our people by ensuring we attract, develop, and retain our operations and training staff, who are integral to meeting our vision of achieving and sustaining excellence," said Steve Kuczynski, chairman, president, and chief executive officer for Southern Nuclear. "Additionally, these replica simulators allow us the opportunity to accelerate our initiative to teach nuclear fundamentals to a broader portion of our workforce. This investment demonstrates our long-term commitment to nuclear energy's role in promoting clean, safe, reliable, and affordable energy."

At each plant, new Operations Training Centers would feature additional control room simulators that would be visually and operationally identical to the plants' reference simulators. In addition, the centers would include classrooms, office space, and conference rooms.

Hatch was the first in the Southern Nuclear fleet to open its new Operations Training Center. The simulator was delivered in May 2018, and training started later that year. Farley's second simulator was delivered in September 2018, and its center opened in March 2019. Lastly, Vogtle received its simulator panels in January 2019, and that simulator opened in May 2019. All three second simulators were built by GSE Systems, a simulation, training, and engineering company headquartered near Baltimore, Md.

Photo: Southern Nuclear

The development of Southern Nuclear's operations and training staff was a key driver behind the company's decision to add "second" simulators to its fleet.

Goals

The first goal of the simulator project was to elevate and strengthen training and operator performance at each station. According to Southern Nuclear, with the additional simulators, fleet training programs will enjoy more flexible scheduling and increased capacity to drive operator performance. "An immediate benefit we see is the availability to support plant systems training," said Farley's nuclear operations training manager, Simon Schwindt. "We can spend time training new operators on the plant system control interfaces while they are still learning plant systems."

The increased capacity also allows for more training sessions to be offered during the day instead of on night shift. The revised schedule is designed to improve work-life balance for Southern Nuclear employees while increasing training effectiveness. "Night-shift training can be swapped to day-shift training for operators and initial licensing training candidates," said Hatch's operations shift manager, Russell Lewis. "We'll be able to optimize training schedules to create the best possible learning environment."

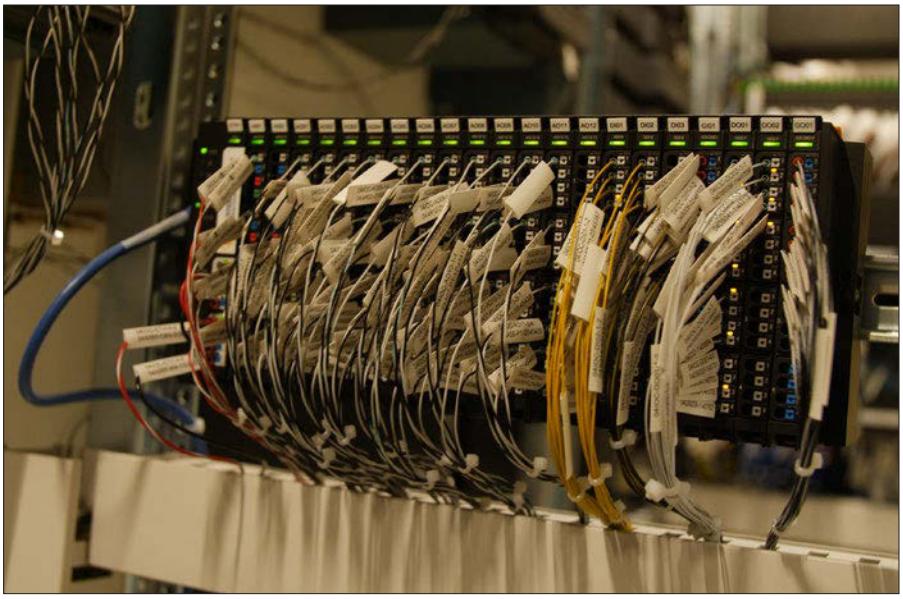

Photo: Southern Nuclear

Updated input/output systems should make the new simulators easier to maintain and troubleshoot.

"In addition, the second simulator is key to managing the class size Southern Nuclear needs to keep the operations shift teams adequately staffed," explained John Campbell, nuclear operations training manager at Hatch. "By having two simulators at each site, we can conduct larger initial classes and put more senior reactor operators on shift and into the organization."

The project's second goal was to enhance longevity for Southern Nuclear's training program. The new simulators feature state-of-the-art simulation technology and digital equipment. The simulator project team also developed each one with an easier-to-maintain-and-troubleshoot modular input/output system. The new equipment generates less heat, is more serviceable due to back-of-panel accessibility, consumes less power, and has a longer life span than the equipment used in the original simulators.

Meeting future training demands was another consideration for Southern Nuclear. After careful consideration of potential future regulations built around Fukushima-related concerns, each new simulator was equipped with GSE's PSA-HD severe accident modeling solution using the Electric Power Research Institute's (EPRI) modular accident analysis code, MAAP*, already in use by its probabilistic risk analysis teams. Southern Nuclear believes that by integrating advanced engineering code into the simulators and providing additional training opportunities for operators and engineering teams, it demonstrates its commitment to remain at the forefront in plant safety.

Lessons learned/findings

The 36-month project schedule for delivery of the three full-scope simulators required a GSE team of over 35 engineers and a multitude of nuclear professionals in Southern Nuclear's cross-functional team of trainers, operators, engineers, and project managers.

According to Southern Nuclear, an agile project delivery process helped improve project outcomes. Early and frequent involvement of Southern Nuclear's cross-functional team of subject-matter experts with GSE's simulation engineers helped reduce risk to the project schedule and improve the overall quality of the simulators. Early interaction among the team helped ensure an efficient handoff from the customer to the vendor and then back to the customer for testing.

Southern Nuclear also credits the process with enabling team members to find and correct potential issues earlier in the project. Ravi Khanna, senior vice president of services for GSE, noted, "Using software automation and proven agile methodologies to achieve continuous delivery enabled comprehensive regression testing and early defect correction. The Southern Nuclear and GSE engineering teams worked together during dedicated shifts, and having Southern Nuclear operators on-site for testing was invaluable to meeting the project schedule and contributed to a smooth factory acceptance testing experience."

By participating in the simulator testing, the on-site Southern Nuclear simulator training staff also had the opportunity to become familiar with the MAAP severe accident model prior to declaring the simulator ready for training.

Thanks to the high-fidelity GSE software platform, engineers were also able to find improvement opportunities for the original simulators. Using a fleet approach, the standardization of each plant's simulator on GSE's software platform avoided fragmented technology, which is more difficult to maintain and more susceptible to aging out. The software platform also allows for more simulator maintenance cross-training opportunities, enabling staff from one site to support other sites in the fleet, resulting in lower maintenance costs.

3-D printing

Since this was the first simulator project of its kind in the United States in several years, many of the physical parts used in the original simulators were unavailable for traditional procurement, presenting a particularly interesting challenge for GSE to replicate an existing simulator down to the size and color of each knob, switch, and instrument.

Continued

Photo: Southern Nuclear

A cross-functional team of GSE engineers and Southern Nuclear trainers, operators, and project managers collaborated to complete the project.

* EPRI (<www.epri.com>) does not endorse any third-party products or services. Interested vendors may contact EPRI for a license to MAAP 5.0.

3-D printing, or additive manufacturing, proved to be the solution for matching specification designs and prefabricating prototypes rapidly. Verified designs were sent out for manufacturing and then installed on the new simulators. In-house rapid prototyping provided more control and consistency in the engineering and quality of the parts.

"There were over 1,000 switches on the Plant Farley simulator that were obsolete and had to be built," said Richard Froelich, senior project engineer for GSE. Froelich described one particularly challenging piece: a brass handle for the Hatch simulator that had multiple machined parts. The team was able to design and verify the part in a couple of days using 3-D printing.

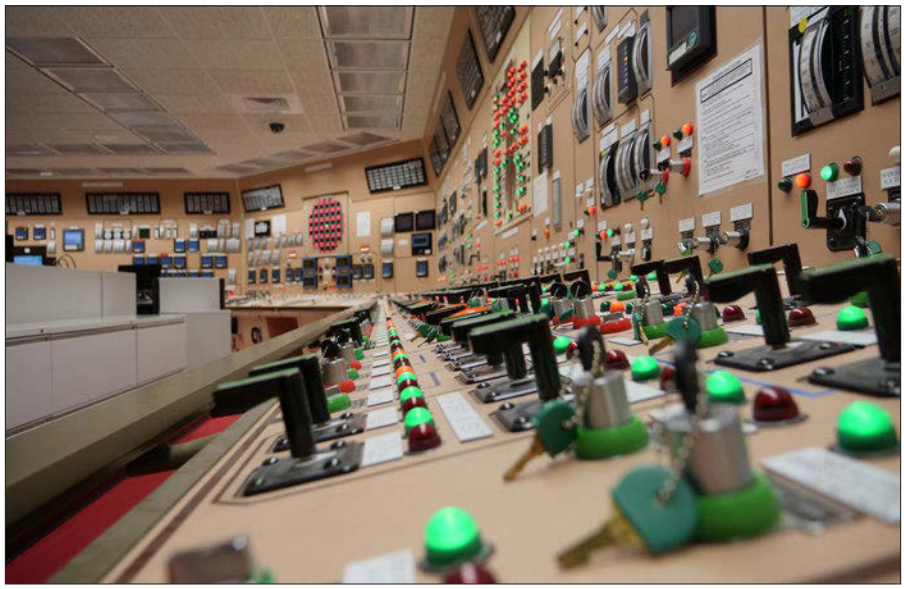

Photo: Southern Nuclear

Replicating each simulator's unique knobs and switches required non-traditional procurement methods, such as 3-D printing.

Industry trends

The challenge of simulator availability is not exclusive to Southern Nuclear, as most U.S. nuclear plants and their original simulators are more than 30 years old. Many utilities have expressed interest in second simulators to increase their trainee throughput and upgrade to modern digital equipment, whether that be through new full-scope simulators, as in the case of Southern Nuclear, or variations, such as so-called glass-top simulators. In fact, the American Nuclear Society dedicated a panel discussion to simulator training during its 2017 Conference on Nuclear Training and Education and showcased several additional papers on the topic earlier this year.

Finally, the events at Fukushima over eight years ago have had a profound impact on the industry. While various strategies have been implemented in the industry as a response, namely FLEX, new regulations specific to training have not been announced by the Nuclear Regulatory Commission. Southern Nuclear and other like-minded utilities, however, are making changes to their operator training programs now. By adding the engineering-grade severe accident modeling code MAAP directly into their simulators, these utilities are attempting to future-proof their training programs. NN