

Technology At Work

Data Mining Outside the Box

EPRI Databases Offer Broader Insights on Nuclear Plant Performance

By Brent Barker

In medicine, insights on an individual's health can be gained by comparing test results with historic readings and benchmarking them against the results from a larger population of the same gender and age. In a similar way, databases of nuclear power plant operations can be a powerful tool for comparison, investigation, and analysis. Over the past few decades, EPRI has compiled databases on water chemistries at boiling water reactors and pressurized water reactors, plant radiation fields, fuel reliability, and steam generators.

Nuclear plant operators can ask EPRI to interrogate these databases to help them analyze plant problems and benchmark performance against similar plants.

"The data we have collected reveal that every plant is unique and reacts differently to a change. While in one plant a given change may result in beneficial changes to radiation fields, in another plant of the same vintage and design, this may not be the case," said EPRI Principal Technical Leader Carola Gregorich. "We must approach every optimization challenge by first considering the unique attributes of the plant under investigation and then comparing the plant with its own history and other plants' histories."

"Querying multiple databases enables us to look at a problem holistically," said Gregorich, who has become a leader at EPRI in database mining. "If we limit ourselves to just one database such as water chemistry, we could potentially miss the right answer entirely."

A Shutdown Inconsistency at Vogtle

In 2016, Southern Nuclear asked EPRI to interrogate the chemistry database to help explain an unusual reading during a normal refueling shutdown at the Vogtle nuclear plant. As part of the shutdown protocol, several tasks are completed before the reactor head is removed: Control rods are inserted into the reactor pressure vessel, the reactor is cooled down, and hydrogen peroxide is injected into the cooling water to dissolve the radioactivity on the fuel rods and remove it from the coolant. In both Vogtle units, plant operators found a peak release concentration of 8 microcuries per milliliter of radioactive cobalt-58—about double the amount they expected although well within the range of values observed by the pressurized water reactor fleet. The inconsistency presented no risk to the public, but it required a longer time to clean up prior to commencing outage operations.

"Shutdown for refueling is a well-orchestrated, deliberate process with fairly consistent readings from outage to outage," said Gregorich. "Southern Nuclear asked us, 'Should we have been surprised? Why did this happen? What can we do to prevent this going forward? What does the database show?'"

Gregorich and her team interrogated the chemistry database for shutdowns at other plants with similar designs and with steam generators made of the same material. "Of the 183 shutdowns at similar plants, we found 25 with a cobalt-58 release that was at least double the typical reading," said Gregorich. "One of these readings occurred at a Vogtle unit. This was uncommon but not rare."

To investigate the causes of the cobalt-58 spike, other EPRI researchers including Principal Technical Leader Dennis Hussey mined among the various databases and gathered additional data on the Vogtle units from

Southern Nuclear. This eliminated several design and chemistry factors and narrowed the potential causes to four that were presented to Southern Nuclear for consideration:

- Random occurrence
- Several mid-cycle forced outages
- Chemistry changes in zinc injection operations (zinc is injected into the reactor cooling water to reduce radiation fields)
- Shutdown procedures

Future Use of Databases

EPRI is making the databases easier to access for utilities. “We are working on improving the user interface so plant staff can benchmark different parameters at their facilities against the industry,” said Gregorich. EPRI Project Engineer Nicole Lynch led the development of the new interface, which has gone live. Members are using this new functionality.

“Utilities increasingly ask us to assess their operational procedures and potential improvements,” said Gregorich. “By going beyond an examination of just one plant, the databases offer a wider view and a much greater variety of improvement options.”

Gregorich expects that the EPRI databases—and others like it in the nuclear industry—will become even more valuable. “There is a growing turnover of staff in the nuclear industry,” she said. “Experience and knowledge are getting lost. These databases are becoming an important historical archive that will benefit the next generation of staff at operating and new plants.”

Key EPRI Technical Experts

Carola Gregorich, Dennis Hussey, Nicole Lynch