Exelon's Limerick station pioneers a surveillance frequency control program

BY BETH RAPCZYNSKI, GENE KELLY, AND PHIL TARPINIAN

Using a risk-informed process to determine how often to test equipment will lead to savings in resources and costs, without compromising safety.

AS PART OF an industry pilot program, Exelon Nuclear's Limerick Generating Station last year became the first plant to receive approval from the U.S. Nuclear Regulatory Commission to internally control the frequency of its surveillance testing using a risk-informed process. This groundbreaking initiative will lead to significant flexibility and resource savings for Exelon and, potentially, the industry.

"Risk-informed" refers to incorporating insights from the plant's probabilistic risk assessment (PRA) into a process that also considers equipment reliability and test/maintenance history to establish surveillance test frequencies.

Using a methodology developed by the Nuclear Energy Institute (NEI), Limerick, which has two 1191-MWe boiling water reactors, piloted and licensed the NRC's Risk Informed Technical Specification Initiative 5b, the Surveillance Frequency Control Program (SFCP), under the sponsorship of the BWR Owners' Group. This initiative allows technical experts at Limerick to make risk-informed decisions regarding how often to test equipment and to change the frequency of the tests accordingly. Changes to technical specification surveillance frequencies no longer require prior NRC approval because all changes would be completed employing the NRC-approved methodology. Adjusting test intervals results in reduced radiation exposure, less wear and tear on equipment, and minimized human error and production risk, as well as savings of resources and costs, while the plant continues to operate safely.

As a broad estimate of the savings, 76 instrumentation and control surveillance tests (at both Limerick units and in all divisions) are performed monthly, each of which entails an average of 4.3 person-hours to conduct. If all of these were to be converted via the SFCP to quarterly intervals, the annual savings would amount to roughly $100 000. And, more important, the 2600 person hours saved could be applied toward preventive maintenance work, elective maintenance backlog, and other station priorities.

Exelon's Limerick Nuclear Generating Station (Photos: Exelon Corp.)

"The licensing and implementation of the SFCP represents a major milestone for the industry, and is the first demonstration of significant regulatory improvement through the use of quality standards for risk analysis," said Biff Bradley, NEI's manager of risk assessment. "This adjustment will preserve or enhance safety while also providing major operational benefits."

For their efforts, the Exelon Nuclear employees who designed and implemented the pilot program received a Top Industry Practice award from NEI, the Configuration Management Process Award, which was presented at the Nuclear Energy Assembly in May.

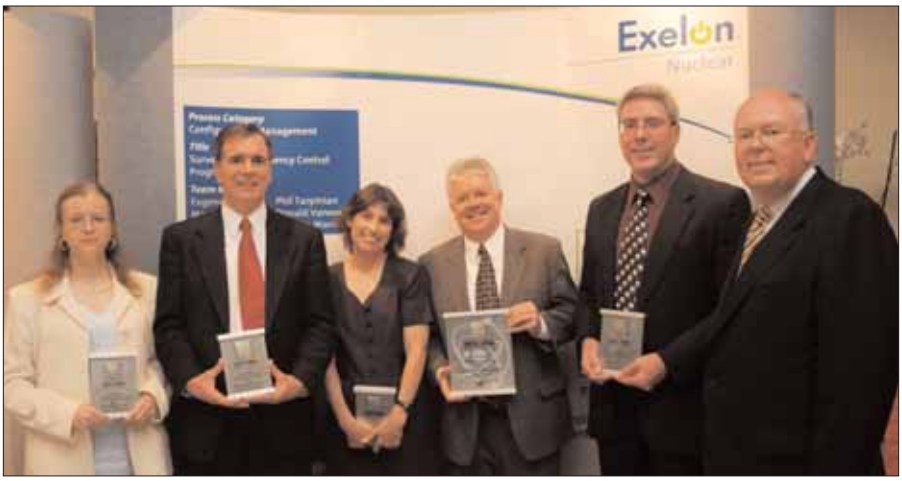
How it works

Essentially all surveillance tests required by a plant's technical specifications can potentially be adjusted under the SFCP. There are approximately 2000 separate surveillance tests at Limerick. The selection of candidate surveillance tests for priority attention—those tests considered to have the highest benefits associated with interval adjustment—are identified using input from various site organizations, including operations, outage management, work management, radiation protection, and engineering. The criteria used to select candidate tests are based on the potential for benefit in the following areas:

- Reactivity management.
- Maintaining dose as low as reasonably achievable (ALARA).
- Burden reduction (resources).
- Outage impact (outage work control).
- Work management simplification (online work control).

Continued

Beth Rapczynski is the community outreach manager at Exelon Nuclear. Gene Kelly is senior manager of engineering at the Limerick Generating Station, and Phil Tarpinian is a senior engineer at the plant.



The Limerick SFCP project team was awarded a Top Industry Practice Award at the 2007 Nuclear Energy Assembly. From left, Exelon Nuclear employees Vicki Warren, Phil Tarpinian, Mary Kowalski, Gene Kelly, and Glenn Stewart, and Exelon Corporation's chairman, president, and chief executive officer, John Rowe.

■ Production risk.
■ Reducing wear and tear on safety equipment.

Each surveillance test considered for interval adjustment is comprehensively evaluated under an NEI methodology (NEI 04-10). The evaluation is then reviewed by an integrated decision-making panel (IDP), which is similar to an expert panel used for maintenance rule (10 CFR Part 50.65) implementation, but with the addition of specialists who have experience in surveillance testing and system or component reliability.

Once the IDP approves the surveillance interval adjustment, the change is implemented and records of the panel's deliberations are documented for assessment and audit purposes. Each evaluation addresses the following attributes:

■ Operation and maintenance history of the components.
■ Maintenance rule unavailability.
■ Past industry and plant-specific operating experience.
■ Vendor-specified maintenance recommendations.
■ ANSI, IEEE, and other code-specified testing standards.
■ Impact on defense-in-depth protection.
■ Impact of test interval change on the calculated core damage frequency and large early release frequency.

This approach can be applied to all Limerick technical specification surveillance tests with fixed intervals (except those governed by ASME Code requirements). In some instances, intervals could conceivably be extended more than once. The methodology demonstrated at Limerick can also be applied to both BWRs and pressurized water reactors.

Examples of the SFCP in use

Control rod drive notch tests: Limerick technical specifications had previously required that the operability of all withdrawn control rods be demonstrated by moving each control rod at least one notch a minimum of once every seven days, and so this time-consuming test had to be performed every week. The change that was evaluated allowed this interval to be extended from seven days to 31 days. This was the first test to be adjusted following the licensing of SFCP at Limerick, and both the IDP and the

Plant Oversight Review Committee approved the change for implementation in January 2007.

The benefit of adjusting this interval—in the area of reactivity management—can be seen in how the test is conducted. Each of the 185 control rods (on each unit) is "notched" individually. Because of this, it takes over five hours to complete the surveillance, which is usually conducted on a Sunday afternoon and involves three to four reactor operators for its entirety.

The potential for a reactivity management event and human error throughout the duration of the testing is always present, and therefore no other activities are allowed while this surveillance is being conducted. By extending the interval between tests from weekly to monthly, the potential for reactivity errors is reduced by more than a factor of four. Over the life of the plant, this constitutes effective risk management. And not to be discounted—it's not just the licensed operators who like this change—control room operators are positively influenced by this change because other valuable control room work can be conducted during the time formerly taken up by the weekly surveillances.

By extending the interval between tests from weekly to monthly, the potential for reactivity errors is reduced by more than a factor of four.

As an example of what the IDP takes into consideration, the control rod drive system at Limerick was found to be highly reliable, having demonstrated excellent equipment performance over the past six years, the period typically examined as part of the NEI methodology. The core average scram times to all critical notch positions were historically found to be 30 percent below the allowable values. In addition, the scram insertion time to the fully inserted position for all control rod drive mechanisms was demonstrated to have substantial margin and to be significantly less than the technical specification scram insertion time limit. Most important, there was no control rod that the operators were unable to reposition as part of the weekly exercise test for the review period examined. Also, the PRA impact was negligible, reinforcing the risk-informed basis for the control rod drive test adjustment.

And so, there was no reduction in safety, impact on performance, or loss of critical test information as a result of conducting this test less often. Therefore, station operating experience and the performance of the control rod drive system provided the basis for changing this surveillance frequency from seven days to 31 days.

Scram discharge level switch calibrations: Scram discharge level switch calibrations are performed quarterly on each unit. A total of eight channels are tested per unit, specifically calibrating level switches at the scram discharge volume located in the reactor enclosure. The switches are installed in a relatively high-dose location. Shielding, hydrolasing, and other ALARA techniques are either impractical or have limited effect in this instance. On an annual basis, the total dose incurred by I&C technicians who perform these calibrations for both Limerick units has been on the order of 1 person-rem.

This surveillance is currently being evaluated for frequency reduction because of the high-dose impact on workers. Safety benefits will be seen in the form of radiological risk reduction resulting from fewer instances at the source point, as well as a reduction in labor required. NN