Minimizing Radiological Effluent Releases

By Electric Power Research Institute.

Lessons Learned

Decades of operating experience and advances in technology have helped nuclear plants make dramatic improvements in radioactive waste processing. These improvements have increased efficiency, flexibility and cost-effectiveness while minimizing solid waste volume and radiation exposure.

To ensure that lessons learned and new radwaste technologies are applied in new nuclear plants, EPRI formed a team of utility and industry experts to review radwaste processing designs and make recommendations regarding best practices. GE Hitachi Nuclear Energy turned to the EPRI team for assistance in designing the radwaste system for the next-generation Economic Simplified Boiling Water Reactor (ESBWR). GE Hitachi implemented EPRI's recommendations for an advanced design that would support efficient, cost-effective waste processing over the 60-plus year life of the plant.

Source: Electric Power Research Institute's Success Story number 1018450, December, 2008.

These efforts benefited STP Nuclear Operating Company, which is incorporating the EPRI state-of-the-art radwaste system into plans for its two new Advanced Boiling Water Reactors (ABWRs) at South Texas Project Units 3 and 4. The enhanced radwaste system design offers features that will benefit not only STP-NOC, but other utilities contemplating nuclear plants. These features include:

- Mobile Processing
- Operating Flexibility
- Near-Zero Effluent Release
- Staffing Optimization

Advanced Plant Designs

The radwaste design project was conducted under EPRI's Advanced Nuclear Technology Program, which focuses on cross-cutting research to build confidence in new nuclear plant deployment. EPRI's recommendations for the Advanced Nuclear Plant radwaste design are based on an extensive foundation of nuclear R&D. In the late 1980s and early 1990s, EPRI developed a Utility Requirements Document that provides a comprehensive set of design requirements for future light water reactors. These requirements are grounded in 50-plus years of commercial U.S. and international light water reactor experience.

EPRI has periodically revised the Utility Requirements Document to reflect industry operating experience and

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technology advances that may offer potential economic, public acceptance, and operational benefits. When GE Hitachi requested EPRI's assistance in developing the radwaste system for the ESBWR, the radwaste expert team defined key design criteria based on the latest processing equipment, best operating practices and top decile industry performance. The team recommended a range of system design improvements that are documented in an EPRI report, Technical Support for GE Economic Simplified Boiling Water Reactor (ESBWR)-Radwaste System Design (1013503). Understanding that the EPRI recommendations for the ESBWR radwaste design reflected current industry best standards, STPNOC staff collaborated with EPRI to ensure that the recommendations could be used in the ABWR radwaste redesign. STPNOC then asked its engineering contractor to use the EPRI documentation in revising the certified design.

"The ABWR certified design that was approved by the Nuclear Regulatory Commission in 1997 included a forced-circulation concentrator system, a cement solidification system, and an incinerator system," says Milton F. Rejcek, STPNOC Radwaste Consulting Engineer. "We knew that we were not going to operate radwaste in that manner, so the EPRI technical report served as our vision for the design we expected for an advanced radwaste processing system. This saved a lot of time and focused the whole design team on the tasks of redesign and writing the Combined Operating License Application."

Features and Benefits

The enhanced radwaste system design represents a major advance in managing and processing boiling water reactor radioactive wastes. Key features and benefits include:

Near Zero Effluent Release. The updated ABWR radwaste design can accommodate nearly 100% recycling of normal liquid radwaste effluent. If STPNOC chooses to operate its own laundry facility, laundry liquid would essentially be the only item not recycled. By minimizing environmental impacts, this design feature enhances siting flexibility: the plant is suitable for most available sites in the United States, including those with discharge limitations due to availability of cooling water or proximity to groundwater aquifers.

Mobile/Skid-Mounted Processing. All waste processing components can be mobile or skid mounted, including filters, demineralizers, and membrane separation systems. This approach allows relatively simple incorporation of new processing technologies over the plant's 60-year life.

Operating Flexibility. The design incorporates a wide range of processing options that can be implemented without future plant modifications. Recommended design flexibility features address items such as tankage, piping cross connections, building arrangement, availability of services (e.g., electrical, cooling water, ventilation, control functions, radiation monitoring, etc.), and staged storage and packaging of wastes. The design's flexibility helps support changes to processing strategies, advances in processing equipment and media technology, and compliance with revisions to regulatory and industry performance standards.

Staff Optimization. By expanding the capacity of the radwaste system, plant waste volumes can be managed using a standard workweek schedule (eight hours per day, five days per week) during normal plant operation. Current BWR systems operate on a 24/7 schedule. Using a standard work week optimizes staffing and delivers a very significant cost benefit over the life of the plant—more than $21 million over a 60-year span.

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