Efficiency Opportunity

December 17, 2018

Efficiency Opportunity: 18–RP–03

Reduction of Class B/C Radioactive Waste Generation and Disposal

Class B/C waste is the highest cost low level waste (LLW) stream that is routinely generated by nuclear plants. Proven optimization strategies exist to reduce the generation and disposal of this waste stream. Implementation of applicable strategies will result in significant, recurring cost savings for the site. From 2005-2013, industry metrics indicated a historical decline in Class B/C generation volumes. However, since 2014, the industry averages have been increasing, possibly indicating that the waste reduction strategies are no longer being consistently implemented. As a result, waste volumes are being generated well above the Desired End State.

Issue:

Summary of Efficiency Opportunity

- Desired end-state— PWRs should generate, on average, less than 100 ft^3/year per unit of Class B/C wet solid waste (includes filters, resins, etc). BWRs with fuel defects should generate less than 100 ft^3/year. BWRs with no fuel defects should generate, on average, near zero volumes/year per unit of Class B/C wet solid waste. Implementation of recent NRC concentration averaging methods could result in near zero volumes of Class B/C wet solid waste disposed for both BWRs and PWRs. Several plants have shown sustained performance well below industry averages, indicating significant improvement is possible. The degree to which reductions in Class B/C wet solid waste can be achieved will vary depending on site priorities, economic factors, and operating/design constraints.

- Value proposition (vision of excellence)— Radioactive waste is a recurring byproduct of operating a nuclear power plant and must be cost effectively managed. 100 ft^3 of Class B/C wet solid waste can cost, on average, $400,000 to dispose of in a LLW disposal facility. Disposal of Class A waste typically costs 10% of Class B/C waste. Implementation of proven operational strategies, innovative media applications, volume reduction methods, and utilization of updated NRC concentration averaging methods will significantly reduce the volume and cost of Class B/C wet solid waste disposal without jeopardizing operational objectives.

Relevant Standards

- U.S. Nuclear Regulatory Commission. 10 CFR Part 61
- U.S. Nuclear Regulatory Commission. Concentration Averaging and Encapsulation Branch Technical Position, Revision 1. ADAMS Accession #ML12254B065. February 2015. Vol. 1.
- *Waste Class B/C Reduction Guide, Revision 1.* EPRI, Palo Alto, CA: 2011. 1023017.
- *Radioactive Wet Waste Reduction Opportunities for Waste Class B and Class C*, EPRI, Palo Alto, CA: 2005. 1011727.

- *Implementation Guidance for the Nuclear Regulatory Commission Branch Technical Position on "Concentration Averaging and Encapsulation, Revision 1.* EPRI, Palo Alto, CA: 2016. 3002008189.
- *WasteLogic RadBench Web Application v3.0.2*. EPRI, Palo Alto, CA: 2014. 3002003994.
- *Nuclear Plant Use Advanced Approaches to Reduce Volume of Low-Level Waste*. EPRI, Palo Alto, CA: 2011. 1024575.
- *Nuclear Plants use EPRI Guidelines and On-Site Assessment to Reduce Low-Level Waste Volume and Storage Costs*. EPRI, Palo Alto, CA: 2009. 1020547.
- *Exelon Saves Millions with EPRI's Implementation Guidance on Low-Level Waste Concentration Averaging.* EPRI, Palo Alto, CA: 2017. 3002011715.

Recommended Industry Actions

- Assess site radioactive waste performance by reviewing Class B/C wet waste generation volumes and compare with other sites' volumes. EPRI's RadBench Web application (3002003994, http://radbench.epri.com) provides an efficient means for conducting this assessment. Enter site data into the application if it is not already included in the database.

- Review waste minimization strategies outlined in the EPRI reports (1023017, 1011727) and determine which strategies are most applicable to the station. Some examples are included below:

  For PWRs
  a) load less anion resin in CVCS and SFP beds
  b) consider on-line lithiation for CVCS operation
  For BWRs
  a) consider shorter RWCU run length if no fuel defects
  b) consider resin blending of RWCU with other resin if operating with fuel defects

- Create a coordinated, interdisciplinary team involving chemistry, engineering, operations, radwaste, and radiation protection to assess the feasibility of implementing each promising strategy. Develop implementation plans as appropriate.

- Review the NRC Branch Technical Position on "Concentration Averaging and Encapsulation, Revision 1" (2015) and the EPRI Implementation Guide (3002008189), and conduct a cost-benefit analysis to determine if the concentration averaging methods can be cost effectively implemented on site or if external vendor blending services are required. In some cases, changes to operational practices and/or design modifications should be considered to increase the efficiency of blending multiple waste streams on site.

- Perform an economic evaluation of filter management options. Many sites send filters to an offsite processor for shearing and cementation. Alternatively, filters can be packaged and cement encapsulated on-site. These methods allow the activity on filters to be averaged over the entire volume of the cemented waste form typically resulting in Class A waste.

Change Management Considerations

Company Actions

- Some waste minimization strategies require a coordinated, interdisciplinary effort involving chemistry, engineering, and operations to ensure no adverse impact to reactor coolant, spent fuel pool, or other system performance.

- Application of some concentration averaging methods may require changes to operation practices and/or design modifications.

Guiderails

- Several sites have successfully implemented the waste minimization strategies and concentration averaging methods for waste classification that are described in the previously referenced EPRI reports. Their successes and experiences have been documented in a few EPRI reports (1024575, 1020547, 3002011715) and may serve as good benchmarks.

Efficiencies Gained Evaluation

- The goal of this Efficiency Opportunity is to decrease the volume of Class B/C wet waste that is routinely generated by the site through the deployment of proven operational strategies, innovative media applications, and volume reduction methods. Another goal is to decrease the volume of Class B/C wet waste that needs to be disposed through the application of updated NRC concentration averaging methods.

- Using the NRC's Branch Technical Position and the new concentration averaging rules to reclassify waste, a large fleet saved in excess of $7M across their fleet as of 2017.

- Applying the techniques documented in the EPRI Guide has helped several plants substantially reduce generation of B/C waste. Examples of efficiency gains include:

  - A two-unit PWR reduced B/C waste generation by more than 50% from 159 ft^3 per year to 77 ft^3 per year.
  - A three-unit BWR avoided $1M in costs through improved segregation of Class A and Class B waste, and an additional $959,000 by carefully monitoring the dose rate of the torus de-sludge filters during a refueling outage to stay within (less-costly) Class A limits.
  - A two-unit PWR avoided $338,000 in costs by eliminating one Class C radioactive filter from a container, allowing the container to keep a Class A designation versus Class C.
  - A single-unit PWR adopted resin short loading on its spent fuel pool vessel based on the EPRI Guide's recommendations. The plant went from a 40 ft^3 bed to a 20 ft^3 bed with no reduction in bed life or water quality.
  - For additional information, see EPRI Reports 1024575 and 1020547.

Industry Review:

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