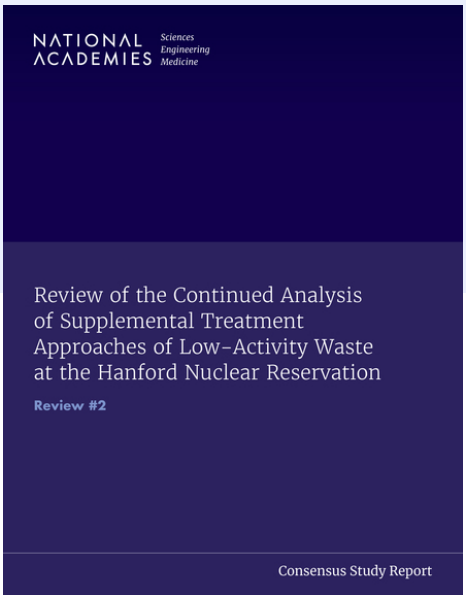
Review of the Continued Analysis of Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #2



The Hanford Nuclear Reservation, located in the state of Washington, is the site of the largest and most complex nuclear cleanup challenge in the United States. From 1944, when the first reactor produced plutonium for the Manhattan Project, until 1987, when the ninth and last reactor was shut down, Hanford produced about two-thirds of the nation's plutonium stockpile for nuclear weapons. The production processes resulted in substantial amounts of radioactive and other hazardous wastes; presently, about 56 million gallons of waste are stored in 177 underground tanks. Treating all the waste at Hanford is expected to take 40-50 years at a cost of more than $50 billion.

The U.S. Department of Energy's Office of Environmental Management (DOE-EM) is responsible for managing the cleanup. DOE plans to use vitrification, or immobilization in glass waste forms, for all of the "high-level waste" at Hanford, which comprises about 10 percent of the volume and 90 percent of the radioactivity. The remainder—about 90 percent of the volume—is designated "low-activity waste," some of which also will be vitrified. However, because of capacity limits at the new vitrification plant that DOE is building, not all of the low-activity waste can be treated there. DOE must determine how to immobilize the remaining low-activity waste—referred to as "supplemental low-activity waste" or SLAW—so that it will be safe for disposal in a near-surface disposal site.

To help inform its decision, DOE contracted with a Federally Funded Research and Development Center (FFRDC), led by Savannah River National Laboratory, to analyze and report its findings about three potential technologies for immobilizing the SLAW (see Box 1). Congress also requested that the National Academies review the commissioned report. This second review evaluates the FFRDC report in terms of its value for decision making and how well it meets various requirements specified in

BOX 1. FOUR SLAW TREATMENT TECHNOLOGIES ASSESSED BY THE FFRDC

The FFRDC reviewed four alternative approaches that are most likely to succeed that have been demonstrated at other DOE sites including Savannah River Site and Idaho National Laboratory. Vitrification is the baseline alternative for comparison to the other technologies.

1. Vitrification—a high temperature technology that blends the SLAW into a glass waste form—with disposal at the Integrated Disposal Facility (IDF) at Hanford.
2. Grouting: Grouting technology operates at room temperature (about 25) and blends the liquid SLAW with dry inorganic materials to produce a cementitious waste form. Disposal would likely occur off-site, but it could happen on-site pending regulatory approval.
3. Steam Reforming: This high temperature technology blends the liquid SLAW with dry inorganic materials at 750°C, forming dry granular mineral particles with a chemical structure that retains the radionuclides and metals. Disposal would likely occur off-site, but it could happen on-site pending regulatory approval.
4. Phased approach: This begins with off-site grouting and disposal then transitioning to on-site operations

Congressional acts related to Hanford cleanup. The review concludes that the FFRDC report is overall very strong, provides a useful framework for evaluating the technology options, and is responsive to guidance from the first National Academies review.

HANFORD TANK INTEGRITY PROGRAM

The report's authoring committee visited the Hanford site to learn about DOE's best in class program for monitoring the integrity of the single-shell and double-shell tanks where waste is stored and for taking corrective actions to preserve the tanks' integrity. In order to meet the congressional mandate to assess "the costs and risks in delays with respect to tank performance over time," the FFRDC should strengthen its report by including a description of the DOE tank integrity program with references to summarize this program's strategy and status to provide perspective for decision makers. The committee understands the tradeoffs that DOE faces in adopting an oversight, monitoring and mitigation approach that includes historical measures such as dewatering tanks and installing asphalt water intrusion barriers while making steady progress in constructing the waste treatment facilities. However, DOE's approach does involve risks if a tank's physical integrity were to fail, although that risk is likely very small.

ASSESSMENT OF THE FFRDC FRAMEWORK

The FFRDC developed a framework for evaluating each of the three options for treating SLAW by analyses based on five criteria: *1. Long-term environmental and safety effectiveness; 2. Implementation schedule and risk; 3. Likelihood of successful mission completion; 4. Lifecycle costs; 5. Securing regulatory permissions; and 6. Community and public acceptance.*

The National Academies review concludes that FFRDC analysis provides a useful framework for the decisions in that it contains structured side-by-side comparisons, using relevant criteria, of a limited number of alternatives for managing SLAW. The framework's top-level criteria are reasonable in that they are reduced in number, relevant to decision-making, and differentiate the alternatives. The hierarchy of criteria was found to be comprehensive, and the criteria were mostly independent and not duplicative of each other, so that one criterion did not have too much influence.

FUNDING AND LIFE-CYCLE COST CONSIDERATIONS

The FFRDC addressed the possibility of funding shortfalls by establishing a flat annual budget of $450 million and comparing this to the year-by-year funding requirements of SLAW treatment alternatives. The committee found that flat budget to be somewhat

arbitrary and recommended a revised approach. Instead, cost considerations should be addressed by estimating a lifecycle cost profile for constructing and operating each alternative that is designed to treat SLAW at the rate consistent with the nominal mission duration assumed in the report while accounting for the variation in construction time. The FFRDC should then compare and contrast the lifecycle cost profiles accompanied by explicitly quantified sensitivity analyses about what funding levels would be required.

While the FFRDC report attempts to address how the confluence of costs, available budgets, and technological realities affect the cleanup mission timing, this attempt is confounded by the use of assumed annual budget limits. Cost tables can be improved to be understood by a broader audience, and there are limited comparison tables and graphics. To address these problems, the FFRDC should:

i. Make defensible assumptions related to cost (e.g. capital cost, interest rates, escalation, operating cost, time to construct), calculate the cost profile for the duration of the mission, and then perform sensitivity studies on this analysis.

ii. Provide graphs depicting the amount of SLAW processed and the amount remaining each year in terms of waste volume and radioactivity, and the annual projected budget requirements for each alternative to achieve a comparable rate of SLAW processing.

REGULATORY CONSIDERATIONS

The FFRDC made a defensible decision to refrain from attempting to estimate in qualitative or quantitative terms the likelihood of specific regulatory outcomes; however, the regulatory approval criterion section would be strengthened by including a more in-depth discussion on potential challenges that may need to be addressed in obtaining the necessary regulatory approvals. The FFRDC should include a discussion of issues associated with obtaining regulatory approval for the various options. Specifically, it would be helpful to focus on the significant adverse consequences of grouted SLAW not being acceptable for disposal at IDF or other out-of-state disposal sites.

ADDRESSING PUBLIC ACCEPTANCE

The FFRDC treated public acceptance as an uncertainty to be considered by the decision makers, but the FFRDC report has little discussion or analysis of the dimensions or potential ramifications of community/public acceptance. In particular, as the SLAW alternatives now consider offsite options, and while FFRDC has received input from individuals and organizations near Hanford, it has not received input from stakeholders at other disposal locations under consideration or along transportation routes. Although the committee agrees with the report that the FFRDC should not attempt to estimate the likelihood of community and public acceptance outcomes, the FFRDC should expand its consideration of the consequences of potential impediments impacting the safe and expeditious SLAW management. The FFRDC should incorporate insights from public comments obtained to date in the final report, as well as the experiences of other sites that have transported radioactive waste to distant treatment or disposal locations.

Native American Nations and Tribes also have a unique interest in what remains on the site and the location and size of the areas that will be accessible to them following completion of treatment. The tribal representatives made a compelling case that maximizing tribal access (reducing contaminated or off-limits footprint), especially to areas of particular cultural or resource significance, is of vital interest. The FFRDC should acknowledge as a sub-criterion consideration of the location and amount of land to which tribal members are likely to have access among the four alternatives that were evaluated and include this in the discussion of community/public acceptance.

ISSUES THAT MIGHT DELAY SLAW TREATMENT

The long lead time of the vitrification option results in a much later waste treatment start date than the other options. This inevitably contributes to an increased

lifecycle cost and a higher potential for tank failure. The committee found the discussion on this observation to be lacking sufficient details in the FFRDC report. The FFRDC should give more discussion of the consequences for cost, time to completion, and likelihood of completion of the delayed start date of the vitrification treatment in their final report.

The FFRDC responded to a recommendation from the first National Academies review to incorporate the concept of parallel approaches. Parallel approaches involve the consideration of multiple, parallel, and smaller scale technologies, which would have the potential to reduce the startup time of waste treatment. In addition, such approaches could provide flexibility in disposal options such that if grouting or steam reforming are pursued, offsite disposal is more likely to be acceptable but still uncertain at this time, and if vitrification is pursued, onsite disposal appears to be a viable option. Therefore, the FFRDC's case for pursuing flexibility via multiple pathways is well founded.

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