Grouting 80% of Hanford's Tank Waste?

Hanford Challenge's Response

The U.S. Department of Energy's (DOE) December 2020 report to Congress claiming 80+% of Hanford's tank waste could be reclassified and grouted is ill-advised and should be abandoned. DOE should instead focus its efforts and resources on immobilizing tank waste in glass, as required under current law.

The Hanford nuclear site contains two-thirds of the nation's dangerous high-level waste, most of it contained in 177 underground nuclear waste tanks.

DOE Report to Congress: The Department of Energy (DOE) claims in its report that up to 80% of Hanford's high-level tank waste (HLW) could be reclassified as low-level waste. This would loosen restrictions, allowing DOE to dispose of more waste in shallow land burial.

The report claims that renaming the waste and using grout instead of glass could reduce the tank waste treatment timeline by a decade, and *potentially* save $70-200 billion dollars. The report does not explain how these cost and schedule savings were calculated. The report does not address the current legally-mandated plan to immobilize HLW in glass (vitrification) before disposing it in a yet to be sited deep geological repository.

According to DOE, "Hanford West Area tank wastes present the best opportunity to realize potential savings of $73 billion to $210 billion by treating low-activity waste by grouting, which would make the waste a candidate for other disposal sites, thus avoiding the production of thousands of canisters of vitrified waste, and decreasing the tank waste mission by at least a decade." DOE says that based on existing data and the assumptions in this evaluation, it is possible *that almost 80+% of all Hanford tank wastes* could be classified as Class C low-level waste or lower (assuming current waste characterization data is accurate) and grouted.

Legal Objections Reclassification: Under federal law (the 1982 Nuclear Waste Policy Act), High-Level Nuclear Waste shall be retrieved and permanently disposed of in a deep geologic repository (which does not yet exist). Low-Level Waste or monitored-retrievable waste, on the other hand, may be disposed of (or respectively, stored for 50 – 100 years) near the surface.

Hanford Challenge supports a fiscally responsible cleanup, but the risk of verbally converting High-Level nuclear waste into Low-Level nuclear wastes are grave. HLW is required to be vitrified and sent to a geologic repository. LLW could legally be covered with

cement and left in the shallow subsurface. Depending on the disposal site, grouting this waste could also trap leaked high-level waste in the vadose zone (ground) making it impossible to dig up this leaked waste.

Scientific and Engineering-based Objections to DOE Report: There are several unresolved scientific and engineering objections to grouting Hanford tank waste.

(1) **Waste Chemistry Uncertainty**: There is no complete laboratory analysis of what is in the 177 massive underground nuclear waste storage tanks that contain HLW at Hanford. Tank waste samples, even core samples provide some information, but it is still a limited view of what is in an individual tank.

(2) **Past Failures**: The track record for successfully grouting nuclear waste is limited, and some historic grouting operations have failed, in part from unpredictable grout-setting behavior in poorly-characterized mixtures of chemical and intensely-radioactive wastes.

Figure 1 *Hanford Tank U-104. One Example of grout/cement failure.* [i]

(3) **Uncertain Behavior of Waste Post-Burial**: DOE has stated that the chemical form and behavior of grouted waste in shallow burial, particularly where plutonium is involved, is unknown. It's assumed that grouted waste will leak into surrounding soils, possibly soon after burial. DOE can't actually predict what chemical form these leaks will take or how they'll behave.

(4) **HLW Separation Technology Uncertainties**: The critical ability to separate low-level waste from high-level wastes in underground storage tanks is speculative.

(5) **Waste in Shallow-Burial May Not Stay Put**: Successfully containing grouted waste for long-term storage in shallow burial is highly suspect, particularly if increased rainfall related to climate change, or future changes in land use and population are considered.

(6) **Nuclear Proliferation/Security Risks:** Unmonitored non-retrievable storage of plutonium-containing grout units represent a nuclear proliferation and a nuclear waste security risk.

One example of grout failure at Hanford relates to variability in predicted groundwater flow rates. As seen in a 1995 PNNL grout test report noting that fracturing in grout monoliths invalidates the models used to estimate leakage from grouted wastes. Normally groundwater would be expected to slowly diffuse through the grout monolith through a series of interconnected pores. This is the basis of the expected groundwater velocity of 0.5 to 5 cm per year. For example, the rate of groundwater flow in unfractured volcanic (igneous) rock is on the order of 0.002 cm per day and less. For fractured volcanic rock, groundwater can flow at a rate of 250 cm per day (Duffield citing Domenico & Schwartz 1990). This is a difference of nearly five orders of magnitude.

In effect, fracturing in grout due to temperature change, loading stress, imperfections in grout chemistry, ground subsidence, mechanical strain, or grout composition boundary (where anti-intrusion grouts and mechanical loading grouts meet); can cause an immediate catastrophic failure of a grout monolith. It is certainly possible that such a fracture could form during the initial pour and set of a grout lift during 'cement it and forget it' nuclear waste abandonment. This means that the grout would not only fail to survive for a millennium; rather it would not even survive its first day in place. In contrast, the report assumes that the peak dose rate for all isotopes occurs at 1,500 years, and the peak radon flux from C-Farm tank wastes occurs at 10,000 years.

Objections to Grout and Reclassification of HLW Based on Experience (after 30+ Years of Hanford cleanup): This is not the first time DOE has proposed the 'easier, faster, and cheaper' grout route for treating Hanford's tank waste. DOE argues in their report that benefits will be realized by *"reducing the higher-complexity facilities and activities and utilizing lower-complexity facilities and activities. In particular, maximizing the use of low-temperature, low-risk, grout facilities, which are well understood and have a considerable base of operating experience…."*[ii]

Clearly, our society has the technology to make both glass and concrete. Drive to the store on a concrete road, look through a glass windshield, enter a store built on a concrete foundation, and buy products packaged in glass. The problem is Hanford tank waste—it is a complex stew of radionuclides and chemicals, and that makes both glass and grout difficult to make. When it comes to Hanford waste, grout facilities are not *"well-understood."* Grout was a large component of the tank waste treatment program in the early 1990s, but was abandoned because DOE was unable to effectively and efficiently produce a solid grout waste form due to the complexities of Hanford tank waste.

The estimated cost savings in the proposal are meaningless. The only numbers are the savings themselves, accompanied by a description of the general estimation methodology. DOE does not present the cost assumptions that make up the total number. Without such transparency, the estimate has no credibility—particularly for an agency that has an extremely poor estimating record (see numerous GAO REPORTS[iv] on this topic).

DOE also relies on the unfounded assumption that grout is easier to make than glass and, therefore, will be completed faster. Grout is not categorically the wrong solution for

treating and disposing Hanford tank waste—it may ultimately play a role. But the information in DOE's report is woefully immature and, therefore, likely misleading. And DOE acknowledges that by including caveats in the report, saying it is, "*preliminary in nature and is intended to serve informational purposes only."* And the cost estimate is a *"rough order of magnitude."*

This is bureaucratic speak for, "Free Beer Tomorrow." Once research and development and design engineering are completed to support transparent, credible cost and schedule estimates, we will certainly find out grout is much more difficult, expensive, and time consuming than advertised. Don't rush to the pub tomorrow unless you've got beer money—it won't be free.

Congress, the State of Washington, and all Hanford cleanup stakeholders should not fall for DOE's latest "Free Beer Tomorrow" campaign. Instead, let's ensure DOE sticks to the agreed upon and legally-mandated plan of vitrifying Hanford's tank waste for a safe and effective cleanup of Hanford tank waste.

END NOTES:

[i] Alvarez, R., Presentation before the National Academies of Science Panel regarding Supplemental Treatment of Low-Activity Waste at the Hanford Nuclear Reservation, December 13, 2017. Diatomaceous earth was dumped into TX-116 (1970), TX-117 (1970), Tank U-104 (1971), BX-102 (1971), SX-113 (1972), and TY-106 (1972). Hundreds of tons of Portland cement were dumped into BY-105. The cement did not set in the high-caustic, high-salt liquid and no further additions of cement were made to this or any other tank.

[ii] DOE Evaluation of Potential Opportunities to Classify Certain Defense Nuclear Waste from Reprocessing as Other than High-Level Radioactive Waste Report to Congress December 2020, page 16.

[iii] *Id.*, page 16.

[iv] See, for example: 1) DOE Is Pursuing Pretreatment Alternatives, but Its Strategy Is Unclear While Costs Continue to Rise, GAO-20-363: Published: May 12, 2020. 2) PRIORITY OPEN RECOMMENDATIONS: Department of Energy, GAO-20-285PR: Published: Apr 22, 2020. 3) HANFORD WASTE TREATMENT PLANT: DOE Needs to Take Further Actions to Address Weaknesses in Its Quality Assurance Program, GAO-18-241. 4) NUCLEAR WASTE: DOE Lacks Critical Information Needed to Assess Its Tank Management Strategy at Hanford, GAO-08-793, Published: Jun 30, 2008. 5) NUCLEAR WASTE: DOE's Hanford Spent Nuclear Fuel Storage Project--Cost, Schedule, and Management Issues, RCED-99-267: Published: Sep 20, 1999.