High-Level Nuclear Waste Redefined - 10041

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INTRODUCTION

What is high-level nuclear waste? It depends upon where you look to find the language. Most statutes and discussions use a relic of the old source-based HLW definition established by the Atomic Energy Commission over 40 years ago which introduces confusion when applying more recent legislation. For example, under current policy, wastes emanating from the reprocessing of irradiated and/or spent nuclear fuel are presumed to be HLW unless formally demonstrated to not be HLW using either:

- Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), or
- One of the DOE Order 435.1 Waste Incidental to Reprocessing (WIR) processes (evaluation or citation)

Both Section 3116 and the WIR Evaluation Process require expensive treatment and extensive analyses to demonstrate that radionuclides have been removed from the subject waste stream(s) to the maximum extent practical along with extensive performance assessments and consultation with the Nuclear Regulatory Commission (NRC). Each waste determination made using Section 3116 or the WIR Evaluation Process can take three to five years to complete and can cost several million dollars.

On the other hand, Congress provided better language to DOE when it defined high-level radioactive waste (HLW) in the Nuclear Waste Policy Act of 1982 (NWPA). That definition directed government agencies to consider both the source and the hazard of wastes resulting from reprocessing spent nuclear fuel, such as is in most of the tanks at Hanford, before classifying the waste as HLW or otherwise. Literally interpreting the NWPA as Congress intended it to be, HLW is defined as:

A. the *highly radioactive material* resulting from the *reprocessing of spent nuclear fuel*, including liquid waste produced directly in reprocessing and any *solid* material derived from such liquid waste that contains *fission products in sufficient concentrations*; and

B. other *highly radioactive material* that the Commission determines by rule to require *permanent isolation*, consistent with existing law.

RESULTS

From this definition, it is clear that for a waste to be HLW it must be:

- highly radioactive,
- result from reprocessing spent nuclear fuel, and
- if a solid waste that was derived from liquid waste produced directly in reprocessing, it must contain fission products in sufficient concentrations to require permanent isolation.

The House Armed Services Committee provided the following rationale for changing the HLW definition from the prior source-based definition to a source plus hazard-based definition:

"The recommended definition takes into consideration both the source and the hazard of the waste and permits the regulatory agency responsible under law for setting standards for radioactivity (EPA) to determine the concentration of fission products and transuranic elements that require permanent isolation." [H.R. Report.97-491, Part II, at 2 and 4 (July 16, 1982)]

The House Armed Services Committee's initial hazard-based language included fission products and transuranic elements. The transuranic language was subsequently removed from the definition before the NWPA was passed. The House Armed Service Committee's notes also indicated that it was at DOE's urging that it changed the HLW definition to one that was both source and hazard based. Unlike the former source-based definition, this definition directed the responsible government agency to consider the characteristics of specific wastes before jumping to any classification decisions:

"[T]he Department believes that the definition of "high-level radioactive waste" should reflect not only the source of waste, e.g., from reprocessing, but also the relative hazard. Such a definition would permit the regulatory agencies to exclude materials from "high level radioactive waste" that need not be disposed of in a repository because of low activity" [reprinted in 1982 USCCAN 3847-3849].

In other words, it should matter what's in the waste.

This is an extremely important distinction at sites like Hanford, where tank wastes are the product of multiple early reprocessing approaches as well as multiple campaigns that removed almost half of the fission products from Hanford tank wastes for use in research and commercial enterprises. Cesium and strontium capsules, and casks containing cesium ion exchange resin, were routinely transferred to Oak Ridge from Hanford to provide cesium-137 for sealed sources and research. The result is that most of the fission products in Hanford tank wastes today are contained in only a few of the 177 underground storage tanks.

To find a conservative interpretation of "*fission products in sufficient concentrations*" the best and only reasonable place is 10 CFR Part 61, a regulation promulgated by the NRC in the 1980s that established upper limits (Class C limits) on the concentrations of fission products (and other radionuclides) that could be safely disposed of in a low-level radioactive land disposal facility. One can only conclude that if fission products below a given concentration have been deemed safe by the NRC for low-level waste disposal in a shallow landfill, then those fission product concentrations are not sufficient to require permanent isolation in a deep geologic repository with extreme treatment and barriers such as super-robust canisters and waste forms such as glass.

The NRC considered a rulemaking to implement the NWPA HLW definition by quantifying terms using metrics such as Class C concentration limits. The Commission ultimately decided not to undertake the rulemaking because it believed that the principles of waste classification were well known and that questions regarding which tank wastes were, or were not, HLW were largely limited to Hanford wastes and could be adjudicated on a case-by-case basis [58 FR 12345]. This was an unfortunate decision that has removed the flexibility needed to address these issues as they evolve. It is also most likely the reason that common sense has not prevailed in this program.

Thus, the WIR Evaluation Process has the cart before the horse, which is to be forgiven since this subject is, at best, opaque to Congress and the public. The first step should be to determine whether fission product concentrations in a final waste form from a given tank are sufficient to warrant permanent isolation. If so the waste is HLW. Otherwise, the waste is not HLW.

- If the fission products are below Class C limits but transuranic element concentrations exceed those acceptable for land disposal, that is, greater than 100 nanocuries per gram of alpha-emitting transuranic radionuclides with half-lives greater than 20 years (the actinides - Pu, Am and Np) then the waste stream would be a transuranic waste (TRU waste). We already have a licensed, permitted operating deep geologic repository for TRU waste in Carlsbad, New Mexico, called WIPP. DOE would need to take appropriate steps to designate the waste as TRU and ensure its acceptability at WIPP, something we do now for many waste streams at Hanford and across the Complex.
- If the fission products are below Class C limits and the waste does not exceed transuranic limits, the waste would be a low-level waste. In this case DOE would need to evaluate the waste against waste acceptance criteria (WAC) for various on-site and off-site disposal options it may have. This may or may not lead to secondary decisions to remove certain radionuclides (such as ^{99}Tc) to ensure WAC compliance.
- If the fission products are above Class C limits, and the waste came from *reprocessing of spent nuclear fuel*, including liquid waste produced directly in reprocessing and any *solid* material derived from such liquid waste, then it is HLW.

CONCLUSION

By these definitions, only about one million gallons of the 57 million gallons of Hanford tank waste is still HLW, and most of it is RH TRU. This should change the path forward dramatically, especially in terms of cost and schedule. With this definition, the site can easily meet the cost and schedule deadlines of the Tri-Party Agreement with existing technology and strategies, and the WTP can be completed in such a way that involves *none* of the technical uncertainties that are strangling the program in its present form. Few issues in history have involved so much unnecessary effort and cost over the details of a technical definition.

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