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# Feasibility of Direct Disposal for Electrorefiner Salt Waste

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## Abstract

For experiments on reactors breeding plutonium using fast-spectrum neutrons, the US Department of Energy (DOE) tested a fuel with a layer of metallic sodium in cladding surrounding the uranium-zirconium metallic fuel to improve heat transfer. Directly disposing of the spent nuclear fuel (SNF) from these reactors without treatment in a geologic repository is not prudent because of the potentially energetic reaction of the sodium metal with water to produce hydrogen gas and sodium hydroxide. Hence, DOE decided in 2000 to treat this sodium-bonded SNF with an electrorefiner (ER) process, which produces a metallic waste, mostly from the cladding, and a salt waste, which contains many of the actinides and fission products. For disposal in a mined repository, two baseline waste forms were developed for waste stream treatment; the metallic waste was to be cast into ingots and the salt waste further treated to form a ceramic waste form. Based on the uncertain future of the mined repository, evaluation of alternative disposal options for ER waste streams are being investigated. For example, performance assessments analyzing the disposal of ER salt waste directly (without treating it to form a glass ceramic) show that both mined repositories in salt and deep boreholes in basement crystalline rock can easily accommodate the ER salt waste. Hence the focus of the direct disposal is on the feasibility of transport. Much SNF and high-level radioactive (HLW) will be transported to a future repository; and the ER salt waste has characteristics that are similar to other HLW (e.g., the temperature range of ER salt waste is similar to that of relatively cool DOE-managed waste). A more practical question, then, is the feasibility of producing a form of the ER salt waste in the near term that is likely to be directly transportable and disposal sometime in the future using (a) the current configuration of the experimental hot cell (in which the ER treatment facility resides), (b) the existing handling hardware, and (c) commonly used handling containers. This practical question addresses the issue as to whether it is necessary to develop plans and secure funding to modify the facility in order for direct disposal of ER salt waste to be feasible. A vessel for direct disposal of ER salt waste has been proposed, designed, and a prototype manufactured based on desirable features for use in the hot cell. The analysis herein focused on the feasibility of transporting this proposed vessel and whether any issues would suggest that a smaller or larger size is more appropriate. Specifically, three issues are addressed (1) shielding necessary to reduce doses to acceptable levels; (2) the criticality potential and the ease which it can be shown to be inconsequential, and (3) temperatures of the containers in relation to acceptable cask limits. The generally positive results demonstrate that the proposed container for direct disposal of ER is feasible without the need to secure funding to modify the facility.

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