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Closing Radioactive Waste Tanks in South Carolina

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The Savannah River Site (SRS) is owned by the United States Department of Energy (DOE) and is operated by the Westinghouse Savannah River Company (WSRC). Since the early 1950s, the primary mission of the site has been to produce nuclear materials for national defense. The chemical separations processes used to recover uranium and plutonium from production reactor fuel and target assemblies in the chemical separations area at SRS generated liquid high-level radioactive waste. This waste, which now amounts to approximately 34 million gallons, is stored in underground tanks in the F- and H-Areas near the center of the site. DOE is closing the High Level Waste (HLW) tank systems, which are permitted by SCDHEC under authority of the South Carolina Pollution Control Act (SCPCA) as wastewater treatment facilities, in accordance with South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities".

To date, two HLW tank systems have been closed in place. Closure of these tanks is the first of it’s kind in the United States. This paper describes the waste tank closure methodologies, standards and regulatory background.

Tank Closure Strategy

DOE considered a number of options to close the high-level waste tanks. The most extreme option considered was to completely excavate the tanks and surrounding structures, decontaminate the equipment, and bury the dismantled tanks in a landfill or vault. This option was considered impractical because of the high cost and dangerous because of potential exposure of workers to high levels of radiation and many other hazards.

Another option was to clean the tanks to the extent practical and essentially walk away from them. The problem with this option is that after a period of time, the reinforcing bar and concrete in the roof of the tanks will eventually fail, and the tank tops will collapse. This would leave large holes in the ground, which would be hazardous, as well as open up pathways for contaminants to be blown from the tanks.

The option selected was to clean the tanks to the extent technically and economically practical, stabilize the residual contamination, and fill the void space with stable backfill materials. Thus, the tanks were essentially buried in place.

Tank Closure Regulatory Background

The SRS tank farms are regulated under an Industrial Wastewater permit issued by the state of South Carolina. The applicable regulation governing closure under this permit is SC Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities". Unfortunately, this regulation is intended for ordinary wastewater facilities, so there is virtually no guidance applicable to high-level waste closures. The tank farms are also subject to a Federal Facility Agreement among EPA, DOE and SCDHEC. This agreement specifies that high-level waste facility closures at SRS must meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

To obtain approvals for the closure process from the regulators, SRS prepared and submitted a comprehensive closure plan to SCDHEC and EPA IV. This plan detailed the proposed methodology and provided a projection of the fate of contaminants after closure. In preparing this plan, SRS did an exhaustive search of regulations and identified all applicable or relevant and appropriate requirements (ARARs). The resulting table of ARARs in the closure plan consists of 148 pages. From this long list of requirements, SRS identified how each requirement applied to the closure and developed performance standards for the closure. Early in the closure process, it became clear that the most limiting requirement would be the dose to an individual drinking water contaminated by the closure.

The exact method of closure for each tank was then described in closure modules, which were also submitted to SCDHEC for approval. Each closure module provided a discussion of the design of the closure, the environmental effects, as well as the projected long term dose to hypothetical receptors living in the area of the closure in future years.

A performance evaluation was performed for each tank to determine the environmental consequences of the closed tanks. The radiation dose to a human receptor was calculated by fate and transport modeling using the computer code called *Multimedia Environmental Pollutant Assessment System* (MEPAS). The requirement was that the cumulative dose to any potential human receptor could not exceed South Carolina standards of 4 millirem from beta-gamma radionuclides per year. As mentioned previously, the limiting pathway was drinking water, specifically a hypothetical person drinking two liters per day of water from the most contaminated credible drinking water source near the closed tanks. This 4 millirem limit, known as the performance objective, is highly dependent on the radioactive species. For example, cesium-137 is a large contributor to the overall curie content on the tank farms; however, its relatively short half-life of 37 years will not be a major contributor to the performance objective since it will not reach the point of compliance (the rivers and streams) before it decays. Plutonium-239 has a high biological effect and a long half-life (89,000 years), so its long-range contribution to the performance objective is much greater. Modeling of the species in the tank farms revealed that the Pu-239, Technetium-99, and Selenium-79 are the main dose contributors and are the *constituents of concern* described in the closure module.

In the analyzed scenario, the mobile contaminants will migrate through the soils into the underlying aquifers and travel to adjacent surface streams. The closure scenario assumes that the tank will be filled with grout with no installed features to impede rainwater inleakage. It was also assumed that the tank would degrade over time. A conservative

assumption was made that the tank top, grout, and basemat will fail completely at 1,000 years with corresponding increase in contaminant mobility via rainwater inleakage.

It was determined that the projected performance for a closed tank was at least two orders of magnitude less than the required performance objective.

Future Plans

Tank 19, which has the same structure as 17 and 20, is planned for closure within the next two years. The last tank (Tank 18) in this "4-pack" of tanks is required by regulatory agreement to be closed by 2004. All other non-compliant high level waste tanks at SRS are required to be closed between 2005 and 2022.