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PROGRESS IN RESOLVING SAVANNAH RIVER SITE HIGH-LEVEL WASTE TANK SAFETY ISSUES(U)

by

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SUMMARY

At the Savannah River Site (SRS), near Aiken, South Carolina, approximately 35 million gallons of high-level radioactive waste are stored in 51 underground, carbon steel waste tanks. These tanks and associated facilities are distributed between the F and H areas, two processing areas at SRS, and are called the F- and H-area high-level waste tank farms.

Within the last few years, issues have been raised about the safety of high-level waste tank farms throughout the DOE complex, including those at SRS. Plans for resolution of these issues were reported at the Waste Management '92 conference. This paper addresses progress made at SRS since 1992.

Most of the efforts for resolving the six safety issues identified at SRS have concentrated on 1) preparing the tanks for waste removal and 2) completing construction, testing, and starting up three key facilities. These facilities will transform the waste into forms suitable for final disposal, specifically borosilicate glass and saltstone (grout). Removing the waste from the tanks and processing it is needed to resolve three of the safety issues.

Two facilities--In-Tank Precipitation and the Defense Waste Processing Facility--are undergoing non-radioactive simulant testing ("cold runs") at this time. The third facility--Sludge Processing--began testing with actual waste in October 1993. In-Tank Precipitation is scheduled to be operating by the end of 1994.

SRS SAFETY ISSUES

The six SRS safety issues identified in the DOE High-Level Waste Storage Tank Safety Issues Report are as follows:

Priority 1

None

Priority 2

1. Storage of high-level waste in tanks that have leaked
2. Inability of waste tanks and ancillary equipment to withstand a design basis earthquake

3. Storage of high-level waste in tanks with no secondary containment

Priority 3

4. Insufficient spare tank volume to handle waste resulting from resolution of other safety issues
5. Possible inadequacies in waste transfer line leak detection
6. Potential for formation of explosive deposits

ISSUES 1, 3, AND 4: THE NEED FOR FINAL DISPOSAL OF THE WASTES

The resolution of issues 1, 3, and 4 requires removing the wastes from the affected tanks and processing them into borosilicate glass and saltstone. Each of the three issues is discussed below, followed by a discussion of the program for removing the wastes.

Issue 1: Storage of High-level Waste in Tanks That Have Leaked

Nine tanks at SRS have leaked some quantity of waste from primary containment into secondary containment pans. The leaks occurred because of nitrate stress corrosion cracking of the carbon steel tanks. One of these tanks leaked some tens of gallons of waste from its secondary containment pan to the environment in 1960. However, no evidence of leakage has been detected from the pans of the other eight tanks.

This issue has been recognized at SRS for many years. Controls have been in place since the mid-1970s to prevent further cracking. These controls include the addition of chemical inhibitors to all tanks and stress relief of the newest tanks. These controls have successfully inhibited the formation of new cracks and the propagation of existing cracks in the SRS high-level waste tanks.

Plans are to remove the waste from the tanks and then retire all nine tanks from service. In the interim, controls are in place to prevent further leaks. These controls include removal of sufficient liquid to prevent leakage, considerable surveillance, and ventilation of the secondary containment to ensure that the leaked waste remains dry and immobile.

Issue 3: Storage of High-level Waste in Tanks With No Secondary Containment

SRS has eight single-shell tanks that do not have secondary containment. The high-level wastes have been removed from these tanks, but some residue remains. Plans are to remove these eight tanks from service. However, three of the tanks must continue to be used for a number of years, primarily as surge tanks for low-level wastes generated from the high-level waste removal program.

In addition to the single-shell tanks, SRS also has nine tanks in which some amount of waste has leaked from primary containment to the secondary containment pans. Thus, only a single containment barrier exists for this small amount of leaked waste.

Plans are to remove the waste from these tanks and retire them from service.

Issue 4: Insufficient Spare Tank Volume for Resolving Other Safety Issues

Resolving issues 1 and 3 will require removing large quantities of waste from the tanks that have leaked and from the single-shell tanks. There is insufficient space in SRS tanks with acceptable secondary containment to accept this waste.

The Program for Disposing of the Wastes

As previously noted, resolving issues 1, 3, and 4 requires removing the wastes from the tanks and processing it into wasteforms suitable for final disposal. The two planned wasteforms are 1) borosilicate glass, a wasteform suitable for permanent geologic isolation in a Federal Repository, and 2) saltstone, a lower-cost grout wasteform. This program is illustrated schematically in figure 1.

SRS wastes exist in two physical forms: insoluble sludges and soluble salts. These physical forms have been segregated into separate tanks, so that some tanks contain predominantly sludge

and others predominantly salt. A different set of processes is planned for each form.

For sludge, the waste will be removed from the tanks using hydraulic slurrying techniques and sent to the three tanks dedicated to sludge processing. On some sludges (those highest in aluminum) the sludge will be treated to remove aluminum because aluminum interferes with glass production. All sludges, including those from which the aluminum has been removed, will be washed with water using hydraulic slurrying techniques. Washing removes the soluble salts from the sludge. This is necessary to limit the volume of glass produced, because the salts have limited solubility in glass. The salts that are removed will be sent to the salt tanks for further processing and eventual disposal in saltstone.

For salt, the waste will also be removed from the tanks using hydraulic slurrying techniques. Then it will be sent to four tanks dedicated to In-Tank Precipitation. In-Tank Precipitation will separate the principal radionuclides in the salt (Cs-137 and Sr-90) from the predominantly non-radioactive salts in SRS wastes. The separation will be accomplished by precipitation and absorption followed by filtration.

In-Tank Precipitation significantly reduces the cost and increases the rate of the overall waste disposal process. This is because the decontaminated salt waste passing through the filters, which is the largest volume component, is sent to saltstone, a low-cost wasteform. Only the precipitate trapped by the filters, a much smaller volume waste stream, is sent to glass. Therefore, the amount of waste sent to glass (and eventual geologic isolation) is greatly reduced.

The washed sludge and the radionuclides separated in In-Tank Precipitation will be sent to the Defense Waste Processing Facility, where the waste undergoes several more processing steps, eventually being incorporated into borosilicate glass. The glass will be stored temporarily at SRS and then later shipped to a Federal Repository.

The decontaminated salt waste will be incorporated into saltstone and will be disposed of in a landfill on the SRS site.

Progress in Processing the Sludge

The first batch of sludge to be washed was transferred into the tanks dedicated to sludge processing in the 1980s. The sludge was partially washed at that time, but processing was halted because of problems with leaking of contaminated water from the slurry pumps used to suspend the sludge.

In the summer of 1993, a program of upgrades to the pumps was completed that included containment cans to contain any water that leaks from the pumps. Sludge washing began in October 1993. Plans are to operate sludge washing in a testing mode through most of 1994 to verify the process. The tests are designed to determine key parameters such as where the pumps should be positioned for good mixing and the optimum speeds for operating the pumps.

Non-radioactive simulant testing at the Defense Waste Processing Facility began in March 1993. Several portions of the process have been tested with simulants, and plans are to test the last portion of the process, the glass melter cell, in the middle of 1994.

Progress in Processing the Salt

Facilities are in place to remove the waste from the next salt tank to undergo waste removal, Tank 41. Starting in the summer of 1994, waste is scheduled to be removed from Tank 41 and transferred to In-Tank Precipitation. Tank 41 is one of the new tanks that must be emptied to allow further processing of the wastes (Issue 4). Facilities for waste removal from tanks that are later on the schedule, such as the tanks that have leaked (Issue 1) and tanks with inadequate secondary containment (Issue 3) are being installed or are being designed at this time.

Non-radioactive simulant testing was begun on In-Tank Precipitation in late 1992. The tests have demonstrated the adequacy of the process, but a number of minor modifications are underway at this time. More testing is planned in early 1994. Start up of the In-Tank Precipitation process is scheduled for late 1994.

The Saltstone facility has been in operation for a number of years. It is currently processing salt wastes from sources outside of the high-level waste removal program.

Issue 2: Inability of waste tanks and ancillary equipment to withstand a design basis earthquake

Within the last two years, the focus of efforts to resolve this safety issue has shifted from studies on stresses in the tank during an earthquake to geotechnical studies of the soils beneath the waste tanks.

A study conducted in 1991 and 1992 suggested that the type III tanks at SRS would withstand a design basis earthquake. But the geotechnical data on which the study was based was not sufficient to meet today's requirements. A program of soil borings to obtain new geotechnical data is underway at this time. The seismic studies of the tanks will be completed once sufficient information is available about soils properties.

Issue 5: Possible Inadequacies in Transfer Line Leak Detection

In 1989, contamination was found in a localized area near an H-area concentrate transfer system line, a line that carries hot, supersaturated waste from an evaporator to a waste tank. A possible explanation for the contamination is that waste leaked from primary containment and subsequently corroded a portion of the secondary containment of the line without activating a leak detection alarm. This scenario raises the concern that current leak detection methods might be inadequate, especially for supersaturated wastes that might solidify before reaching leak detection equipment. It is also possible that the secondary containment may have failed sometime before the leak occurred in the primary.

As a result of this incident, an ongoing program was initiated to periodically test the primary and secondary containment of all transfers lines used for transfers. As a result of this program, several leaks have been successfully discovered and repaired in secondary containment systems associated with transfer lines. The program is continuing at this time.

Issue 6: Potential for the Formation of Explosive Deposits

In 1992, a comprehensive study was completed that identified all shock-sensitive or explosive deposits that could form in SRS wastes. The conclusions of the study were that SRS waste chemistry does not provide conditions required for the formation of most explosive compounds. The study identified only three classes of explosive compounds that could form in SRS wastes, and controls were already in place to limit the generation or accumulation of these compounds.

Plans are to expand the study to include more quantitative information about the quantities and concentrations of explosive compounds and potential precursor compounds. This expanded information will provide additional assurance that the hazard posed by explosive compounds is low.

The study also identified two classes of compounds that could be a concern after startup of the Defense Waste Processing Facility, the process that will convert the high-level waste into borosilicate glass. The Defense Waste Processing Facility will send a recycle stream back to the tank farms. This stream will contain new compounds not previously encountered in the tank farms. Experiments are underway to determine if these classes of compounds could be hazardous and what controls, if any, are needed. This concern will be resolved before startup of the Defense Waste Processing Facility.

CONCLUSION

Since 1992, considerable progress has been made in resolving the SRS high-level waste safety issues. Most of the progress has been the result of efforts to complete construction and start up the processes that will remove the waste from the tanks and process it into its final form, which is required to resolve three of the issues. One key process began operating in a testing mode in 1993. The startup of another key process and waste removal from the first tank is scheduled to occur by the end of 1994.

ACKNOWLEDGMENT

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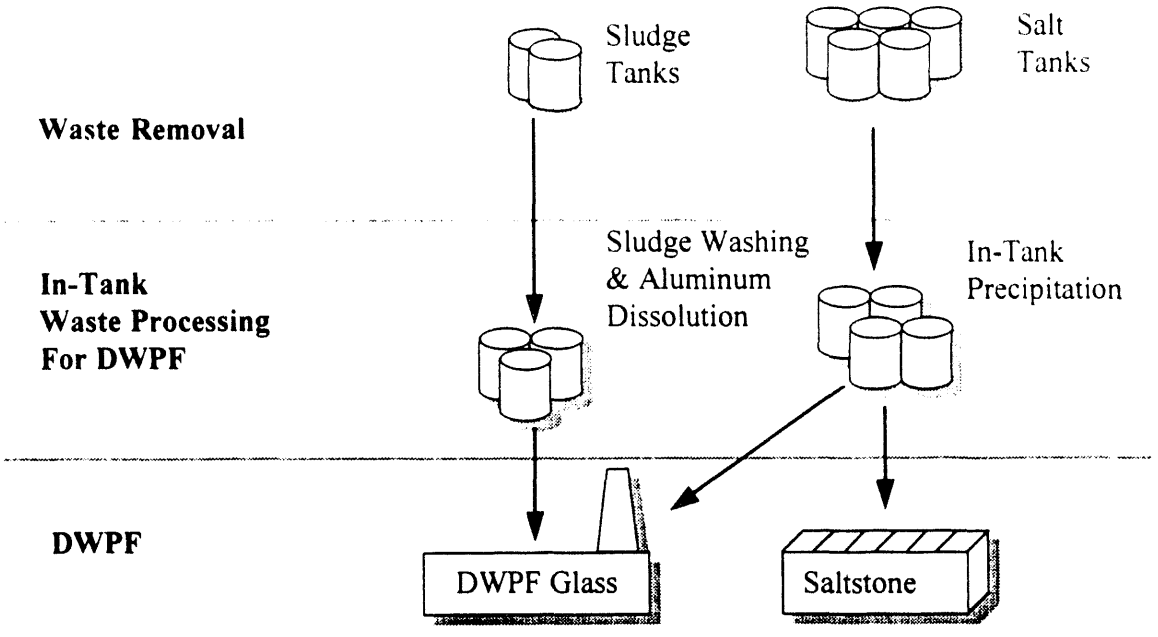
Figure 1

Program for Disposal of SRS Wastes



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