

# Liquid Nuclear Waste Facilities

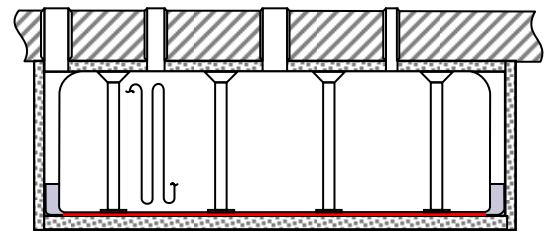
Liquid radioactive waste is generated at the Savannah River site (SRS) as byproducts from the processing of nuclear materials for national defense, research and medical programs. The waste, totaling about 38 million gallons, currently is stored in 48 underground carbon-steel waste tanks grouped into two “tank farms” at SRS.

## Tank Farms

There are four types of waste tank designs:

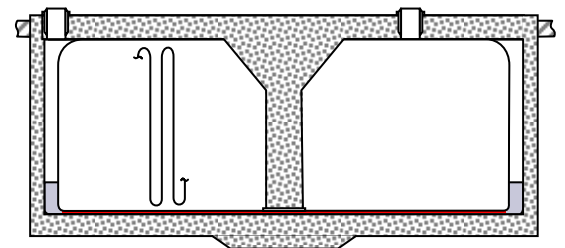
### Type I Tanks

- 12 Type I tanks were built between 1951-53
- 750,000 gallon capacity; 75 feet in diameter by 24 ½ feet high
- Partial secondary containment and leak detection
- Contain approximately 10 percent of the Site’s waste volume
- Seven Type I tanks have leaked waste into the tank annulus – a waste collection system; the amount of waste stored in these tanks is kept below the known leak sites that have appeared over the decades of operation
- Two Type I tanks are targeted for operational closure by 2015



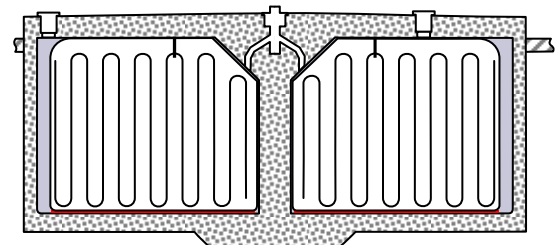
### Type II Tanks

- Four Type II tanks were built between 1955-56
- 1 million gallon capacity; 85 feet in diameter by 27 feet high
- Partial secondary containment and leak detection
- Contain approximately 3 percent of the Site’s waste volume
- Four Type II tanks have leaked waste into the tank annulus; a waste collection system; the amount of waste stored in these tanks is kept below the known leak sites that have appeared over the decades of operation



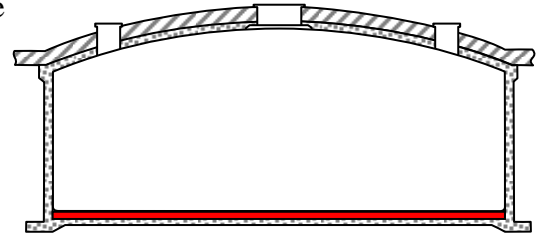
### Type III Tanks

- 27 Type III tanks were built between 1967-81
- 1.3 million gallon capacity; 85 feet in diameter by 33 feet high
- Most modern tank farm design at SRS, including heat stress relief on the tank walls to prevent cracking
- Full height secondary containment and leak detection
- Contain approximately 76 percent of the Site’s waste volume
- No Type III tanks have leaked any waste



### Type IV Tanks

- Eight Type IV tanks were built between 1953-63; two closed; two are operationally closed and two more have been cleaned of as much waste as practical
- 1.3 million gallon capacity; 85 feet in diameter by 34 feet high
- No secondary containment
- No active leak detection system
- Contain approximately 11 percent of the Site's waste volume
- Two Type IV tanks are empty and targeted for operational closure in 2012
- Two Type IV tanks were closed and grouted in 1997



The Type I, II and IV tanks do not meet current secondary containment requirements set by state regulators and will be emptied and closed first in accordance with a federal agreement. Closure of the Type III tanks, with state-of-the-art designs, will follow.

### Evaporators

While the waste is stored in the tanks, it separates into two parts: a sludge that settles on the bottom of the tank and a liquid supernate that resides on top of the sludge. The waste is reduced to about 30 percent of its original volume by evaporation. The condensed evaporator "overheads," or water removed from the waste, are transferred to the Effluent Treatment Facility for final cleanup prior to release to the environment. As the concentrate cools, a portion of it crystallizes, forming solid salt cake. The concentrated supernate and salt cake are less mobile and, therefore, less likely to escape to the environment in the event of a tank crack or leak.

SRS currently has three evaporators operating. They are:

#### **2F Evaporator, located in F Area**

- Single-stage, bent-tube design
- Began operating in 1980

#### **2H Evaporator, located in H Area**

- Single-stage, bent-tube design
- Began operating in 1982

#### **3H Evaporator, located in H Area**

- Single-stage, bent-tube design
- Began operating in 2000

Two other evaporators previously operated at SRS were decommissioned in the early 1990s.



## **Effluent Treatment Facility**

The Effluent Treatment Facility, located in H Area, treats the low-level radioactive wastewater that was formerly sent to seepage basins. Treated streams include evaporator overheads, segregated cooling water, contaminated surface water runoff, transfer line catch tank streams and others.

- Began operating in 1988
- Processes approximately 20 million gallons of wastewater per year
- Treatment processes include pH adjustment, filtration, organic removal, reverse osmosis and ion exchange
- Treated waste water streams are released to a permitted outfall

## **Waste Removal**

Sludge and salt cake must be removed from the storage tanks to be processed for ultimate closure. This process is ongoing.

- Sludge waste is removed by installing slurry mixing pumps and adding water. The pumps suspend the sludge in the water so that it can be removed.
- Salt waste is removed by installing slurry mixing pumps and adding water. The pumps circulate the water to dissolve the salt cake before it is removed.

## **Defense Waste Processing Facility**

The Defense Waste Processing Facility (DWPF), located in S Area, immobilizes the radioactive waste sludge by vitrifying it into a solid glass waste form.

- The sludge and borosilicate glass “frit” are mixed together forming melter feed for the DWPF melter.
- The sludge / precipitate / glass mixture is fed to a melter and heated to approximately 2,100 degrees Fahrenheit (1,150 degrees Celsius).
- The molten glass is poured into stainless steel canisters to cool and harden.
- Each canister is 10 feet tall and 2 feet in diameter.
- The glass canisters are sealed, decontaminated, welded shut and stored onsite in a building designed for safe interim storage until a federal repository is available.
- DWPF has poured more than 3,000 canisters since processing radioactive sludge began in March 1996.

## **Salt Waste Processing**

Removing salt waste, which fills over 90 percent of the tank space in the SRS tank farms, is a major step toward closing the Site’s 49 high-level waste tanks that contain approximately 38 million gallons of waste as of June 2011



## Interim Salt Processing

An interim salt waste processing procedure has been developed that integrates a set of salt-decontamination processes designed to eliminate nearly all of the radioactive isotopes from about 5.5 million gallons of salt solution until the Salt Waste Processing Facility (SWPF) becomes operational, which is targeted for 2014 to 2015.

This interim salt processing is being performed through two facilities, which began operation in April 2008.

- **Actinide Removal Process (ARP)**

ARP will remove long-lived radioactive contaminants, such as plutonium, americium, and strontium, by adding a chemical that attaches itself to the radioactive particles and can then be filtered out. The radioactive filtrate will then be transferred to DWPF, where it will be mixed with molten glass and poured into 10-foot-tall stainless steel canisters, which will be welded shut to be shipped later to an off-site federal repository. The remaining filtered salt solution will then be sent to MCU.

- **Modular Caustic Side Solvent Extraction Unit (MCU)**

Using principles involving centrifugal force and a special engineered solvent, MCU takes the high activity salt solution and divides it into two waste streams. The cesium is removed and sent to DWPF. The remaining decontaminated salt waste solution will be transferred to the Saltstone Production Facility to be mixed with dry cement-like materials to form a grout for safe, permanent disposal in engineered vaults.

## Salt Waste Processing Facility (SWPF)

The Salt Waste Processing Facility (SWPF) will process the majority of the Site's salt waste inventory. SWPF will treat highly radioactive salt solutions currently stored in underground tanks at the SRS and prepare these solutions for ultimate disposition. SWPF will use processes similar to those found within ARP and MCU, but on a larger scale.

SWPF will separate key high-activity radionuclides from the low-activity salt waste, using proven separation technologies of filtration and centrifugal contactors. After separation, the high-activity salt waste will be vitrified at DWPF and temporarily stored onsite until a federal repository is chosen. The remaining high-volume / low-activity salt waste will be treated and disposed of by the Saltstone Production Facility. This dual-track approach reduces the number of DWPF canisters to be filled and the facility's associated lifecycle costs.

Lessons learned from ARP and MCU processing experiences are evaluated and are factored into the design and operation of the SWPF.



## Saltstone Facility

The Saltstone Production Facility treats and permanently disposes of low-level liquid waste by stabilizing it in a solid, cement-based waste form.

- Liquid waste is combined with a dry blend of cement, slag and fly ash.
- The resulting mixture is referred to as “grout.”
- The grout is pumped to above-ground engineered Saltstone Disposal Units, where it solidifies into “saltstone.”
- Saltstone is a non-hazardous waste form.

This facility has been modified to accommodate higher radioactivity levels in support of the interim salt processing strategy. Currently, the facility has two Salt Disposal Units. One additional Salt Disposal Unit is under construction and are targeted to begin operation in 2012.

## Closing Waste Tanks

Ultimately, the vast majority of the waste in the tanks will be removed, and the tanks operationally closed. The U.S. Department of Energy, S.C. Department of Health and Environmental Control, U.S. Environmental Protection Agency, Nuclear Regulatory Commission, SRS workers and the public are working closely together to establish strict closure requirements that support all state and federal regulations for tank closure.

Closure activities begin years before the actual closing of the tanks.

Safely closing waste tanks involves an intricate set of steps that includes emptying the waste tanks of bulk waste, then removing as much of the remaining residual waste as practical through various technologies and techniques, and demonstrating that the closure is protective of human health and the environment. Once those steps are complete, the tanks can be filled with grout, a cement-like material created especially for these waste tanks. This grouting process is designed to stabilize the tank and protect the environment.

Fifteen of the 49 waste tanks are in the closure sequence with two of the 15 tanks presently being prepared for operational closure by 2012.

SRS is owned by DOE. The SRS Liquid Waste contract is managed by SRR, a team of companies led by URS Corp. with partners Bechtel National, CH2M Hill and Babcock & Wilcox. Critical subcontractors for the contract are AREVA, Energy Solutions and URS Safety Management Solutions.

*August 2011*

