



Employees of SRR, the liquid waste contractor at the DOE's Savannah River Site, monitor the grout-pour control room for the grouting of Tank 16, a radioactive liquid waste tank. (Photos courtesy of SRR)

Reducing the Risk

Closing radioactive waste tanks at the Savannah River Site is a multistep process involving federal and state regulators, along with other stakeholders.

By Colleen Welch

The federal nuclear reservation, Savannah River Site, located in South Carolina, is performing work in radioactive liquid waste disposition and tank closure that was almost unheard of six years ago. The U.S. Department of Energy began a new focus on the way to handle this waste by contracting a company to focus solely on that effort.

Enter Savannah River Remediation (SRR), which is currently filling its fifth waste tank with grout, the final stage of operational tank closure for a liquid waste tank. Making it to this point takes a number of steps—layers of complexity not easily seen.

Beginning with a tradition of safety, the liquid waste mission is a culmination of steps and examination from all entities—federal and state regulators, plus stakeholders—involved. Each layer builds off the next and the steps are sometimes serial, sometimes parallel, but always working together to craft a real-life story of success unheard of in many places in our nation or in the world. The liquid waste mission involves positive interaction with operational diligence, state regulatory agency compliance, and an overall value of safety.

As with most long-term missions, the SRS liquid waste mission has a rich history that began long before the first

SRR employees prepare the piping that is used to fill Tank 16 with grout. Tank 16 will be the fifth waste tank closed since 2012 by the contractor.





Cement trucks line up on June 2, 2015, to begin filling Tank 16 with specially formulated grout.

tank was ever closed. The history of SRS is the foundation of this mission. Beginning more than 60 years ago, the Savannah River Site set the stage for environmental cleanup of Cold War-era waste.

History of SRS

SRS, located near Aiken, S.C., was a product of the Cold War. Owned by the DOE, the 310-square-mile nuclear site was built in the early 1950s. President Harry Truman ordered the construction of what was then the Savannah River Plant—or just “the bomb plant,” as locals called it—to support national defense programs. SRS was built to produce basic material used in the fabrication of nuclear weapons, primarily tritium and plutonium-239. Five reactors and two chemical-separations facilities were built to meet the nuclear proliferation needs of the Cold War. The waste from the facilities needed to be managed, so underground carbon-steel waste storage tanks were built to hold the liquid radioactive material. Averaging around 1 million gallons each, the 45 tanks (down from the original 51 tanks) now hold about 37 million gallons of waste—almost five decades worth—from the Cold War era.

There are four different tank designs at SRS: Type I, Type II, Type III/IIIA, and Type IV (Type III/IIIA is considered one tank type). Built between 1954 and 1980, the tanks are designed to safely store radioactive waste. Lessons learned from early tank construction led to innovations in tank design and better means of containing the waste to provide human and environmental protection. Type IV tanks have no secondary

containment systems. Type I and II tanks, including Tank 16, each have a reinforced concrete vault with a 5-foot-high annular secondary pan, much like a cup and saucer arrangement. During its use, the annulus was designed to contain any leaks that may have developed in the primary tank wall. Types I and II, known as “old-style” tanks, are a top priority for operational closure. Constructed in 1956, Tank 16, the tank now being filled with grout, is the first closure of a Type II tank.

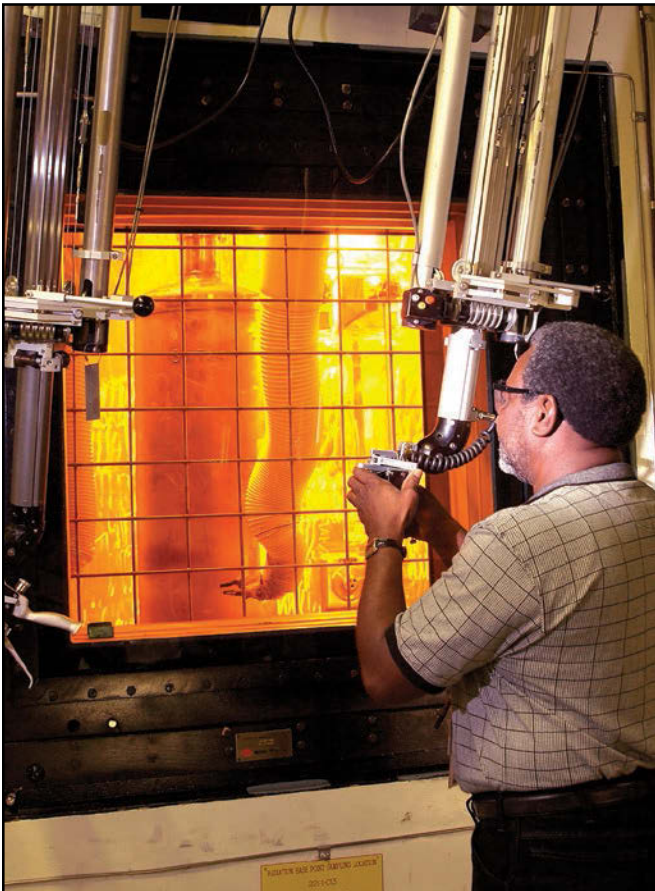
The old-style tank closure schedule and deadlines are outlined in a federal facility agreement (FFA) signed by the DOE, the South Carolina Department of Health and Environmental Control (SCDHEC), and the Environmental Protection Agency (EPA). The agreement is to remove old-style tanks from service, a significant step toward the country’s efforts to safely handle the Cold War legacy waste and to reduce the risk to employees, the public, and the environment. In 2009, the DOE contracted SRR to focus on this work. SRR is led by AECOM, with partners Bechtel, CH2M, and Babcock & Wilcox, with critical subcontractors Areva and URS Professional Services.

Tank closure process

The grouting of Tank 16 is a significant milestone for the liquid waste mission. Tank 16 is the first tank that will be closed in H Tank Farm, the seventh tank closed at SRS, and the fifth closure under the SRR contract. The first six tanks cleaned and closed were in F Tank Farm. The initial two (Tanks 17 and 20) were closed in 1997 under a legacy company of SRR and were the first two radioactive waste storage



A cement truck begins the initial pouring of grout into Tank 16 at the Savannah River Site on June 2.



A worker inspects a canister through a 4-foot-thick oiled glass at the SRS Defense Waste Processing Facility. The facility, operating since 1996, vitrifies high-level waste for safe storage.

tanks closed in the nation. Tanks 18 and 19 were filled in 2012 and were the first to be closed under the SRR contract. The more recent two tanks operationally closed under SRR's lead were Tanks 5 and 6 in 2013.

But tank closure does not happen overnight. Fieldwork (operational diligence) is the second layer of the tank-closure complexity. The fieldwork focuses on safely transferring the waste out of the tanks to other compliant tanks. The disposition of the liquid waste can be boiled down into two phases: waste removal and tank stabilization. While those are simple terms, the process is still a part of that detailed complex of methodology outlined in the FFA.

SRR's bottom line in tank closure is to safely and efficiently reduce risk through waste disposition, said Stuart MacVean, SRR president and project manager.

"While we have reached and continue to reach many other waste removal milestones during our mission, tank closure is one key way we document our success at Savannah River Remediation," MacVean said.

Waste removal

While in the tank, the radioactive liquid waste separates into two main constituents known as salt waste and sludge. The salt waste, with its lower levels of radioactivity, makes up about 90 percent of the volume in the tanks and contains approximately 50 percent of the tank's entire radioactivity. The sludge, which settles to the bottom of the tank, contains the other half of the radioactivity while filling only about 10 percent of the tank's volume. The sludge, which resembles peanut butter in texture, contains the heavy metals of the waste



High-activity liquid waste from the waste tanks at SRS goes to the DWPF, where it is vitrified, then stored in these 10-foot-tall stainless steel canisters. A forklift operator transports an empty canister.

and has the higher levels of radioactivity.

When removed from the tank, the sludge is sent to the Defense Waste Processing Facility (DWPF) where it is mixed with a borosilicate glass in order to be vitrified. The vitrified waste is poured into 10-foot-tall stainless steel canisters and is safely stored in an on-site interim facility until a federal repository is designated.

The salt waste, which contains small amounts of sludge, is treated at the interim salt processing facilities: the Actinide Removal Process (ARP) and the Modular Caustic Side Solvent Extraction Unit (MCU), both built in 2008. The ARP removes the radioactive contaminants and sends the particles to the DWPF. The MCU divides the salt solution into two waste streams: the high-activity waste is sent to the DWPF, and the decontaminated salt waste is sent to the Saltstone Production facilities. Here, the waste is mixed with dry cementitious materials to form a cement-like grout that is poured into on-site disposal cells. The waste will cure over time to form a long-lasting, nonhazardous waste form.

Once the bulk of the waste is removed, efforts turn to the residual waste leftover in the tank. Residual waste sticks to the sides and bottom of the tank over time and is referred to as the “heel.” Both mechanical and chemical techniques are used to remove the heel to the maximum extent possible. High-pressure hydro-spray from robots is used to remotely clean the inside of the tanks. Sometimes acid is used as well, depending on the tank type.

SRR robots are used in the high-level waste tanks for three reasons. One, the robots can traverse the tank bottoms where humans are unable to work safely. Two, robots are able to effectively help clean the residual waste in the tanks. And third, the robots collect samples of the residuals for analysis

to confirm that the tanks are ready to be closed.

Tank cleaning is not complete until the DOE and regulators are satisfied that the tanks are clean enough to grout.

Stabilization

Tank 16 has journeyed through the entire waste removal process, as well as decommissioning and isolation from the rest of the Tank Farm complex. The next step is stabilization, which begins when the specially formulated grout is ready to be poured into the tank. For this job, cement trucks began entering SRS on June 2, 2015. Up to six trucks per hour, eight hours a day, four days a week, have traversed H Tank Farm this past summer. More than 70 SRR workers, contractors, and construction employees are playing a part in Tank 16’s stabilization activities to ensure the residual waste is immobilized. The stabilized tank will reduce the risk to employees, the public, and the environment.

The final closure activities include grouting the tank’s equipment and riser openings at the top of the structure. The grouting of Tank 16 was slated to be completed by late August 2015.

Working with state regulators

Tank closure is a large and important mission and also one that is not free from legal compliance. The operational work of dispositioning waste and cleaning tanks is the first step of the overall two-step process. Alongside the fieldwork step,



Glass Waste Storage Building 1 at SRS is the interim storage facility for vitrified waste after being treated at the DWPF. The vehicle, called the shielded canister transporter, transports canisters one-by-one from DWPF to the Glass Waste Storage Buildings.

SRR is working with the customer (the DOE) and state regulators to ensure that every nuance of the work receives the right vetting, explanation, and understanding.

Developing partnerships with the outside agencies is another integral layer of the tank closure process. Tank closure at SRR would not see its first steps without approval from state regulatory agencies. The legal process of tank closure involves three primary parties—DOE, EPA, and SCDHEC—and implements federal and state requirements and agreements.

The FFA between the DOE, EPA, and SCDHEC requires that four tanks be closed before September 30, 2015. Tanks 5 and 6 met this mark in 2013; Tanks 16 and 12 received an extension to October 27, 2015, and May 30, 2016, respectively, with a recent dispute resolution agreement reached between the DOE, EPA, and SCDHEC. Both are on schedule to be closed by the extended deadline.

“Grouting Tank 16 says a great deal about the partnerships necessary to close SRS waste tanks,” said Jim Folk, DOE-Savannah River acting assistant manager for waste disposition.

“The filling of this tank with grout is the result of good communications and teamwork between the DOE, SRR, SCDHEC, and EPA.”

Regulatory agencies ensure that every step is carefully documented and is consistent with the governing laws and agreements in place. Therefore, it is imperative that SRR maintains an open, interactive partnership with its customer and state regulators.

Open relations with the customer have been proven to reap positive rewards. For example, the DOE has successfully negotiated extensions for Tank 16, and the next tank, Tank 12, which is slated for grouting next spring. According to Victor Franklin, SRR general counsel and waste determinations official, this agreement came because SCDHEC, the DOE, and SRR all agree on a closure vision and on milestones.

Safety culture

Safety has always been and continues to be at the forefront of any SRR mission. Boasting millions of hours of work without a lost-time injury during its first six years as the liquid waste contractor, SRR’s liquid waste mission is one of the safest projects in the DOE complex. In addition, SRR’s construction workforce has reached more than 27.2 million hours without a lost-time injury, a 16-year streak dating back to June 1998.

“Safety is the price of admission,” said President MacVean. “We know the real reason for safety is so we can go home in the same condition we arrived to work.”

The mission is far from finished at SRR, but the path forward is clear, and Tank 16 is a monumental step in this long-term environmental cleanup process. Lessons learned from Tank 16 and other past tank closures will aid in accelerating the pace in which future tanks can reach operational closure. According to MacVean, the SRR mission is successful because of the employees on the ground, ensuring liquid waste operations progress safely every single day.

SRR is using lessons learned from past tank closures, current operations, and partnering with outside agencies to improve future tank closure. One of these lessons is maintaining interactive, two-way communication with the regulators. Understanding the agreement between contractor and customer is imperative to moving forward in any project—no matter what the industry. Safety, transparency, and communication—and a healthy supply of grout—are the tools used to ensure the mission gets done and gets done well.

Ultimately, cleaning and closing these waste tanks reduces the risk to everyone, and that’s the right thing to do.

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