Chapter 2

Environmental Management

Al Mamatey
Environmental Protection Department

Dean Campbell
Public/Employee Communications Department

George Morris
Facilities Decontamination/ Decommissioning Program

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ENVIRONMENTAL restoration, waste management, and facility disposition at the Savannah River Site (SRS) are part of the U.S. Department of Energy's (DOE) Environmental Management program, which was established in 1989 to address the environmental legacy of nuclear weapons production and other sources of potential pollutants, such as nuclear research. Progress continued in all three facets of the environmental management program during 2001. This chapter provides a brief overview of the high-level waste management and facility disposition activities and describes some of their major 2001 milestones. Details of environmental restoration and solid waste program activities can be found in the two divisions' annual reports, which also are accessible on this CD. These programs reflect the site's ongoing efforts to ensure the safety of its workers, the public, and the surrounding environment.

"Environmental restoration" involves the assessment and cleanup of inactive waste units and groundwater (remediation). "Cleanup" means actions taken to deal with the release or potential release of hazardous substances. This may refer to complete removal of a substance, or it may mean stabilizing, containing, or otherwise treating the substance so it will not affect human health or the environment [DOE EM, 1991]. Determining the most environmentally sound methods of cleaning up waste units is a major focus of the SRS environmental restoration program.

"Waste management" refers to the safe, effective management of various kinds of nonhazardous, hazardous, and radioactive waste generated on site. Identifying the need for appropriate waste management facilities and ensuring their availability have been major components of the SRS waste management program.

"Facility disposition" encompasses the management of SRS excess facilities—from completion of operations shutdown through final disposition—in a way that minimizes facility life cycle costs without compromising health, safety, or environmental quality.

Regulatory Compliance

Applicable environmental management guidelines can be found in appendix A, "Applicable Guidelines, Standards, and Regulations."

High-Level Waste Management

"High-level waste" is highly radioactive liquid waste that results primarily from the reprocessing of spent nuclear fuel. This category includes liquid waste produced directly in reprocessing. The waste contains both transuranic waste and fission products in concentrations requiring permanent isolation from the environment.

SRS continues to manage approximately 38 million gallons of high-level liquid radioactive waste (about 400 million curies), which is stored in 49 large, shielded, and partially underground tanks grouped into two "tank farms." Twenty-nine tanks are located in the H-Area Tank Farm and 20 in the F-Area Tank Farm. All SRS tanks are built of carbon steel inside reinforced concrete containment vaults.

The major waste streams in the F-Area and H-Area tank farms include transfers from the canyons, receipts from the Receiving Basin for Offsite Fuels, and a low-activity waste stream from the Defense Waste Processing Facility (DWPF).

High-Level Waste Facilities

The F-Area and H-Area tank farms consist of large underground storage tanks that hold high-level liquid radioactive waste. Fresh waste received from the processing of the spent nuclear fuel separates into two parts, as follows:

- a sludge (which contains most of the radioactivity) that settles on the bottom of the tank
- a watery "supernate" that occupies the area above the sludge

The supernate is transferred to an evaporator system, where it is processed further. The evaporator system reduces this supernate to 30 percent of its original volume. The concentrated supernate that remains eventually will form a solid as it is cooled. This solid, commonly known as salt cake, generally resides in the evaporator concentrate tanks. The sludge layer remains in its original tank until a sludge processing campaign is executed.

Both F-Area and H-Area have their own evaporator systems. F-Area has one operating system (2F) while H-Area has two (2H and 3H). These evaporators reclaimed about 2.8 millions gallons of tank farm space in 2001.

SRS has successfully conducted this space reclamation operation in the tank farms since 1960, when the first evaporator facilities began operation. More than 100 million gallons of space have been reclaimed during this time. Without these evaporator systems, SRS would have required 86 additional waste storage tanks—at $50 million apiece—to store waste produced over the site's lifetime.

The Extended Sludge Processing Facility, one of two DWPF pretreatment operations in the High-Level Waste Division, washes sludge (settled insoluble waste) to reduce the concentration of sodium salts, which ensures glass quality when the sludge is processed at DWPF. In 2001, the facility finished processing the second of 10 sludge batches that will be required to vitrify all the high-level waste sludge, and continued preparation of the third sludge batch. Three million gallons of sludge must be pretreated in this manner.

The washed and decanted sludge is transferred to DWPF as part of "sludge only" operations. DWPF then processes the sludge from the original waste by combining it with glass frit. The mixture is heated until it melts, then is poured into stainless steel canisters to cool. The glass-like solid that forms contains the highly radioactive material and seals it off from the environment. Another word for this process is "vitrification." The sealed canisters will be stored at SRS until a federal repository is established.

The Salt Processing Facility, the second pretreatment operation for DWPF, was expected to process the salt cake and highly concentrated supernate waste (the result of the evaporation process) in tanks. However, work on salt processing was suspended in January 1998 because of technical issues with the system.

In October 2001, DOE approved a record of decision for the SRS Salt Processing Alternative Supplemental Environmental Impact Statement, identifying caustic side solvent extraction (CSSX) as the technology to be used for separation of radioactive cesium from SRS high-level waste salt.

In December 2001, a request for proposal was issued by DOE for a two-phased design/build process for design, construction and commissioning of a Salt Waste Processing Facility using CSSX technology. In parallel, DOE is evaluating the implementation of other salt processing alternatives for specific waste portions that would not need to be processed in the CSSX facility. The evaluation of alternatives and potential operations would be undertaken to maintain operational capacity and flexibility in the high-level waste system and to meet commitments for the closure of high-level waste tanks.

Accomplishments

SRS continued to manage its high-level waste facilities in support of the integrated high-level waste removal program in 2001.

Tank Farms

The tank farm evaporators recovered more than 2.8 million gallons of tank space in 2001 through evaporation of the watery supernate that resides atop the sludge in the tanks. The 2H evaporator system contributed 200,000 gallons to the recovery of space during 2001. The 3H evaporator system recovered more than 1.9 million gallons during the year, while the 2F evaporator system recovered more than 700,000 gallons. One of the keys to this achievement was an interarea line used to transfer waste from H-Area to F-Area via a 2-mile underground system. Approximately 1.6 million gallons of radioactive waste were transferred via the interarea line during 2001.

Modifications to the evaporator systems and tank farms ensured the continuation of safe operations in 2001—without affecting productivity. Also, Tank 49, which was out of service because it formerly was used in salt separation activities, has been returned to service, adding more than 1 million gallons of storage space to the tank farms.

DWPF

The successful processing of radioactive sludge continued in 2001. DWPF produced 195 canisters of immobilized high-level waste during the year, bringing the total to 1,220 canisters since radioactive processing began in March 1996.

DWPF will continue processing sludge until the "precipitate" from one of the salt processing alternatives is available. Approximately 220 canisters of glass are expected to be produced in 2002.

Facility Disposition

Deactivation and Decommissioning

With the reduced need for a large U.S. nuclear weapons stockpile, many SRS facilities no longer are required to produce or process nuclear materials. These inactive facilities must be placed in a safe, low-cost condition and properly maintained until they can be safely disposed.

SRS has approximately 126 inactive facilities, and many others are expected to be declared inactive within the next decade. These facilities range in size and complexity from large nuclear reactors to small storage buildings. Many site facilities have underground structures, storage tanks, and piping that require a large amount of excavation to access; some are more than 100 feet high. Many contain residual materials that could be hazardous to workers, the public, and the environment if improperly handled or stored. Others are located within the site's nuclear industrial areas—surrounded by buildings that are occupied or still being used—which makes their demolition extremely difficult. SRS faces a significant challenge in the safe maintenance, surveillance, cleanup, and disposition of these inactive facilities.

At SRS, Facilities Decontamination and Decommissioning program (FDD, formerly the Facilities Disposition Division) personnel manage the disposition phase of a surplus facility's life cycle in a manner that considers life cycle costs without compromising either (1) the health or safety of workers and the public or (2) the quality of the environment. The disposition phase begins upon completion of operations shutdown and extends through establishment of the facility's end state.

The facility disposition process consists of three activities, as follows:

- *Deactivation*, which places a facility in a known, safe, and stable configuration by removing hazardous chemical and radioactive materials, shutting down or mothballing the equipment, and mitigating other hazardous conditions.
- *Safe storage*, which is a dormant period involving only surveillance and maintenance (S&M) of the facility to ensure the continued safety of workers, the public, and the environment. S&M activities are performed during the entire disposition process to ensure that all structures, systems, and materials are monitored adequately and that a safe configuration is maintained.
- *Decommissioning*, which places the facility in its end state. This could involve decontamination, dismantlement, or some other activity to make the land available for either unrestricted use or limited applications. If not released for unrestricted use, institutional controls will be established and maintained under DOE's long-term stewardship program to ensure the safety of the public and the environment.

SRS has continued to manage the disposition of its surplus facilities safely through its Inactive-Facilities Risk Management Program. The immediate goal is to remove hazardous materials from surplus facilities and to place the facilities in a safe and stable condition. The site continues to seek opportunities to reuse these facilities for mission-related activities, as well as for other industrial uses. An S&M program is established and maintained to ensure that no facility deteriorates to the point that it becomes dangerous to workers or threatens the public and the environment with a release of hazardous materials.

Disposition Program Management

The WSRC Facility Disposition Procedure Manual, developed and issued in 1999, provides a consistent, disciplined process for facility disposition activities. The procedures are consistent with DOE's Life Cycle Asset Management System requirements and employ a graded approach to ensure cost effectiveness. FDD continues to provide management and direction to the WSRC Facilities and Assets Disposition Management Council, which coordinates the disposition processes across the site's operating divisions.

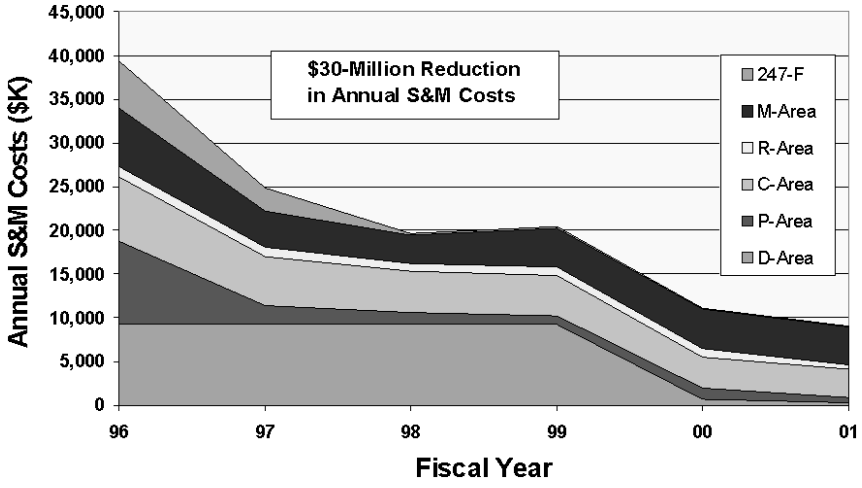
Facility Disposition Long-Range Planning

In 2000, FDD developed and implemented a standardized facility disposition long-range planning process integrated with DOE's long-term stewardship program. The process was developed to form a consistent basis for planning and estimating the cost of long-range facility disposition activities. The National Deactivation and Decommissioning Committee is pursuing use of this program to form the basis for a standardized facility disposition long-range planning process for DOE complexwide application.

Figure 2–1 Reduced Hazards with Reduced Costs

Facility shutdowns, risk reduction actions, and deactivation and decommissioning projects have combined to significantly reduce potential environmental hazards at SRS while cutting the annual cost of performing the surveillance and maintenance of FDD's inactive facilities to less than $10 million since 1996.

FDD Graphic (modified)



Accomplishments

Facility Transitions

FDD accepted custodial responsibility for an additional 12 facilities from other operating divisions during 2001. Ten of these were TNX facilities, with the custodial responsibility shifted as part of a 3-year program to transfer personnel out of T-Area. The transfer of 19 additional TNX facilities, planned for 2002, will complete the multiyear transfer program.

During the past 5 years, the cost to provide S&M for facilities in C-Area, D-Area, M-Area, P-Area, and R-Area has been reduced from more than $39 million to less than $10 million through similar shutdown and deactivation activities (figure 2–1).

Inactive-Facilities Risk Management Program

The WSRC Inactive-Facilities Risk Management Program augments the more traditional approach of conducting complete facility deactivation projects with a program that ensures that the limited funding available is directed toward reducing the greatest hazards, regardless of the facility in which the hazards are located.

Forty-one risk reduction actions were accomplished at 19 different facilities in 2001. These actions have reduced the risk assessment score for these facilities by more than 50 percent (figure 2–2).

As part of the annual program process, FDD personnel

- performed 81 detailed facility assessments
- updated the Inactive-Facilities Risk Ranked Priority List
- developed corrective action plans for the significant hazards identified
- planned 28 risk reduction actions for 2002

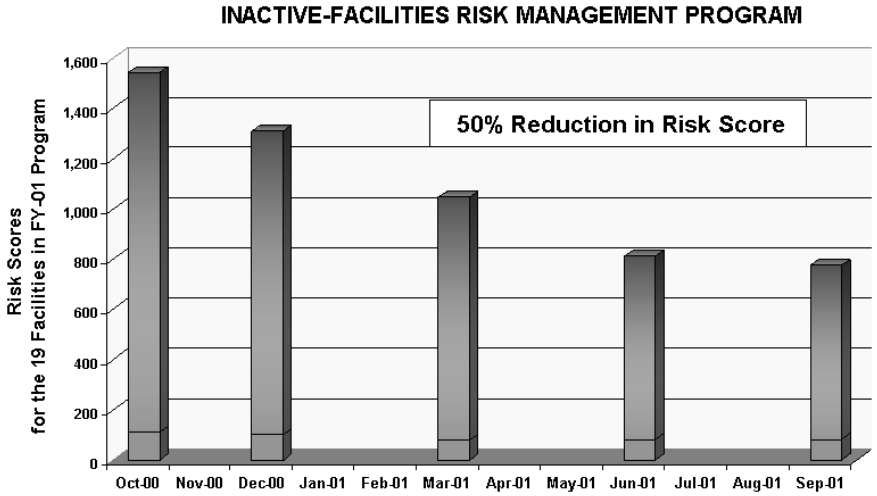


Figure 2–2 Facility Risk Management

The site's Inactive-Facilities Risk Management Program involved 19 SRS facilities in FY–01. Forty-one risk reduction actions were accomplished in these facilities; the completed actions reduced the total risk assessment score for the 19 facilities by approximately 50 percent (1543 to 776).

FDD Graphic (modified)

Disposition of Inactive Facilities

Major facility disposition activities conducted at SRS during 2001 included substantial progress on the 321–M Fuel Fabrication Facility, the 341–8M Vendor Treatment Facility, the R-Area Reactor Disassembly Basin, and the 284–F Powerhouse. A brief summary of the status of each of these facilities follows.

321-M Fuel Fabrication Facility

Highly enriched uranium was removed from the 321–M Fuel Fabrication Facility beginning in 2000 to the extent necessary to eliminate any potential for criticality and to allow reclassification of the facility from "radiological" to "other industrial." This removal project was completed in 2001, and subsequent deactivation actions are proceeding.

Vendor Treatment Facility

The goal to deinventory and decontaminate the Vendor Treatment Facility and place it in a passively safe condition was met in 2001. Deactivation activities included flushing and draining the melter, process lines, and tanks. All residual chemicals, samples, materials, tools, and miscellaneous equipment were removed from the facility.

The completed work required no significant decontamination or fixing of radioactive contamination. Pathways were sealed to prevent the migration of contamination out of the facility, and the remaining equipment in the facility was abandoned in place without the need for additional decontamination. All utilities were turned off or disconnected, placing the facility into a cold, dark, and secure condition, with only an annual building entry required.

R-Area Reactor Disassembly Basin

The demonstration of two parallel selective ion-exchange process systems to remove cesium and strontium from the R-Area Reactor Disassembly Basin was conducted in 2001. The demonstration showed that the systems were capable of reducing concentrations of cesium and strontium below DOE release limits.

This basin contains a large volume of water contaminated with fission products (cesium, strontium, and tritium). The ion-exchange process systems had been initiated in 2000 under a federally funded demonstration to remove a large part of the cesium and strontium. The systems were deployed under an Accelerated Site Technology Deployment project sponsored by DOE's Environmental Management Office of Science and Technology. The water was processed through the systems and returned to the basin. At the conclusion of the 2001 demonstration, the systems proved successful in removing approximately 80 percent of the cesium and strontium in a relatively brief time period, and in showing that the isotope levels could be reduced to near or below U.S. Environmental Protection Agency drinking water standards, which would be sufficient to allow release to normal surface streams. However, a decision since has been made not to release the basin water to surface waters regardless of radioisotope concentrations.

An interim deactivation project was begun in 2001 at the R-Area Reactor Disassembly Basin to stabilize hazards and reduce the potential for leakage. The project also is designed to reduce stewardship costs and to place the facility into a long-term, passively safe condition.

Removal of 284–F Powerhouse

WSRC placed a contract in May 2000 to dismantle and remove the 284–F Powerhouse—one of the highest-risk-ranked inactive facilities at SRS. Completed in 2001, the contract employed an assets-for-services approach that applied surplus government assets from the K-Area Cooling Tower and the 247–F Naval Fuels Manufacturing Facility to partially offset the cost of removing the powerhouse.

The contract was placed for less than $600,000, and the work was completed for less than $800,000—a savings of about $2.5 million over the estimated cost of $3.3 million to remove the powerhouse and other surplus equipment using site personnel.

During the past 4 years, FDD personnel have successfully used the assets-for-services approach to accomplish approximately $11.1 million in disposition services for an expenditure of about $1.1 million. This program has reduced surplus facilities at SRS by about 71,000 square feet.

Decontamination Facility Operations

FDD operates the Decontamination Facility to provide cost-effective decontamination and equipment size-reduction services for all WSRC divisions. These operations provide a valuable service for the SRS recycling and waste minimization programs.

The Decontamination Facility had its most productive year in 2001, with cost savings approaching $7.6 million. The savings were generated by

- processing more than 13,600 cubic feet of contaminated equipment and materials, including two trackhoes and two bulldozers
- rolling back more than 38,000 square feet of contaminated areas, including five waste tanks at the SRS Tank Farms, to radiologically controlled or buffered areas
- minimizing waste primarily through a 5-month project to repackage small solid waste boxes into larger drums prior to storage and disposal

New Decontamination Facility Technologies

FDD works closely with DOE's Environmental Management Office of Science and Technology, the National Energy Technology Laboratory, and the Savannah River Technology Center to review and deploy technologies that can lower costs, increase employee efficiency and safety, help eliminate waste production, and promote pollution prevention. Two of these technologies involve a remote-operations size-reduction system and a remotely controlled hydraulic shears machine.

Size Reduction SRS has identified a need for size-reduction capabilities to dispose of a growing quantity of large, contaminated equipment, to provide improved second-sort capabilities, and to size-reduce newly generated waste. A system (the remote-operations size-reduction system, also known as "ROSRS") was designed and constructed at a cost of approximately $9.5 million for use at the Rocky Flats Environmental Test Site Closure Project to size-reduce a variety of plutonium-contaminated gloveboxes. With deployment of the system cancelled primarily because of mission changes at Rocky Flats, SRS requested and was awarded the system in 2001 for use at the site's Decontamination Facility. The system has remotely operated size-reduction and material handling capabilities in a fully contained and ventilated environment.

Hydraulic Shears The Decontamination Facility also obtained a remotely controlled, tracked vehicle in 2001 that can be fitted with hydraulic shears. This configuration allows large components to be segmented while the operator remains in a safe location. The equipment was used to size-reduce contaminated large equipment during 2001, and although it can be taken anywhere on site, its primary use will be for various size-reduction tasks at the Decontamination Facility.