This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U.S. Department of Energy.

SDD-2007-00165

Decommissioning of the 247-F Fuel Manufacturing Facility at the Savannah River Site (SRS)

Joseph K. Santos and Stephen M. Chostner

Washington Savannah River Company (WSRC), Savannah River Site, Aiken, SC 29808
joe.santos@srs.gov and stephen.chostner@srs.gov

INTRODUCTION

Building 247-F at SRS was a roughly 110,000 ft^2 two-story facility designed and constructed during the height of the cold war naval buildup to provide additional naval nuclear fuel manufacturing capacity in early 1980s. The building layout is shown in Fig. 1. A photograph of the facility is shown in Fig. 2. The manufacturing process employed a wide variety of acids, bases, and other hazardous materials. As the cold war wound down, the need for naval fuel declined. Consequently, the facility was shut down and underwent initial deactivation. All process systems were flushed with water and drained using the existing process drain valves. However, since these drains were not always installed at the lowest point in piping and equipment systems, a significant volume of liquid remained after initial deactivation was completed in 1990. At that time, a non-destructive assay of the process area identified approximately 17 (+/- 100%) kg of uranium held up in equipment and piping.

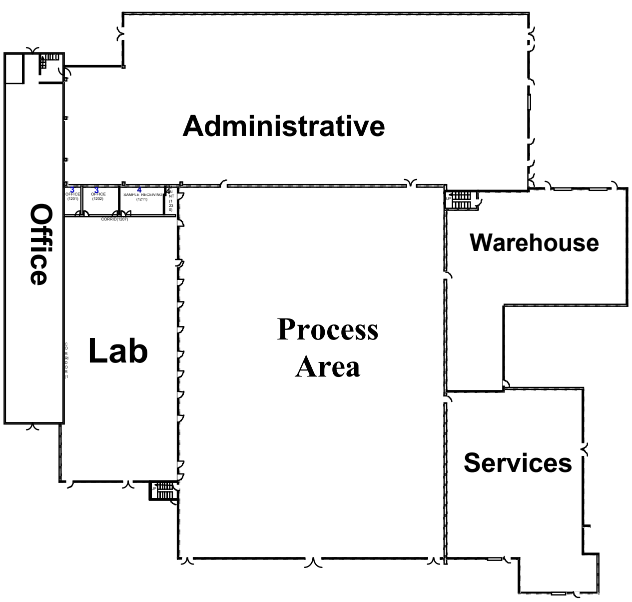

Fig. 1. Building 247-F layout.

The facility was placed in Surveillance and Maintenance mode until 2003, when the decision was made to perform final deactivation and then decommission the facility.

Fig. 2. Building 247-F prior to deactivation, seen from the southwest.

DESCRIPTION OF THE ACTUAL WORK

The disposition of building 247-F was managed as the 247-F D&D Project. As the name indicates, the project scope included both a deactivation phase and a decommissioning phase.

Disposition of excess facilities at SRS is managed under the WSRC *Facility Disposition Manual*, 1C. [1] This manual defines activities necessary to deactivate and decommission facilities in accordance with DOE Guides G 430.1-3 and G 430.1-4. [2], [3]

Deactivation Phase of Project

Deactivation is defined as the process of placing a contaminated excess facility in a stable condition to minimize risks to workers, the public and the environment. As required, a deactivation project manager was assigned and a deactivation project plan was prepared. [1], [2]

Preparation of this plan involved:

- Identification of residual hazards in the facility
- Definition of project goals and objectives
- Determination of deactivation endpoints
- Development of a scope of work, cost estimate and schedule to achieve the selected endpoints

Identification of Residual Hazards

Hazards expected to be encountered during deactivation were identified and evaluated using the following standard SRS methods by teams of knowledgeable project personnel led by Washington Safety Management Solutions, the hazards assessment sub-contractor for WSRC:

- Consolidated Hazard Analysis
- Auditable Safety Analysis
- Deactivation Fire Hazards Analysis
- Hazards Assessment Document

The above analyses generally concluded the risks resulting from 247-F deactivation activities were mainly borne by the local worker as result of exposure to residual process materials during equipment and piping removal. In contrast, risks to offsite receptors were insignificant.

The SRS excess facility disposition program uses a graded approach to requirements whereby the level of effort and commitment of resources is commensurate with the size and complexity of the facility. The measure of a facility's importance to safety is its facility hazard category as defined in DOE-STD-1027-92. The hazardous material inventory available for dispersion from the facility varies with the hazard category, with Nuclear facilities being the most hazardous, Radiological or Chemical facilities moderately hazardous, and Other Industrial or clean facilities being the least hazardous. Nuclear facilities are further subdivided into Hazard Categories 1, 2, and 3, the highest to the lowest risk, based on inventory.

Deactivation Endpoints Development

The Department of Energy (DOE) requires development of detailed deactivation endpoints for facility systems, spaces and major equipment is required. [1]

The DOE/EM-0318 manual describes two methods for determining these end points; the "hierarchical method", which is to be used for large or complex facilities, and the "checklist method", which is suitable for smaller and simpler facilities. [4]

The "hierarchical method" end points development method is normally used for Nuclear Facilities of Hazard Category 2 or higher. All other facilities must have end points determined by the "checklist method".

Due to the low inventory of radiological constituents prior to deactivation, building 247-F met the criteria for a categorization as a Radiological facility. Consequently, the checklist method of developing endpoints was used.

Scope of Work, Cost, and Schedule Development

In order to effectively achieve the desired endpoints, the 247-F facility and associated structures were partitioned into approximately 100 geographical zones. The main process area, which was historically known as the process core contained 82 of these zones.

A work breakdown structure (WBS) was developed with four main deactivation work elements.

- Baseline preparation - project site setup, zone deactivation sequencing, and waste management and safety evaluations
- Asset and equipment removal from the non-core zones
- Equipment removal from the core zones
- Disposal of 501 legacy shipping containers found in the facility

Regulatory Approval

The South Carolina Department of Health and Environmental Control (SCDHEC) has primary environmental regulatory authority for all activities at SRS. Like any other activity at SRS, the deactivation of building 247-F had to be executed in such a way that planned and unplanned releases to land, air and surface water were within the approved site permit limits. Other than these general regulatory requirements, SCDHEC has no specific regulatory authority over deactivation activities at SRS facilities.

During deactivation, releases to air and surface water complied with existing permits issued by SCDHEC. During deactivation of the 247-F complex, all radioactive, hazardous, mixed and sanitary waste was removed from the facilities and disposed of per the appropriate regulations.

Decommissioning Phase

By July 2005, essentially all the radiological inventory was removed from the facility. The hazard category of the facility was then downgraded form Radiological to Other Industrial. This action had major ramifications for the management of decommissioning phase of the project as described in the section below.

All the deactivation endpoints were completed by September 2005, allowing the project to transition to the decommissioning phase.

Regulatory Approval

DOE has decided on the use of Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Non-Time-Critical Removal Action as the approach for decommissioning SRS facilities, using the tailored process negotiated with the Environmental Protection Agency (EPA), unless circumstances at the facility make it inappropriate. DOE Savannah River (DOE-SR) is the lead agency for CERCLA actions at SRS. DOE-SR, SCDHEC, and EPA, have agreed that DOE-SR will perform decommissioning work under its lead agency authority. SRS will seek regulatory participation in this process through concurrence of the Facility Decommissioning Evaluation (FDE) and the Decommissioning Project Final Report (DPFR). Concurrence means that the information provided is acceptable to the SCDHEC and EPA. Concurrence by the regulators is provided in writing for each document. DOE and the regulators work collaboratively to resolve any document comments. If comments cannot be resolved, DOE may elect to continue work execution, as planned. The regulators may elect to use the SRS Federal Facility Agreement Site Evaluation Process to address unresolved comments.

A 22 step process is defined, which is taken as the model for decommissioning facilities at SRS. [3]

The 22 step framework for decommissioning is applied differently, depending on the facility hazard category. The degree of complexity and rigor ranges from the Engineering Evaluation/Cost Analysis (EE/CA) Model for Nuclear facilities, to the Streamlined Model for Radiological and Chemical facilities, to the Integrated Sampling Model for Other Industrial facilities to the Simple Model for Clean facilities.

In general, decommissioning of Nuclear facilities Hazard Category 2 or 3 will be conducted as a CERCLA non-time-critical removal action. This is accomplished by the preparation of an EE/CA, as prescribed by CERCLA regulations. The EE/CA is put into the public record by DOE-SR, and review and comments are solicited from stakeholders.

For facilities that are classified Radiological, Chemical (High Hazard), or Chemical (Low Hazard), decommissioning will be accomplished in a streamlined manner, using simplified documentation that is similar to what is required by the Nuclear Regulatory Commission for commercial nuclear facilities. An Analysis of Decommissioning Alternatives is prepared, which addresses the same evaluation factors as an EE/CA, but in a more simplified manner.

Facilities classified as Other Industrial hazard category are those that have a small amount of contamination arising from their operational history. These follow the Integrated Sampling Model. That model is identical to the Simple Model described below, except for the requirement to perform a final verification characterization to demonstrate that residual contamination is within acceptable limits.

For clean facilities, the only safety risks associated with the decommissioning are risks to the workers that arise from standard industrial hazards. The same is true for facilities in the Other Industrial hazard category, unless there have been releases to the environment from the facility, or it had been downgraded from a higher hazard category. In that case, the project may be required to follow the Streamlined model described above, i.e. an Analysis of Decommissioning Alternatives.

The specific model to be followed by a project is determined by the FDE. After deactivation of the buildings comprising the 247-F complex with resultant inventory removal and hazard category downgrade, FDEs were prepared for all the buildings. The FDEs determined that building 247-F itself and a supporting chemical process building, 247-7F would be decommissioned following the Integrated Sampling Model. Since all other buildings were Clean, uncontaminated facilities, they would follow the Simple Model. The documents were transmitted to the regulators for concurrence per the above agreement.

The decommissioning end state of the buildings that comprised the 247-F complex required that the structures be demolished to the building slab. South Carolina regulation 61-86.1, Standards of Performance for Asbestos Projects, mandates that the owner/operator of a building to be demolished provide SCDHEC with written notice of intent to demolish at least 10 working days in advance of the demolition.

Decommissioning activities were subject to the same limitations on environmental releases as described for deactivation activities. Decommissioning waste was also subject to the same management and disposal requirements described in that section for deactivation wastes.

During decommissioning, releases to air and surface water complied with existing SCDHEC permits. After decommissioning, a single DPFR for the 247-F complex was transmitted to the regulators for concurrence.

During demolition all facilities were demolished to slab. The demolition waste was removed from the site and disposed of per the appropriate regulations.

Fig. 3. Building 247-F after decommissioning, seen from perspective as in Fig. 2. Note location of yellow bollards in both figures.

RESULTS/LESSONS LEARNED

The following lessons were learned as a result of the D&D of building 247-F. Successful D&D of a major radiochemical process building requires significant upfront planning by a team of knowledgeable personnel led by a strong project manager. The level of uncertainty and resultant risk to timely, cost effective project execution was found to be high. Examples of the types of problems whose scope and consequent impact on cost and schedule include:

Unknown Extent of Undrained Equipment

Low level and sanitary waste acceptance criteria do not allow free liquids in waste containers. These liquids, which are often corrosive, must be safely removed from the equipment before it is loaded to waste containers. Drained liquids must be properly managed, often as hazardous or mixed waste. Tapping and draining of process lines is a dangerous operation, which must be performed carefully. The temptation to become complacent when breaking into lines is great. Incidents of personnel exposure to liquids during draining are likely.

Though records from the initial 1990 deactivation led early work planners to assume the facility was cold, dark and dry. This turned out to be a poor assumption. Work instructions were modified to require that engineers evaluate each of several hundred process lines to identify the low point, where a tap and drain system could be installed to allow positive verification that the line was empty before the line was cut for removal.

Mold Hazards

During the period when 247-F building was shut down, roof leaks had developed, allowing rain water to enter the building, which provided an environment for mold growth. Sampling confirmed the presence of *Stachybotrys chartarum*, a toxic indoor mold that grows on wet cellulosic material, such as drywall paper. D&D workers in areas where this hazard was identified were required to where proper personal protective equipment, which complicated work execution.

Uniquely Hazardous Chemicals

Discovery of the potential presence of uniquely hazardous chemicals such as shock sensitive compounds and toxic uranium hexafluoride became issues which required investigation and special handling strategies. Team access to subject matter experts, who could quickly provide the required guidance for safe material handling, was critical to keeping the project on schedule.

Mechanical and Electrical Isolation

In old legacy facilities, it is possible that the D&D workers will be exposed to undocumented energy sources such as energized electrical conductors and pipes containing hazardous materials that originate outside the boundaries of the facility. Significant effort must be expended on adequate mechanical and electrical isolation.

Waste Management and Disposal

Waste management must be carefully planned. The rate of waste generation as the facility is converted from a structure to waste can frequently exceed the D&D team's resources to characterize, package, store and transport the waste to a disposal facility in a timely manner. This can lead to schedule delays and/or increased project cost. [1]

REFERENCES

1. "Procedure Manual 1C Facility Disposition," Westinghouse Savannah River Company, Aiken, South Carolina (2006).
2. "Deactivation Implementation Guide G 430.1-3," U.S. Department of Energy, Washington D.C., (1999)
3. "Decommissioning Implementation Guide G 430.1-4," U.S. Department of Energy, Washington D.C., (1999)
4. "Facility Deactivation Guide Methods and Practices Handbook DOE/EM-0318," U.S. Department of Energy, Washington D.C.