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Establishment Of The Final End State For Decommissioning Of Reactors At SRS: Collaboration Between Stakeholders, Regulators, And The Federal Government – 15279

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ABSTRACT

The Savannah River Site (SRS) is an 802 square-kilometer (310 square-mile) United States Department of Energy (USDOE) nuclear facility located along the Savannah River near Aiken, South Carolina. Nuclear weapons material production began in the early 1950s, utilizing five (5) production reactors. In the early 1990s all SRS production reactor operations were terminated.

The first reactor closure end-state declaration was documented in a Comprehensive Environmental Response and Compensation and Liability Act (CERCLA) Early Action Record of Decision. The decision for the final closure of the 29,543 square-meter (318,000 square-foot) 105-P Reactor was determined to be in situ decommissioning (ISD). ISD is an acceptable and cost-effective alternative to off-site disposal for the reactor building, which will allow for consolidation of remedial action wastes generated from other cleanup activities within the P Area.

ISD is considered protective by the regulators, U.S. Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC), public and stakeholders as waste materials are stabilized / immobilized, and radioactivity is allowed to naturally decay, thus preventing future exposure to the environment. Stakeholder buy-in was critical in the upfront planning in order to achieve this monumental final decision. Numerous public meetings and workshops were held in two different states (covering a 321 kilometer (200-mile) radius) with stakeholder and SRS Citizens Advisory Board (CAB) participation. These meetings were conducted over an eight- month period as the end-state decision making progressed. Information provided to the public evolved from workshop to workshop as data became available and public input from the public meetings were gathered.

ISD is being considered for the balance of the four (4) SRS reactors and other hardened facilities such as the chemical Separation Facilities (canyons).

Closure of the SRS P Reactor Area was precedent setting and sets the stage for closure of other reactors and hardened facilities. The DOE, USEPA, and SCDHEC engaged in active, up-front, and timely involvement with the SRS.

The SRS CAB, elected officials, and citizens of South Carolina and Georgia met to discuss the P reactor area closure and associated risks. Early public involvement gave SRS and the regulators assurance that the selected decision was valid and would not be overturned. Public input improved the process and made sure that the important decision on the final end-state of the reactor facilities was not made in a vacuum. ISD of P Reactor will provide adequate protection of human health and the environment and the lowest cost since short-term risk is minimized to remedial workers from exposure to contaminated equipment and facilities by leaving the reactor vessel in place allowing for radiological decay over time.

INTRODUCTION

The SRS is a USDOE nuclear facility located along the Savannah River near Aiken, South Carolina. Construction of SRS began in the early 1950s to enhance the nation's nuclear weapons capability. Nuclear weapons material production began in the early 1950s, eventually utilizing five (5) production reactors constructed to support the national defense mission. SRS is located in the sandhills in Aiken, Barnwell, and Allendale counties of South Carolina. SRS is bounded by the Savannah River that runs between Georgia and South Carolina to the Atlantic Ocean at Savannah, Georgia, nearly 160 kilometers (100-miles) downstream of SRS.

The towns of Aiken, North Augusta, New Ellenton, and Jackson, South Carolina and Augusta, Georgia are closest to SRS; however, SRS operations spark interest in the citizens from the nearby communities as well as those all the way to the coast, including the downstream cities of Savannah, Georgia and Hilton Head, Charleston, and Beaufort, South Carolina.

With the end of the cold war, after 40 years of producing nuclear materials for defense and non-defense uses, the USDOE shifted its strategic direction. In the early 1990s, SRS production reactor operations were officially terminated. This change in mission shifted SRS focus from reactor and nuclear materials production to environmental cleanup and management. Environmental remediation work gained momentum, and by 2002, more than half the waste disposal areas had been completed. At this point, SRS also initiated an aggressive deactivation, decommissioning, and demolition (D&D) program.

In their focus on waste unit cleanup and D&D activities, SRS and the regulators recognized that with a shift in how the two (2) programs were being implemented, opportunities existed to accelerate both programs while also reducing the lifecycle costs. In May 2003, the USDOE, the USEPA, and SCDHEC signed a Memorandum of Agreement (MOA) to support accelerated cleanup of the SRS using an Area Completion strategy for cleanup. The SRS Federal Facility Agreement (FFA) and cleanup milestones were renegotiated to support the Area Completion strategy.

Under the Area Completion strategy, SRS uses an Area Operable Unit (AOU) concept to clean up and close large industrial areas of the Site. This strategy integrates D&D activities and soil and groundwater characterization, assessment, and remediation functions in each of the 14 SRS industrial areas to realize efficiencies of scale in the characterization, assessment, and remediation activities.

There are five (5) reactor areas (P, R, C, K and L) that will undergo closure under Area Completion requirements consistent with the SRS FFA. The SRS reactors were built in the 1950s and 1960s and are extremely robust since they were designed and constructed to resist seismic and blast events. P and R Areas were the first reactor areas to undergo the Area Completion process and are located approximately (~) 4 kilometers (2.5-mi) east-southeast of the geographical center of SRS and about 6 kilometers (4-mi) west of the nearest site boundary. The areas have been unoccupied since the early 1990s when the decision was made to place the reactors in cold standby (i.e., never re-start the reactor). Both P and R Areas have been designated as having no future mission and thus, deactivation and decommissioning activities were initiated in these areas in the mid 2000 time-frame. The final decommissioning of these facilities was completed, five (5) to six (6) years ahead of the respective baseline schedules thanks to American Recovery and Reinvestment Act (ARRA) funding.

105-P/105-R REACTOR BUILDINGS

Similar to the other SRS reactors, P/R Reactors produced special nuclear materials for defense programs. To characterize the facilities, concrete samples were collected throughout the building along with water and sludge samples.

In addition, radiological surveys were also performed. Modeling determined the radiological inventory within the reactor vessel. In P area, the reactor vessel has been estimated to contain 211,000 curies (Ci) of neutron-activated metal and concrete. The balance of the building (including contaminated concrete and process related equipment), along with the disassembly basin (DB), contained ~28,800 Ci **(Figure 1)**. Overall, tritium is responsible for ~99% of concrete contamination throughout the buildings. Approximately 88% of the radiological inventory in the reactor buildings is contained within the activated matrix of the stainless steel reactor vessels and associated concrete biological and thermal shields.

Between 90-95% of the radioactivity from 105-P will be decayed within 100 years and 99.9% within 1,000 years. Structural analysis of the both the P and R Area buildings reveals that the building roof will last ~1,400 years provided maintenance activities such as vegetation removal are performed.

Groundwater impacts were analyzed utilizing a tiered modeling approach. The intent was to determine if contaminants remaining in the facilities would pose an impact to groundwater over time. Modeling results showed that leaving the contaminants within the facilities would provide for groundwater conditions that are protective of human health and the environment for the long term.

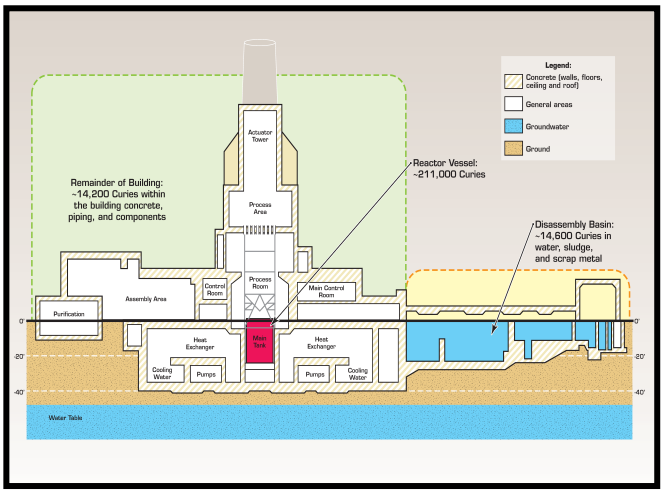

Figure 1. Savannah River Site P Reactor Cross Section

PUBLIC INVOLVMENT AND REMEDY SELECTION

SRS, USEPA, and SCDHEC recognized very early in discussions on selecting cleanup remedies for the P-Area Operable Unit (PAOU), that public acceptance of the final end-state for P Reactor would be critical. The parties recognized that any action selected for P Reactor would require stakeholder support and endorsement. While the sheer magnitude and complexity of the P Reactor and the nuclear processes that were conducted in the facility made the public involvement process daunting, the regulators and SRS committed to establishing a public involvement process that allowed complete and thorough understanding of the P Reactor and its various possible end-states.

The three parties approached the SRS CAB to discuss opportunities and options for PAOU public involvement. Understanding the significance of closing the first SRS reactor and that decisions made for P Reactor would be precedent setting for other SRS reactors and hardened facilities, the CAB formally recommended that SRS, USEPA, and SCDHEC enter into an extensive public involvement process to

solicit stakeholder input on the P Reactor end-state decision. Further, the CAB recommended that the public involvement activities should focus not only on stakeholders in the immediate vicinity of the SRS, but also those living and working downstream of the SRS to the Atlantic coastal area. Upon receiving the recommendation, SRS and the regulators agreed to maintain active information exchange sessions with the CAB and public and to host workshops designed to help the CAB and public assess the potential end-states for P Reactor.

In designing an effective public involvement program for this activity, SRS and the regulators understood there were several key attributes that would be required to effectively engage the stakeholders.

- Education about the history of the reactor facility, including construction details and operational history
- Current conditions of the reactor facility, such as the structural integrity
- Inventory of wastes and nuclear materials and equipment in the reactor facility
- Description of the 14 waste units within the 40 hectare (100-acre) footprint of P Area that must be addressed and the contamination associated with each of the waste units
- Geologic conditions, including depth to groundwater, receptor points, migration pathways
- The regulatory required process to clean up the 14 waste units
- Typical reactor closure techniques used for commercial reactors
- Evaluation of each of the options that could be used to close the reactor facility, focusing primarily on cost and risk reduction
- Evaluation of post closure care and monitoring options designed to provide long term protection of human health and the environment.

Over the next few years, SRS and the regulators deployed a public involvement process that enabled stakeholders to provide educated, meaningful, and timely input into the remedy selection process for the PAOU, and specifically for the selected end-state of the
P Reactor. SRS developed specific communication tools, including posters, presentations, and animated graphics aimed at making the information regarding the complicated reactor facility and its past operations and current conditions “stakeholder friendly”. Public involvement activities that were conducted included tours of the Reactor, three workshops in Aiken, South Carolina and Savannah, Georgia, nearly 10 briefings to the SRS CAB, and one-on-one meetings with stakeholders who needed additional information. These same approaches were used in the public involvement process for closure of the R-Reactor Operable Unit.

An advantage of performing this extensive public involvement process over several years was the public was given sufficient time to become informed on this complex topic so the input process was not rushed. In the summer of 2008, the SRS CAB and members of the general public provided SRS and the regulators with their input to support the remedial action selection for the reactor facility. The public endorsed leaving the reactor building in place while stabilizing the below-ground portions of the facility with grout to minimize contaminant migration. This approach was determined to be not only the most cost-effective approach, but also one that provided long term protection to human health and the environment. This input was used to select the final action for the reactor facility; additionally, stakeholders provided input for the cleanup of the waste units in the
100-acre P Area.

DESCRIPTION OF THE SELECTED REMEDY

In situ reactor decommissioning consisted of minimal removal actions whereby the structure remains basically intact. The stack was removed and all of the below-grade equipment, including the vessel, was grouted in place. The DB was demolished above grade, contents grouted in place, and covered. **Figure 2** illustrates the before and after end-state. The selected ISD remedy avoided an additional $200M expenditure versus complete removal of the building.

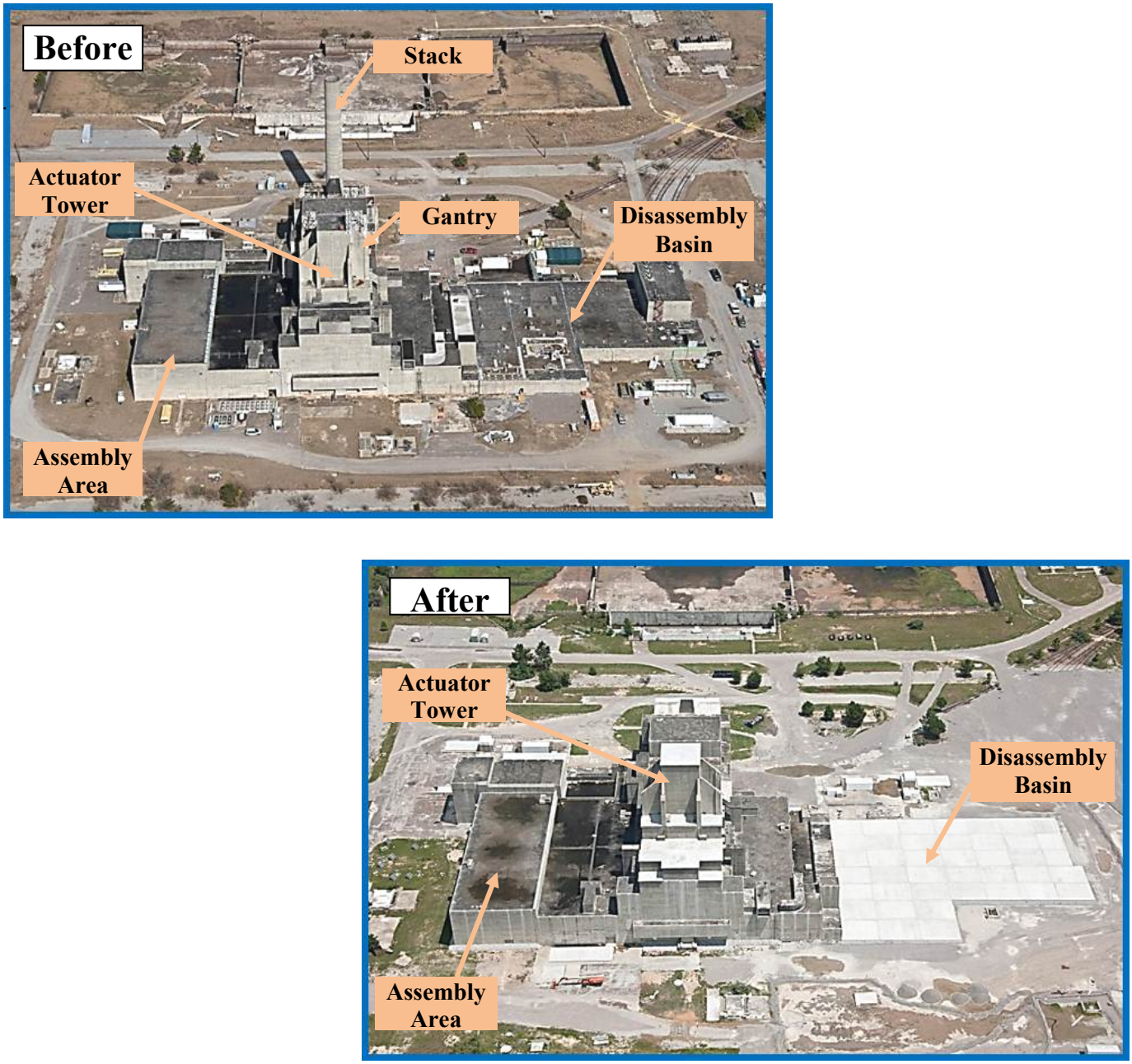

Figure 2. Pre and Post Decommissioning

CONCLUSIONS

Closure of the SRS P Reactor Area was precedent setting and sets the stage for closure of other reactors and hardened facilities. The DOE, USEPA, and SCDHEC engaged in active, up-front, and timely involvement with the SRS.

The SRS CAB, elected officials, and citizens of South Carolina and Georgia met to discuss the P reactor area closure and associated risks. Early public involvement gave SRS and the regulators assurance that the selected decision was valid and would not be overturned.

Public input improved the process and made sure that the important decision on the final end-state of the reactor facilities was not made in a vacuum. ISD of P Reactor will provide adequate protection of human health and the environment and the lowest cost since short-term risk is minimized to remedial workers from exposure to contaminated equipment and facilities by leaving the reactor vessel in place allowing for radiological decay over time.