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FROM CONCEPT TO REALITY
IN-SITU DECOMMISSIONING OF THE P AND R REACTORS AT THE SAVANNAH RIVER SITE (SRS)

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INTRODUCTION

SRS recently completed an approximately three year effort to decommission two SRS reactors: P-Reactor (Building 105-P) and R-Reactor (Building 105-R). Completed in December 2011, the concurrent decommissionings marked the completion of two relatively complex and difficult facility disposition projects at the SRS. Buildings 105-P and 105-R began operating as production reactors in the early 1950s with the mission of producing weapons material (e.g., tritium and plutonium-239). The "P" Reactor and was shutdown in 1991 while the "R" Reactor and was shutdown in 1964. In the intervening period between shutdown and deactivation & decommissioning (D&D), Buildings 105-P and 105-R saw limited use (e.g., storage of excess heavy water and depleted uranium oxide).

For Building 105-P, deactivation was initiated in April 2007 and was essentially complete by June 2010. For Building 105-R, deactivation was initiated in August 2008 and was essentially complete by September 2010. For both buildings, the primary objective of deactivation was to remove/mitigate hazards associated with the remaining hazardous materials, and thus prepare the buildings for in-situ decommissioning. Deactivation removed the following hazardous materials to the extent practical: combustibles/flammables, residual heavy water, acids, friable asbestos (as needed to protect workers performing deactivation and decommissioning), miscellaneous chemicals, lead/brass components, Freon®, oils, mercury/PCB containing components, mold and some radiologically-contaminated equipment. In addition to the removal of hazardous materials, deactivation included the removal of hazardous energy, exterior metallic components (representing an immediate fall hazard), and historical artifacts along with the evaporation of water from the two Disassembly Basins. Finally, so as to facilitate occupancy during the subsequent in-situ decommissioning, deactivation implemented repairs to the buildings and provided temporary power.

DESCRIPTION OF THE ACTUAL WORK

Initial alternatives analyses and end state definition were completed for Buildings 105-P and 105-R in 2004 and 2006, respectively. Shortly thereafter, supporting structural analyses were completed. The structural analyses determined that the robust, reinforced-concrete structures would stay relatively intact for up to 500 years provided (1) the gantry cranes for the shield doors were removed, (2) the stacks were demolished, and (3) new concrete roofs were placed over critical areas of the building.

The Building 105-P in-situ decommissioning was conducted as an "early action remedial action" under CERCLA, while the Building 105-R in-situ decommissioning was conducted as a "removal action" under CERCLA. For both in-situ decommissionings, removal/early actions supported comprehensive P-Area and R-Area *remedial* actions that addressed all structures and media within the respective areas. In support of the 105-P early action, an Early Action Remedial Action Implementation Plan (EARAIP) was prepared in late 2009 after issuance of a "record of decision" (ROD) for the 105-P in-situ decommissioning, which was issued in early 2009. In support of the 105-R removal action, an Engineering Evaluation/Cost Analysis (EE/CAs) was prepared. The corresponding action memorandum for the 105-R removal action was issued in early 2010.

The early action at 105-P had the following objectives:

- Minimize human and ecological exposure to unacceptable risk associated with radiological and hazardous constituents that are or may be present;
- Prevent migration of radiological and chemical contamination from the buildings to groundwater to the extent practicable; and
- Eliminate or control all routes of human exposure to radiological or chemical contamination.

The removal action at 105-R had the following objectives:

- Prevent industrial worker exposure to radioactive or hazardous contamination exceeding "principal threat source material" (PTSM) levels or that exceed a 1.0E-06 risk for an industrial worker;

- Prevent the migration of radioactive or hazardous contaminants from the building to the groundwater at concentrations that exceed regulatory standards (maximum contaminant levels or preliminary remediation goals) to the extent practical; and
- Prevent animal intruder exposure to radioactive and hazardous contamination.

Figure 1 – Building 105-R Looking East (Disassembly Basin Concrete Cap in the Foreground and Sealed Building 105-R in the Background with Stack/Grantry Removed and Roofs Modified)

For both buildings, in-situ decommissioning was initiated in October 2009 and completed in September 2011. In-situ decommissioning placed both buildings in their final decommissioning end state and included the following primary activities:

- Grouting of below-grade spaces (e.g., -20' and -40' elevations of both buildings (e.g., Heat Exchanger Bays, Near and Far-Side Pipe Trenches, Motor Rooms, Pump Rooms, and Storage Tank Room) along with the Disassembly Basins, and contiguous 108 Buildings (four below-grade "engine houses" containing emergency diesels/generators);
- Grouting of some above grade spaces (e.g., cells within the Purification Area and in P-Area, evaporators within the Assembly Area;
- Removal of remaining, exterior, non-embedded metal (e.g., railings and catwalks along with the gantry for the shield doors);
- Removal of the stack;
- Sealing of exterior openings with reinforced concrete;
- Demolition of the above-grade portions of the Disassembly Area, and placement of a reinforced concrete cap over the below-grade and at-grade remnants;
- Grouting of the Reactor Vessel and placement of a thick, reinforced concrete cap over the Reactor Vessel; and
- Placement of new concrete roofs over select existing concrete roofs (primarily over the existing roofs above the Process Room and Purification Area).

RESULTS

SRS successfully decommissioned Buildings 105-P and 105-R over an approximately three year period. The effort was complex and difficult due to the buildings' radiological contamination, height, extensive basement, and thick concrete walls. Extensive planning and hazard analysis ensured the in-situ decommissioning was completed safely and without incident. The two decommissioning projects met contractual and regulatory standards/objectives for residual contamination and physical/chemical hazards, and fully supported an overall effort to remediate the P and R-Areas at the SRS.

Actual, fully-burdened costs for the in-situ decommissioning projects were $73M and $71M for Buildings 105-P and 105-R, respectively. In both cases, actual costs exceeded initial estimates; however, the actual costs were a fraction of the estimated cost for full demolition of the above-grade structures along with reactor vessel removal and below-grade decontamination (e.g., approximately $250M for Building 105-P (2006 dollars)). Building 105-P had an overall footprint of approximately 150,000 square feet, while Building 105-R had an overall footprint of approximately 175,000 square feet. In-situ decommissioning costs were therefore approximately $500/square feet and $400/square feet for Buildings 105-P and 105-R, respectively.

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