**Project Name:** SR-Decomm Inactive 105-P-D&D-R

**Project Name (Expanded)**: Savannah River ARRA Decommission Inactive 105-P Reactor D&D [Deactivation and entombment the 105-P Reactor and Disassembly Basin, including deactivation (removal of haz mat, installation of evaporators, and contaminated equipment removal), demolition of basin building, grouting of all below grade voids (principally reactor vessel and disassembly basin), and isolation and entombment of the remaining above grade reactor building]

**Project Type:** Building / Facility D&D Project Type

**Building Type:** B Typ 3

**Project Type Detail:** Reactor - Weapons Production/Commercial

**Supplementary Reference Documents**:
- P-Reactor Decommissioning CD-4 2011-11-11 Rev 1; FROM CONCEPT TO REALITY IN-SITU DECOMMISSIONING OF THE P AND R REACTORS AT THE SAVANNAH RIVER SITE (SRS); John C. Musall, John K. Blankenship, and William B. Griffin, SDD-2012-00002

**Site Context:**
All ARRA Projects are specific EM projects developed and executed between 2008 and 2011 in response to the American Reinvestment and Recovery Act. These projects were based on a total of 106 ARRA “Subprojects”, 77 managed by the SRS M&O Contractor (Savannah River Nuclear Solutions, LLC) and 39 managed by the Liquid Waste Program contractor (Savannah River Remediation, LLC), at a total cost of over $1.1B. The projects exist within larger ongoing site operations, depend on those larger elements for site services and support, and typically include costs for those services as indirect costs.

The historical Savannah River Site mission was to reprocess reactor core material to produce plutonium for nuclear weapons, enriched uranium for weapons and military and commercial use, and numerous specialty isotopes such as 238Pu for thermoelectric generators. It covers 300 square miles, and its ongoing mission is storage of weapons-grade plutonium, recovery of tritium from weapons, processing and downblending of enriched uranium materials, construction and operation of a mixed uranium-plutonium oxide nuclear reactor fuel production plant, remediation contamination due to past production activities, and management of wastes from both current processing and remediation activities.

The two major activities associated with the DOE-EM mission are the facility decommissioning, environmental cleanup, and transuranic and solid waste management performed by the M&O, and the vitrification/stabilization of high-level waste held in large below-ground tanks by the Liquid Waste Program contractor. The SRS EM ARRA scope has been divided into three ECAS Level 4 Parent Projects based on the SRS organizational and PBS groupings: Transuranic/Solid Waste Management (PBS SR-0011C and SR-0013), Area Completion Projects (PBS SR-0030 and SR-0040C), and Liquid Waste Program (SR-0014C).

**ECAS Level 4/Parent Project Context:**
The Area Completion Projects (ACP) ARRA Projects Parent Project grouping includes the ARRA ECAS projects shown in the list below. These projects are administered under the SRNS ACP and include decommissioning of facilities (preparation, deactivation, and demolition),
remediation of environmental media, and surveillance and maintenance of facilities and areas. There were several ACP ARRA projects that were excluded from the ECAS database pending development of additional data and/or project completion.

- SR-710 B Decommissioning-D&D-R
- SR-A Area 53-D&D-R
- SR-C Area Cask Car Railroad Tracks-ER-R
- SR-D Area Bubble Tower Soil Remediation-ER-R
- SR-D Area CPRB D006 Soil Remed-ER-R
- SR-D Area Fac Concrete Soil Detritiation-ER-R
- SR-Decomm Inactive 105-P-D&D-R
- SR-Decomm Inactive 105-R-D&D-R
- SR-ECODSB3/B5 Remedial Action-ER-R
- SR-F Area D-Bio,D&D Plan,Stk Hght Red-D&D-R
- SR-Gunsite 012 Rem Action Construction-ER-R
- SR-H Area (CIF Characterization)-D&D-R
- SR-HWCTR (770-U) Decommissioning-D&D-R
- SR-Inactive Facilities S&M-D&D-R
- SR-K Area 185-3K Cooling Tower D&D-R
- SR-M Area Remedial Action-ER-R
- SR-P Area Cask Car RR Tracks Remedial-ER-R
- SR-P Area Groundwater Remedial Action-ER-R
- SR-P Area P-007 Outfall Remedial Act-ER-R
- SR-P Area Process Swr Lines Remed Act-ER-R
- SR-P Area PSA-3A & 3B Remedial Act-ER-R
- SR-P Area Regulatory Documents-ER-R
- SR-P Area Site Restoration-ER-R
- SR-PAR Pond Facilities-D&D-R
- SR-R Area Cask Car RR Tracks Remedial-ER-R
- SR-R Area Groundwater Remedial Action-ER-R
- SR-R Area North of 105-R Remed Act-ER-R
- SR-R Area Process Swr Lines Remedl Act-ER-R
- SR-R Area Regulatory Documents-ER-R
- SR-R Area Site Restoration-ER-R
- SR-R Discharge Canal & LTR Char-ER-R
- SR-Remediate Inactive P Ash Basin-ER-R
- SR-Remediate Inactive R Ash Basin-ER-R
- SR-SATA Remediation & Decommm-ER-R

<table>
<thead>
<tr>
<th>Building</th>
<th>Title</th>
<th>Area (SF)</th>
<th>In-Service Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>105-P</td>
<td>Reactor Bldg</td>
<td>385,010</td>
<td>1954</td>
</tr>
<tr>
<td>108-1P</td>
<td>Engine House</td>
<td>6,162</td>
<td>1954</td>
</tr>
<tr>
<td>108-2P</td>
<td>Engine House</td>
<td>9,161</td>
<td>1954</td>
</tr>
</tbody>
</table>
Project Name: SR-Decomm Inactive 105-P-D&D-R

| 191-P | STANDBY PUMP HOUSE | 340 | 1965 |

Constrcution Details:
The reactor (including the disassembly basin and engine houses are massive concrete structures; the pump house is a small steel frame structure located adjacent to the disassembly basin. More information is provided below.

Facility Use:
The P-Reactor is located in the east-southeast quadrant of the Savannah River Site in P-Area. It is located in an upland area between Steel Creek and Lower Three Runs (UTR) watershed. P-Reactor began operations in February 1954 with the mission of producing weapons material (e.g., tritium and plutonium-239). It was taken off-line for maintenance and safety upgrades in 1987 and placed in warm standby in 1988. The P-Reactor Building (105-P) was put into a ‘cold standby’ status, followed by ‘cold shutdown with no capability of restart’ status in 1991. In the intervening period between shutdown and the deactivation activities, Building 105-P saw limited use. Limited deactivation was completed during that period and included activities such as the removal of fuel and target components from throughout Building 105-P, the removal of bulk moderator from process piping/vessels, the removal of records and surplus assets, and the cleanup of the Disassembly/Emergency Basin.

Principal threat source material (PTSM) was determined to be present within the P-Reactor Building (105-P) which would exceed the industrial worker risk threshold (risk greater than 1.0E-06) and PTSM levels (risk greater than 1.0E-03) should exposure occur. The radionuclides also had the potential to adversely impact groundwater. This remedial action was necessary to reduce risk to industrial workers and the environment and is consistent with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Initial alternatives analyses and end state definition were completed for Building 105-P in 2004. 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; the early action supported comprehensive P-Area remedial action that addressed all structures and media within the P area. 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.

Regulatory documents included:
- The Early Action Record of Decision (EAROD) Remedial Alternative Selection for the P-Area Operable Unit (U) (WSRC, 2008a) presented a range of in-situ decommissioning alternatives. In-situ decommissioning end state was selected as the preferred alternative for P-Reactor Building (105-P) Complex. With the passage of the American Recovery and Reinvestment Act (ARRA) of 2009 accelerating the PAOU project, the DOE, EPA Region 4
Project Name: SR-Decomm Inactive 105-P-D&D-R

and SC-DHEC agreed to utilize an Explanation of Significant Difference (ESD) to accelerate the project regulatory documentation.

- The Explanation of Significant Difference (ESD) for the Revision 1.1 Early Action Record of Decision for the P Area Operable Unit (PAOU) (U) (SRNS, 2009a) selected Alternative R-2A – in-situ decommissioning with Reactor Vessel Grouted in place as the preferred alternative.
- The Early Action Remedial Action Implementation Plan (EARAIP) for the P Area Operable Unit (U) (SRNS, 2009b) documented the items for implementation of the selected remedial action established in the EAROD (WSRC, 2008a) and ESD (SRNS, 2009b).
- The Statement of Basis/Proposed Plan for the P Area Operable Unit (PAOU) (U) (SB/PP) (SRNS, 2009c) was issued to the public on February 12, 2010.
- The Record of Decision Remedial Alternative Selection for the P-Area Operable Unit, (PAOU) (ROD) (SRNS, 2010a) reaffirmed the decisions that were previously documented in the ESD (SRNS, 2009a) and SB/PP (SRNS, 2009c). Also, as part of the ROD (SRNS, 2010a), the facility footprint was placed under a land use restriction to prevent future excavation, worker exposure or unrestricted (residential) use. Groundwater monitoring and surveillance will continue to assure the facility remains in a safe and stable condition.

The Decommissioning of P-Reactor Building (105-P) is defined a capital project in accordance with EM Recovery Act Program Portfolio Management Framework, and this CD-4 completion report addresses the P-Reactor Building (105-P) Decommissioning Project.

Processes causing contamination:
See above.

Contaminants of concern (including extent of contamination by major contaminant):

<table>
<thead>
<tr>
<th>Building</th>
<th>Chemical Hazard</th>
<th>Location/Extent</th>
<th>Radiological Hazard</th>
<th>Location/Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactor</td>
<td>Asbestos, Lead, mercury, hydraulic</td>
<td>Generally located throughout the buildings</td>
<td>Substantial contamination, principally fission</td>
<td>Principally activated metal in the pressure</td>
</tr>
<tr>
<td>Buildings</td>
<td>oils, batteries, PCBs, universal</td>
<td></td>
<td>and activation products</td>
<td>vessel and activation or fission products in</td>
</tr>
<tr>
<td></td>
<td>waste, and mold</td>
<td></td>
<td></td>
<td>the steam generator and primary systems and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>basins</td>
</tr>
</tbody>
</table>

The majority of the remaining source term resided within the Reactor Vessel as activated structural materials, within the Disassembly Basin in the form of titrated water and sludge, and within the reactor’s primary cooling loop as moderator “heels” (titrated heavy water). Prior to the project all irradiated-fuel and target assemblies had been removed from the reactor vessel, and all moderator had been drained from the process systems to the extent practical.

D&D Project Execution
Site WBS Organization within the ECAS Project Scope:

The SR-Decomm Inactive 105-P-D&D-R ECAS Project included costs from some of all of the following WBS elements:
- SR-0030.R1.1.01 P Reactor Deactivation
- SR-0030.R1.2.01 Decomm Inactive 105-P (Capital)
- SR-0030.R1.1.21 P Area Operations
SR-Decomm Inactive 105-P-D&D-R

- SR-0030.R1.1.19, Batch Plant Ops & Maint; The P Reactor used 113,951 CY of grout to fill below-grade contaminated voids, which represented 52.7% of batch plant grout volume and allocated 52.7% of batch plant costs (Level 5 project indirect cost).

**Deactivation:**
For Building 105-P, deactivation was initiated in April 2007 and was essentially complete by June 2010.

The primary goal of the deactivation project was to remove/mitigate hazards associated with the remaining hazardous materials. This deactivation project removed the reactor gantry crane, various legacy materials, materials containing hazardous constituents, and some radiologically-contaminated equipment. In addition to the removal of hazardous materials, deactivation activities completed removal of hazardous energy, exterior components (representing an immediate fall hazard), and historical artifacts along with the evaporation of water from the Disassembly Basin. Finally, so as to facilitate occupancy during the subsequent in-situ decommissioning, deactivation implemented repairs to the buildings and provided temporary power. Additional description is provided below.

**Decommissioning:**
The decommissioning scope included removal of the grouting of void spaces, removal of the above grade disassembly basin, removal of the stack, capping of the reactor vessel and disassembly basin, and various final sealing of the entombed structure. Additional description is provided below. As part of the Record of Decision (SRNS, 2010a) the facility footprint has been placed under a land use restriction to prevent future excavation, worker exposure or unrestricted (residential) use. Groundwater monitoring and surveillance will continue to assure the facility remains in a safe and stable condition. The removal action objectives noted above have been met.

**Surveillance and Maintenance:**
Surveillance and maintenance activities including radiological surveys, installation of temporary power & lighting, inspections of emergency equipment, inspection of buildings, and environmental walk down for 400,673 ft² of buildings. Also included were costs for utilities (power and water), SVE Well Operations/Maintenance/Monitoring and Material Acquisition Center Operations. Maintenance activities performed as part of long term surveillance and maintenance will include prevention of vegetative growth on the roofs and sealing the cracks in the cover system to prevent significant rainwater infiltration.

**Batch Plant Operations**
Design, installation, startup, mix qualification, equipment leasing and demobilization of two concrete batch plants, including installation of rail spurs, water lines, and other infrastructure, to provide concrete and grout principally for production reactor and disassembly basin entombment.

**Methods of execution:**
*Management:* The scope was planned, managed, and executed as a single element. Management included technical and project oversight, planning, project controls, and quality assurance.

*Regulatory:* The project was performed in accordance with the requirements of the SRS Federal...
Facility Agreement; additional discussion of documents is provided above.

**Physical Approach:** The project activities were as follows:

- **Design**
  - 105-P Decommissioning Design
  - Disassembly Basin Cap Design
  - Seal Opening Design
  - Roof water drainage design.
- **Batch Plant Operations**, including activities and day to day operations to provide grout and concrete materials for grouting below grade and above grade areas of P-Reactor Building (105-P).
- **Removal of Gantry Crane from 105-P Reactor**
- **Complete Area Disassembly Basin Water Evaporation**
- **Removal of the following materials:** combustibles/flammables, moderator, acids friable asbestos (as needed to protect workers performing deactivation), miscellaneous chemicals, loose lead/brass components, Freon®, oils, mercury/PCB2 containing components, mold and some radiologically-contaminated equipment.
- **Removal of hazardous energy, exterior components (representing an immediate fall hazard), and historical artifacts**
- **Evaporation of water from the Disassembly Basin**
- **Repairs to the buildings and provided temporary power**
- **Grouting Disassembly Basin - The Disassembly Basin was filled with grout (cementitious and foam mix) to form a stabilized structure.**
- **Grouting the P-Reactor Vessel - The reactor vessel was filled with a specialty grout (near neutral pH) to form a stabilized structure.**
- **Grouting all below grade structures/sections - Below grade structures were filled with grout to form a stabilized structure (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)**
  - Reactor Vessel using specialty grout (near neutral pH mix)
  - 108-1P plus Access Well
  - 108-2P plus Access Well
  - 191-P Pump Pit
  - Elevation -14 foot-level of Purification
  - Stack Void
  - Assembly -20 foot elevation pit area
  - Purification Cells
  - Miscellaneous pits external to P-Reactor Building (105-P)
  - P-Reactor Building grouting to grade from the -20 and -40 foot elevations
- **Grouting of some above grade spaces (e.g., cells within the Purification Area and in P-Area, evaporators within the Assembly Area;**
- **Demolished stack - The stack was demolished to the +55 foot-level and the rubble was placed in the Storage Tank Room prior to grouting.**
- **Removing the Disassembly Basin above grade - The Disassembly Basin above ground**
structure was demolished and transported to Solid Waste for disposal in the slit trenches.

- Capping Reactor Vessel - A concrete cap was placed over the Reactor Vessel.
- Modifying selected roof structures - Selected roofs were modified to preclude water intrusion into the building by placement of new concrete roofs over select existing concrete roofs (primarily over the existing roofs above the Process Room and Purification Area).
- Removal of remaining, exterior, non-embedded metal (e.g., railings and catwalks along with the gantry for the shield doors);
- Sealing openings - Openings into the building were filled with concrete with the exception of one opening that was welded shut.
- Capping Disassembly Basin - At the ground surface, a concrete cap was placed over the disassembly basin to preclude infiltration of precipitation and eliminate direct exposure to humans or ecological receptors.
- A total of 122,464 CY of grout and concrete were placed by subcontract (113,951 from the batch plant) and SRNS personnel.

Waste generation was as follows:

<table>
<thead>
<tr>
<th>Subproject Number</th>
<th>Generic Project Name</th>
<th>LLW On-site (CM)</th>
<th>LLW Off Site (CM)</th>
<th>Hazardous (CM)</th>
<th>Sanitary (CM)</th>
<th>Mixed Waste (CM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR-0030.R1.1.01</td>
<td>P Reactor Deactivation</td>
<td>972</td>
<td>1.2</td>
<td>482</td>
<td>4.80</td>
<td></td>
</tr>
<tr>
<td>SR-0030-R1.2.01</td>
<td>P Area Disassembly Basin</td>
<td>8,284</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Technologies:
The work was accomplished utilizing tri-axle dump trucks, roll off transport haulers, water trucks, bulldozers, skid steers, front end loaders, cranes, concrete pump trucks, track hoes, and water cannons. In order to reach the elevated heights of the reactor building extended reach cranes and pump trucks were employed. The cranes were used to lift materials and equipment to all elevations of the reactor building. The track hoes were primarily used in the demolition of above grade portions of the disassembly basin. The track hoes included those with ram hoes for the physical breaking up of the concrete, those with sheers for cutting of metal components (duct work, reinforcing steel, conduit, structural steel, piping, etc.), and those with pickers for stock piling of the rubble and loading of roll off containers. The concrete pump trucks were used for filling of the reactor building, placing concrete on the roofs and construction of the cover over the disassembly basin. The water cannons and trucks were used for dust suppression.

Activities self-performed:
Savannah River Nuclear Solutions (SRNS) provided design, project management and oversight of this project including worker protection, and regulatory integration. SRNS also performed various phases of the work including grouting of the D&E Canal to grade, grouting of Disassembly Basin to grade, grouting of the 105-P Building/Disassembly Basin seismic gap, demolition of the Disassembly Basin above grade structure, Disassembly Basin rubble removal, and grouting of the Reactor Vessel.

Activities subcontracted:
<table>
<thead>
<tr>
<th><strong>Project Name:</strong></th>
<th>SR-Decomm Inactive 105-P-D&amp;D-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcontractors and their sub-tiers performed the following phases of work including grouting 105-P Building below grade (including caps over openings), 105-P roof modifications, armament installation, stack demolition and rubble removal, seal openings of 105-P Building, P-Reactor Vessel cover, and grouting of 108-1P, 108-2P and 191-P to grade and cap openings. Grout and concrete were provided by off-site concrete suppliers and an on-site batch plant located in P Area.</td>
<td></td>
</tr>
</tbody>
</table>

**Issues that impacted the project:**
- None

**Scope Growth:**
No identified scope growth

**Notes Regarding Use of Data**
- None