ARF # 15839

United States Department of Energy

Savannah River Site

Early Action Record of Decision Remedial Alternative Selection for the P Area Operable Unit (U)

CERCLIS Number: 94

WSRC-RP-2008-4037

Revision 1.1

December 2008

Prepared By:
Savannah River Nuclear Solutions, LLC
Savannah River Site
Aiken, SC 29808

Prepared for the U. S. Department of Energy under Contract No. DE-AC09-08SR22470

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Prepared for
U.S. Department of Energy
and
Savannah River Nuclear Solutions, LLC
Aiken, South Carolina

ARF # 15839

EARLY ACTION RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION (U)

P Area Operable Unit (U)

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Savannah River Site
Aiken, South Carolina

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Aiken, South Carolina

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DECLARATION FOR THE EARLY ACTION RECORD OF DECISION

Unit Name and Location

P Area Operable Unit

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: OU- 94

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy

The P Area Operable Unit (PAOU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/ Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS). This Early Action Record of Decision (EAROD) document addresses five subunits within the PAOU that are identified as CERCLA only units.

The FFA is a legally binding agreement between regulatory agencies [United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC)] and regulated entities [United States Department of Energy (USDOE)] that establishes the responsibilities and schedules for the comprehensive remediation of SRS.

The media associated with the early action subunits discussed in this document includes surface soil, vadose zone soil, and rail bed materials (i.e., gravel and crossties). Media evaluated for the P-Reactor Building (105-P) include metal components, concrete, and sediment. Although portions of this document discuss the localized impacts to the groundwater from soil contaminant migration, the groundwater is not part of the PAOU; it will be addressed under the P-Area Reactor Groundwater (PRGW) Operable Unit (OU).

Statement of Basis and Purpose

This decision document presents the final end state decision for P-Reactor Building (105-P) and selected remedies for the PAOU early action subunits, located at the SRS near Aiken, South Carolina. The P-Reactor Building (105-P) and the early action subunits are a subset of the units within PAOU at which the FFA parties agreed the potential releases of hazardous substances, pollutants, or contaminants needed to be investigated. Early remedial actions are performed under remedial authority and can occur in conjunction with a long-term action at a site to ensure the site is cleaned up as quickly and effectively as possible. The remedies were chosen in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record File (ARF) for this site.

The USEPA, SCDHEC and USDOE concur with the selected remedies.

Assessment of the Site

SRS is currently accelerating cleanup by using an area-completion approach to Deactivation and Decommissioning (D&D) and environmental restoration. Separate subunits and D&D facilities within large industrial areas are undergoing integrated assessment and remediation together under CERCLA. This approach streamlines CERCLA documentation and enhances the ability to make large-scale decisions about cleanup.

There has been a release of hazardous and radioactive substances at the PAOU into the environment. The response actions selected in this EAROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The current land use for the PAOU is industrial and the decisions for the final end-state of P-Reactor Building (105-P) and the PAOU early action subunits are based on the future industrial worker scenario. While land use controls (LUCs) are expected to be part of the final remedy for the PAOU, this EAROD does not select specific LUCs for the early action subunits. Instead, unit-specific LUCs for the P-Reactor Building (105-P) and the PAOU early action subunits will be determined in the final Record of Decision (ROD) for the PAOU.

In June 2007, USEPA, SCDHEC and USDOE identified PAOU subunits as early action candidates. These early action subunits include two volatile organic compounds (VOC) soil contaminated subunits (Potential Source Area [PSA]-3B within the Northern Vadose Zone Investigative Unit [IU] and PSA-3A within the P-Reactor IU), the High Contamination Area (HCA) associated with the P-Area Reactor Area Cask Car Railroad Tracks as Abandoned and the P02 Outfall located at the periphery of P Area. In addition, this document also identifies the final end-state of the P-Reactor Building (105-P) including the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P). Agreement on the final end-state for the P-Reactor Building (105-P) including the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P) will allow subsequent engineering efforts and regulatory decisions to focus only on closure alternatives that are appropriate for that end state and allow for consolidation of PAOU remediation waste inside the P-Reactor Building (105-P).

These remedies, although taken as early actions, are the final remedial actions for the following PAOU subunits:

- Final End-State Decision:
  - P-Reactor Building (105-P) including the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P).

- Early Remedial Action Decisions:
    - PSA-3A (VOC-contaminated soils);
    - PSA-3B (VOC-contaminated soils);
    - P02 Outfall (radiological contaminated soils); and
    - High Contamination Area (HCA) at the P-Area Reactor Area Cask Car Railroad Tracks as Abandoned (contaminated rail bed materials and soils);

Throughout this document, mention of the P-Reactor Building (105-P), unless otherwise specified, also includes the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P).

Based on the detailed evaluation of alternatives performed in *RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for the PAOU* (herein referred to as the Combined Document) report (WSRC 2008c), the selected remedies for final remedial actions for the PAOU early action subunits are discussed in the following paragraphs.

P-Reactor Building (105-P)

Alternative AR-2- In Situ Decommissioning: This alternative entails *In situ* decommissioning (ISD) of the P-Reactor Building (105-P) with associated radiological waste. Although this alternative is the selected end-state decision, the engineering details of the final actions with regard to closure for the building will be selected in the final ROD for the PAOU.

VOC Source Areas

Alternative AV-2- Soil Vapor Extraction at PSA-3B: This alternative entails the removal of VOC-contaminated soil that exceeds a concentration of 0.53 mg/kg. Soil vapor extraction (SVE) will be used to extract VOCs from the vadose zone soils. A series of wells are drilled with screens located in the region of the contaminated soil and are connected to a vacuum blower that draws air through the porous soil, which volatizes the solvents. The vapor is transferred to the atmosphere where the trichloroethylene (TCE) and tetrachloroethylene (PCE) are rapidly destroyed by photolytic degradation. SVE is a presumptive remedy, has been proven to be an effective low-cost technology, and is widely used to remediate a variety of organic compounds in the subsurface.

Alternative AV-3- SVE at PSA-3A, enhanced with soil fracturing and chemical oxidation: This alternative entails the removal of VOC contaminated soil that exceeds a concentration of 0.53 mg/kg. SVE is supplemented by fracturing subsurface soil to improve permeability and injecting an oxidizing chemical that will degrade TCE down to non-hazardous compounds in near saturated soils.

P02 Outfall

Alternative AP-2- Excavation and removal: This alternative entails the removal of contaminated soil that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60. In conjunction with this alternative, confirmatory sampling will be used to determine the extent of radionuclide contamination in the soil. Confirmatory sampling has two purposes; 1) to define the extent of radionuclide contamination prior to excavation; and 2) to confirm removal of contamination. In addition, this risk-based concentration would ensure removal of cesium-137 (+D) contaminated media. After excavation, the radiological contaminated surface soil will be placed in containers for removal and disposition at an approved facility. The final decision to the location for waste disposition will be documented in the final ROD for PAOU.

HCA at the Cask Car Railroad Tracks

Alternative AC-2- Excavation and removal: This alternative would entail removal of contaminated soil and rail bed materials that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60. In addition, this risk based concentration would ensure removal of cesium-137 (+D) contaminated media. After excavation, the radiologically contaminated railroad bed material will be placed in containers for removal and disposition at an approved facility. The final decision to the location for waste disposition will be documented in the final ROD for PAOU.

The assessment of early action subunits within this area has been completed and the FFA parties agreed that potential releases of hazardous substances, pollutants, or contaminants needed to be investigated; thus, early (final) actions have been identified to accelerate area cleanup. The final actions with regard to closure for P-Reactor Building (105-P), in addition to the final completion of all remaining PAOU subunits and remnant facilities will be documented in the final ROD for PAOU.

Statutory Determinations

Based on the Combined Document report (WSRC 2008c), the PAOU early action subunits pose a threat to human health and the environment. To address the threat, conventional SVE at PSA-3B, SVE with soil fracturing and chemical oxidation at PSA-3A, and the excavation and disposal of contaminated media at the HCA at the Cask Car Railroad Tracks and the P02 Outfall, have been selected as the early action remedies for the PAOU. In addition, ISD has been selected as the final end-state decision for P-Reactor Building (105-P). The future land use of the PAOU is assumed to be industrial land use.

Because these remedies will result in hazardous and radioactive substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedies are and will continue to be protective of human health and the environment.

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action (unless justified by a waiver), are cost-effective, and utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. These remedies also satisfy the statutory preference for treatment as a principal element of the remedies (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment).

The selected final end-state decision for P-Reactor Building (105-P) and the early action remedies at PAOU leave hazardous substances in place that pose a potential future risk; therefore, PAOU will require LUCs for an indefinite period of time. As previously stated, unit-specific LUCs for the PAOU early action subunits will be selected in the final ROD for the PAOU.

Data Certification Checklist

This EAROD provides the following information for each of the units identified for early remedial actions:

- Constituents of concern (COCs) and their respective concentrations (Section V);
- Baseline risk represented by the COCs (Section VII);
- Cleanup levels established for the COCs and the basis for the levels (Section XI);
- Current and reasonably anticipated future land and groundwater use assumptions used in the Baseline Risk Assessment (BRA) and EAROD (Section VI);
- Potential land and groundwater use that will be available at the site as a result of the selected remedy (Section XI);
- Estimated capital, operation and maintenance, and total present worth cost; discount rate; and the number of years over which the remedy cost estimates are projected (Section IX);
- Key decision factor(s) that led to selecting the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria) (Section X); and
- How source materials constituting principal threats are addressed (Section VI)

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ARF # 15839

DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)

P Area Operable Unit

CERCLIS Number: 94

WSRC-RP-2008-4037
Rev. 1.1

December 2008

Savannah River Site
Aiken, South Carolina

Prepared By:

Savannah River Nuclear Solutions, LLC
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U. S. Department of Energy under Contract DE-AC09-08SR22470
Savannah River Operations Office
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

APPENDIX **PAGE**

LIST OF ACRONYMS AND ABBREVIATIONS

(+D)	plus daughters
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
ARF	Administrative Record File
bgs	below ground surface
BRA	Baseline Risk Assessment
CAB	Citizens Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulation
Ci	curie
CM	contaminant migration
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	constituent of concern
CSM	conceptual site model
D&D	Deactivation and Decommissioning
EAPP	Early Action Proposed Plan
EAROD	Early Action Record of Decision
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESD	explanation of significant difference
FFA	Federal Facility Agreement
FS	Federal Facility Agreement
ft	feet
HI	hazard index
HAD	Hazard Assessment Document
HCA	high contamination area
HH	human health
HHRA	human health risk assessment
IC	Institutional Controls
IOU	Integrator Operable Unit
IRIS	Integrated Risk Information System, USEPA
ISD	*In situ* decommissioning
IU	Investigative Unit
LUC	Land Use Controls
LUCAP	Land Use Controls Assurance Plan
LUCIP	Land Use Controls Implementation Plan
µg/L	microgram per liter
MCL	maximum contaminant level

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

NA	not applicable
NaI	sodium iodide
NBN	no building number
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-detect
NEPA	National Environmental Protection Act
NPDES	National Pollutant Discharge and Elimination System
NPL	National Priorities List
O&M	Operations and Maintenance
OU	operable unit
PAOU	P-Area Operable Unit
PCB	polycyclic chlorinated biphenyl
PCE	tetrachloroethylene
pCi/g	picocuries per gram
PRG	preliminary remediation goal
PRGW	P-Area Reactor Groundwater
PSA	potential source area
PTSM	principal threat source material
RAIP	Remedial Action Implementation Plan
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RCOC	refined constituent of concern
RfC	reference concentration
RfD	reference dose
RFI	RCRA Facility Investigation
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RG	remedial goal
RGO	remedial goal objective
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendment Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
scfm	standard cubic feet per minute
SCHWMR	South Carolina Hazardous Waste Management Regulations
SRS	Savannah River Site
SVE	soil vapor extraction
TBD	to-be-determined
TCE	trichloroethylene
UCL	upper confidence limit
USDOE	United States Department of Energy

LIST OF ACRONYMS AND ABBREVIATIONS *(continued)*

USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
WSRC	Washington Savannah River Company, LLC

I. SAVANNAH RIVER SITE AND OPERABLE UNIT NAME, LOCATION, AND DESCRIPTION

Unit Name, Location, and Brief Description

P Area Operable Unit

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: 94

Savannah River Site

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Identification Number: SC1 890 008 989

Aiken, South Carolina

United States Department of Energy (USDOE)

Savannah River Site (SRS) occupies approximately 310 square miles of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is located approximately 25 miles southeast of Augusta, Georgia, and 20 miles south of Aiken, South Carolina.

The USDOE owns SRS, which historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. Chemical and radioactive wastes are by-products of nuclear material production processes. Hazardous substances, as defined by the CERCLA, are currently present in the environment at SRS.

The Federal Facility Agreement (FFA) (FFA 1993) for SRS lists the P-Area Operable Unit (PAOU) as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/ CERCLA unit in Appendix C of the FFA for the SRS.

The PAOU was evaluated through an investigation process that integrates and combines the RCRA corrective action process with the CERCLA remedial process to determine the actual or potential impact to human health and the environment of releases of hazardous and radiological substances to the environment.

II. SITE AND OPERABLE UNIT COMPLIANCE HISTORY

SRS Operational and Compliance History

The primary mission of SRS has been to produce tritium, plutonium, and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense program was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes are by-products of nuclear material production processes. These wastes have been treated, stored, and in some cases, disposed at SRS. Past disposal practices have resulted in soil and groundwater contamination.

On December 21, 1989, SRS was included on the National Priorities List (NPL). The inclusion created a need to integrate the established RCRA facility investigation (RFI) program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA 42 United States Code Section 9620, USDOE has negotiated a FFA (FFA 1993) with United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) to coordinate remedial activities at SRS into one comprehensive strategy which fulfills these dual regulatory requirements. USDOE functions as the lead agency for remedial activities at SRS, with concurrence by the USEPA - Region 4 and the SCDHEC.

PAOU Operational and Compliance History

The PAOU is located approximately 2.5 mi east-southeast of the geographical center of SRS and about 4 mi west of the nearest site boundary. PAOU is approximately 126 acres (including the P-Area Ash Basin) and located in an upland area between Steel Creek and Lower Three Runs and has a flat to gently rolling topography; it is about 315 ft above mean sea level (amsl) (Figure 2).

In February 1954, P-Reactor began operations. It was taken off-line for maintenance and safety upgrades in 1987 and placed in warm standby in 1988. In

1991, 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 its present state, all irradiated-fuel and -target assemblies have been removed from the reactor vessel and all fluids have been drained from the process systems. Currently, P-Reactor Building (105-P), together with facilities within the P Area fence, is undergoing deactivation in preparation for decommissioning. All electrical and mechanical hazards have been eliminated by severing or terminating the original lines that entered P Area. The P-Reactor Building (105-P) has been declared "cold and dark" because of this action. To execute the deactivation work, a temporary power supply has been installed, which will be removed after deactivation and decommissioning (D&D) is complete.

P-Area groundwater contaminants, determined from previous groundwater investigations, are trichloroethylene (TCE), tetrachloroethylene (PCE), and tritium. These contaminants exceed maximum contaminant levels (MCLs). Various former maintenance facilities in P Area have been identified as contributors to the volatile organic compound (VOC) contamination. These facilities are not contaminated with VOCs, but rather, contamination is present in areas outside these facilities where drain lines exited to process or storm water sewer lines. Although portions of this document discuss the localized impacts to the groundwater associated with P Area, the groundwater is not part of the PAOU; it will be addressed in the P-Area Reactor Groundwater (PRGW) Operable Unit (OU).

Investigative Units

To facilitate characterization of the PAOU and risk assessment in the *RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for the PAOU* (herein referred to as the Combined Document) report (WSRC 2008c), the PAOU was divided into five investigative units (IUs) at Work Plan scoping. The IU represents a large geographic area in which one or more subunit(s) are located. The grouping of subunits into an IU allows for the inter-relationship between subunits to be evaluated as a whole in determining impact to human health and the environment.

For the PAOU, most of the identified subunits are associated with subsurface contamination. For this reason, IUs are designed to identify problems warranting action from a contaminant migration and principal threat source material (PTSM) perspective, rather than a surficial risk. Therefore, the specific groupings of subunits within the IUs are not necessarily defined by the receptor exposure.

The proximity of the subunits within the IU allowed for a more holistic investigation to determine impacts to the environment. The five PAOU IUs are listed below:

- Southern Vadose Zone IU
- P-Area Ash Basin IU
- Cooling Water System IU
- Northern Vadose Zone IU
- P-Reactor IU

The following is a listing of all subunits (including the early action subunits) that comprise the PAOU. PAOU subunits include those waste units designated in the FFA, D&D Facilities, potential source areas (PSAs) identified during previous groundwater investigations, and other subunits identified during PAOU characterization.

Table 1 lists the relationship between the five IUs and all PAOU subunits. Figure 3 shows the location of the early action subunits within the five IUs.

Federal Facility Agreement Subunits

As listed in the FFA, the PAOU contains five FFA waste units. The (*) designation identifies the early action subunits as follows:

- P-Area Ash Basin (188-0P);
- Potential Release from Reactor Water Cooling System (186/190-P);
- Potential Release from P-Area Disassembly Basin (105-P);
- Process Sewer Lines As Abandoned (No Building Number [NBN]); and
- P-Area Cask Car Railroad Tracks As Abandoned (NBN)*.

Figure 3 shows the location of the early action subunits with the five IUs.

Deactivation and Decommissioning Subunits

The P-Reactor Building (105-P) and its associated facilities, as well as four D&D building slabs, were also incorporated into Appendix K of the FFA (FFA 1993) as D&D facilities in the PAOU to be decommissioned. These D&D subunits are as follows:

- P-Reactor Building (105-P)*;
- Engine House (108-1P)*;
- Engine House (108-2P)*;
- Process Water Storage Tank (106-P);
- Process Water Storage Basin (109-P);
- Primary Substation (High Voltage 115/13.8) (151-1P);
- Standby Pumphouse (191-P)*;
- Containment Tank within Emergency Cooling Water Retention Basin (904-86G);
- Pipe Fabrication Building (717-9P);
- Radiological Zone Storage Building (710-P);

- No. 2 & 5 Basin Deionizers Pad (105-1P); and
- Telephone Exchange Building (702-P) (still in service, not part of this EAROD)

Only, the P-Reactor Building (105-P), the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P) have been identified as early action candidates from the D&D subunits (Figure 3).

Throughout this document, mention of the P-Reactor Building (105-P), unless otherwise specified, also includes the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P).

Potential Source Areas

Previous groundwater investigations identified five Potential Source Areas (PSAs), not listed in the FFA, but with the potential to contribute to groundwater contamination. These PSAs are not related to a specific subunit of the PAOU identified in the FFA, or to an individual D&D structure, but have resulted from spills and releases during historic facility operations. Through implementation of the remedial investigation (RI) for the PAOU, the following five PSAs were evaluated. The (*) designation identifies the early action subunits as follows:

- PSA-1 Emergency Cooling Water Retention Basin (904-86G);
- PSA-2 Area around the Cooling Water Effluent Sumps (107/107-1P);
- PSA-3A Area near the northern end of the P-Reactor Building (105-P) *;
- PSA-3B Area west of the Administrative/Maintenance slab*;
- PSA-4 Area east of the P-Reactor Building (105-P); and
- PSA-5 Two localized areas in the southwestern part of P Area

As an outcome of the PAOU RI activities, PSA-3A and PSA-3B were identified to have been the result of spills/releases that contaminated the vadose zone and subsequently resulted in groundwater contamination (Figure 3). Volatile organic compounds (VOCs) are the primary contaminants: trichloroethylene (TCE) (PSA-3A) and tetrachloroethylene (PCE) (PSA-3B). No vadose zone contamination was determined to be present at PSAs-1, -2, -4, and -5, therefore, these subunits are no longer under consideration for further action (WSRC 2008c).

Other Subunits

In addition to the FFA waste units, the PSAs, and the D&D subunits that comprise the PAOU, the P02 Outfall, located on the periphery of P Area, was identified as an early action candidate and is included in the scope of this EAROD. This outfall is included based on previous characterization data that indicated a potential impact to surface soils from intermittent releases from processes within P Area.

Early Action Subunits

This EAROD describes a final end-state decision for the P-Reactor Building (105-P) and early actions that are to be undertaken at five subunits. The subunits included in this EAROD are as follows:

Final End State Decision

- The P-Reactor Building (105-P), including the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Standby Pumphouse (191-P) (P-Reactor IU).

Early Remedial Action Decisions

- The High Contamination Area (HCA) at the Cask Car Railroad Tracks (P-Reactor IU);
- The source of the PSA-3A (P-Reactor IU);.
- The source of the PSA-3B (Northern Vadose Zone IU); and

- P02 Outfall, which is located in the northeastern periphery of P Area and is not associated with an IU.

Early Action Subunits Operational History

P-Reactor Building (105-P) Operational History

Similar to the other SRS reactors, the reactor at P Area produced special nuclear materials (mainly plutonium and tritium) for defense purposes. The basic layout of the P-Reactor Building (105-P) is shown in Figure 4. The building consists of four main operating sections at ground level: the assembly area, the process room, the purification wing, and the Disassembly Basin. The Engine Houses (108-1P and 108-2P), together with the Standby Pumphouse (191-P) provided backup for the reactor cooling systems, are included as part of the P-Reactor Building (105-P). The underground 108-1P and 108-2P emergency diesel engine houses are concrete structures that are located below-grade and contiguous to the P-Reactor Building (105-P) at the minus 20 ft level. Each structure consists of a large concrete room that housed diesel generators, switchgear, day tanks for fuel and oil, and air compressors for the P-Reactor Building (105-P) air. Bulk storage for diesel fuel was located in storage tanks outside of the 108-1P/108-2P/105-P footprint. Physical evidence of a lead spill/stain was noted. The area has been cleaned with Biosolve. Characterization data external to these engine houses confirms that fuel contamination is not present in soil or groundwater. The primary reactor cooling circuit, which includes the heat exchangers, is located at the minus 20 ft level. The cooling water pumps, storage tanks, collection sumps and reactor instrument rooms are located at the minus 40 ft level. The minus 49.5 ft level represents the lowest point in the P-Reactor Building (105-P) and is the bottom of two sumps. The reactor control and safety rod latches with the drive mechanisms are located in the actuator tower above the process room.

Prefabricated fuel and target materials were shipped from M Area and were received in the reactor assembly area where they were cleaned with solvents and prepared for charging into the reactor tank. The reactor tank is in the shape of a cylinder, is approximately 18 ft wide and 22 ft deep, and is made of 304-grade stainless steel.

The fuel and targets were irradiated in the reactor tank and then transferred to the Disassembly Basin where they were stored for 6 months to allow cooling and the high activity isotopes to decay. They were then transported to F and H Areas for further chemical processing.

To generate these special materials, the SRS reactors utilized a process of neutron irradiation of either uranium-238 or lithium-6 targets to produce plutonium-239 and tritium, respectively. The source of neutrons came from the fission of uranium-235, which is an isotope present in the uranium reactor fuel. The fission of uranium-235 is a process whereby the uranium nucleus disintegrates to emit a great deal of energy in the form of heat and radiation, and also generates many extraneous radioactive fission isotopes that form the predominant basis of the radioactive waste products from the process. In the SRS reactor design, the fuel and target assemblies were clad with aluminum, which was intended to contain the fission products until chemical processing could be completed in the F and H canyons. However, a small amount of leakage occurred through ruptured aluminum cladding over the 35 years of operation, resulting in a gradual accumulation of low levels of radioactive fission products within the reactor process systems. The transfer of targets and spent fuel through the Disassembly Basin resulted in accumulation of the radioactive fission products within the basin itself. These fission products are predominantly tritium, cesium-137 (+D), and strontium-90 isotopes. When fuel and target assemblies were moved from the reactor to the Disassembly Basin, fission products on the surface of the assemblies were flushed into the basin. Fission products were also added to the basin when failed fuel and target assemblies were discharged to the Disassembly Basin. In the early years, the Disassembly Basin water was continuously purged into the process sewer. In the later years, the basin water was continuously filtered to remove silt and particles from the basin water. In addition, as a safety precaution to protect facility worker, the basin water was occasionally purged to the seepage basins when the tritium concentration in the basin approached 400,000 pCi/mL.

Radioactive byproducts, as detailed in Section VII, were generated within the reactor process in other ways. The continual neutron bombardment of reactor components during operations activated their construction materials, mainly the stainless steel and concrete in and around the reactor vessel. Neutron bombardment of the heavy water moderator also produced unwanted tritium, mainly in the form of tritiated water and water vapor. The majority of this airborne tritium was removed by the building ventilation system, but some tritium accumulated in the Disassembly Basin water, and a very small amount was absorbed into the building structure and components.

A Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) was completed for the Disassembly Basin (WSRC 2008d). The report evaluated various alternatives for disposition of the Disassembly Basin water. Likely alternatives selected as part of the evaluation were to use the water for making grout, evaporation, or trucking to the SRS Effluent Treatment Plant. An Action Memorandum for the Non-Time Critical Removal Action for disposition of the water has been submitted (USDOE 2008). In the letter, the preferred alternative of forced evaporation was selected. The implementation of this alternative will provide for a protective and cost-effective method for disposition of the Disassembly Basin water. This action is considered an interim measure that supports final decommissioning of the Reactor Building (105-P).

VOC Source Areas Operational History

During the historical research and characterization of P Area, no particular process or activity was identified as the origin of the VOC contamination at either of the PSAs (WSRC 2008c). However, the characterization data confirms that releases did occur.

PSA-3A is located to the north of the P-Reactor Building (105-P) (Figure 3). It is primarily contaminated with TCE; the highest concentrations of TCE have been determined at a depth of approximately 45 ft below ground surface (bgs), close to the water table (50 ft bgs). Other contaminants that have also been detected in PSA-3A, but to a lesser extent, are cis-1,2-dichloroethylene, ethylbenzene, methyl chloride, o-xylene, PCE, and toluene. This subunit is linked to TCE contamination in the groundwater, indicating it is an active source zone of groundwater contamination. Documentation of the origin of the TCE source is either unavailable or inconclusive. However in the Assembly Area of the P-Reactor Building (105-P), fuel and target rods were thoroughly degreased using TCE to remove any grease or oils that contained hydrogen or carbon which would inhibit reactor operations.

A second source area, known as PSA-3B, exists in an area to the west of the Administrative/Maintenance slab (704-P) (Figure 3) and is primarily contaminated with PCE. The highest concentrations of PCE are located at a depth of 24 ft bgs with concentrations detected down to the water table (50 ft bgs). This subunit is linked to PCE contamination in the groundwater, indicating it is an active source zone of groundwater contamination. Documentation of the origin of the PCE source is either unavailable or inconclusive. Degreasers, such as PCE and to a lesser degree TCE, were used in an area within the Administrative/ Maintenance Building (704-P) to support equipment maintenance. As a result of this work, an area outside of the building became contaminated with PCE and subsequently has impacted the groundwater..

Outfall P02 Operational History

When the reactor was constructed, the storm sewers were cross-connected to the process sewers to take limited quantities of process wash water from the reactor building. Over the years, this resulted in an accumulation of radioactive contamination at the outfall.

P02 Outfall, a tributary to PAR Pond, is located to the northeast of the PAOU and appears to have radiological contaminants in subsurface soil.

At the P02 outfall, historical characterization activities determined that cesium-137 (+D) and cobalt-60 may be contaminants in the soil. In addition, gamma overflight surveys indicate localized areas of elevated levels of radionuclides in shallow soil at the outfall area.

HCA at the Cask Car Railroad Tracks Operational History

During reactor operations, the irradiated fuel and target assemblies were loaded underwater into lined casks in the Disassembly Basin. These casks were then transported by rail to the separations areas for chemical processing. Inevitably some leakage (water contaminated with radionuclides - mostly cesium-137 (+D)) occurred, which resulted in a release of radioactive contaminants along the railroad tracks to the southeast of the P-Reactor Building (105-P) (Figure 3).

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

CERCLA requires the public to be given an opportunity to review and comment on the proposed remedial alternatives for the early action subunits. Public participation requirements are listed in Sections 113 and 117 of CERCLA (42 United States Code Sections 9613 and 9617). These requirements include establishment of an Administrative Record File (ARF) that documents the investigation and selection of the remedial alternative. The ARF must be established at or near the facility at issue.

The SRS FFA Community Involvement Plan (WSRC 2006d) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The SRS FFA Community Involvement Plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act, 1969 (NEPA). South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.124 and Section 117(a) of

CERCLA, as amended, require the advertisement of the draft permit modification and notice of any proposed remedial action, and provide the public an opportunity to participate in the selection of the remedial action. The *Early Action Proposed Plan for the P Area Operable Unit (U)* (WSRC 2008a), a part of the ARF, highlights key aspects of the investigation and identifies the preferred action for addressing the PAOU early action subunits.

The FFA ARF, which contains the information pertaining to the selection of the response action, is available at the following locations:

US Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina – Aiken
171 University Parkway
Aiken, South Carolina 29801
(803) 641-3465

Thomas Cooper Library
Government Documents Department
University of South Carolina
Columbia, South Carolina 29208
(803) 777-4866

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to citizens in South Carolina and Georgia, and through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspaper. The public comment period was also announced on local radio stations.

Because the EAROD Revision 0 submittal period overlapped with the EAPP public comment period, additional comments received during the 30 day public comment period for the EAPP are included in Appendix A.4.

The Facilities Disposition and Site Remediation Committee of the SRS Citizens Advisory Board (CAB) has met and reviewed strategy for closure of P Area. This resulted in the CAB adopting recommendation #233 on May 23, 2006, which supported public involvement in the process to determine the P-Reactor end state. At their subsequent July 23-24, 2006 meeting, the CAB formally issued recommendation #248, which requested DOE to hold public workshops to discuss selection of the P-Reactor end state. In response to this request, USDOE held two workshops for the Aiken area: the first on October 16, 2007, and the second on

February 28, 2008. An additional public workshop was held in Savannah, GA on May 19, 2008. These workshops were well publicized and included representatives from the USEPA Region 4 and SCDHEC. Additional workshops may be held if it is determined a need exists. Responses to public comments received during the three public workshops are also included in Appendix A.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT

Due to the complexity of multiple contaminant areas, the SRS is divided into Integrator Operable Units (IOUs) for the purpose of managing a comprehensive cleanup strategy. Waste units within an IOU are evaluated and remediated individually.

Portions of the PAOU are located in both the Steel Creek and Lower Three Runs watersheds (Figure 2). Upon disposition of all operable units within the Steel Creek and Lower Three Runs watersheds, a final comprehensive ROD for both the IOUs will be pursued with additional public involvement.

The overall strategy for addressing the PAOU was to (1) characterize the waste unit, delineate the nature and extent of contamination, and identify the media of concern; (2) evaluate the media of concern to identify exposure pathways, characterize potential risk, and identify constituents of concern (COCs); and (3) evaluate and perform a final action to remediate, as needed, and to address identified media of concern.

The current land use for the PAOU is industrial, and the decision for the final end-state of P-Reactor Building (105-P) and the PAOU early action subunits are based on the future industrial worker scenario. Remedial action objectives (RAOs) and likely response actions were developed based on industrial land use.

The selected final end-state decision for Reactor Building (105-P) and the early action remedies at the PAOU leave hazardous substances in place that pose a potential future risk; therefore, the PAOU will require LUCs for an indefinite period of time. Unit-specific LUCs for the PAOU early action subunits will be selected the final ROD for the PAOU. In addition, CERCLA actions taken to address the early action units and the remaining PAOU units will be included in the final ROD for the PAOU as part of the overall cleanup strategy.

The principal sources of contamination for the early action PAOU subunits that require remedial action include the following:

- Radiological and hazardous constituents associated with the P-Reactor Building (105-P) that present a risk/hazard to future human receptors.
- Two source zones of VOC contamination in soil that present a threat of contaminant migration to groundwater above MCLs at PSA-3A and PSA-3B;
- Radiologically contaminated soil at Outfall P02;
- Radiologically contaminated media in the rail bed material along the Cask Car Railroad Tracks.

The response action for the P-Reactor Building (105-P) will minimize human exposure to unacceptable risk associated with radiological and hazardous constituents that are or may be present within P-Reactor. The response action for the VOC source areas will reduce vadose zone concentrations of TCE (PSA-3A) and PCE (PSA-3B) to levels that will not exceed the MCLs in groundwater. The response action for the Outfall P02 and the HCA at the Cask Car Railroad Tracks will reduce risk to the industrial worker from direct exposure to radionuclides (cesium-137 (+D) and cobalt-60).

Groundwater contamination in the vicinity of the PAOU will be addressed in the in the PRGW Operable Unit (OU).

V. OPERABLE UNIT CHARACTERISTICS

This section presents the conceptual site models (CSM), provides an overview of the characterization activities, and presents the characterization results and COCs.

Conceptual Site Model for the PAOU Early Action Subunits

The CSMs identified and evaluated suspected sources of contamination, contaminant release mechanisms, potentially affected media (secondary sources of contamination), potential exposure pathways, and potential human and ecological receptors.

The primary sources of contamination at the PAOU are due to P-Reactor Facility and other P Area operations. Spills, leaks, accidental releases, or simply the operation itself resulted in releases of hazardous and/or radioactive substances. If the primary source were to contact other media, secondary sources of contamination could be created through several release mechanisms. Typically, the potential secondary release mechanisms include release of volatile constituents from the soil (volatilization), generation of contaminated fugitive dust by wind or other surface soil disturbance, biotic uptake, radiation emissions, bioturbation between surface and subsurface soils and infiltration/ percolation/leaching to groundwater. Contact with contaminated environmental media created potential pathways for both human and ecological receptors. The future industrial worker was chosen as the baseline risk assessment exposure scenario for quantitative evaluation of human receptors at this site. Although a quantitative evaluation of the future resident scenario was not performed, it was qualitatively assessed by recognizing that residential use of the area will be restricted by implementing land use restrictions to ensure long-term protectiveness. Potential ecological receptors include terrestrial receptors such as soil invertebrates, herbivorous mammals, insectivorous mammals, omnivorous mammals, insectivorous bird, and carnivorous birds.

The primary exposure pathways for evaluation relative to the future industrial worker include:

- Exposure to surface (0-1 ft) soil or gravel via incidental ingestion, dermal contact, inhalation of windblown dust, inhalation of volatile organic constituents, and external exposure to radionuclides. These exposure pathways apply to the HCA at the Cask Car Railroad Tracks and the P02 Outfall. In addition, sediment media within the Disassembly Basin was evaluated using the same pathways as soil media.

- Exposure to concrete surface media via the incidental ingestion and external radiation pathways. These exposure pathways apply to the P-Reactor Building (105-P) proper.
- Exposure to metal media via the external radiation pathway. This pathway applies to the Reactor Vessel only, and is considered a conservative evaluation since currently there is not a complete exposure pathway due to access controls and various shielding structures within the facility.

A potentially complete exposure pathway exists for ecological receptors for the surface (0-1 ft) and subsurface (1-4 ft) soil via incidental ingestion, dermal contact, inhalation of windblown dust (surface only), biotic uptake, and external exposure to radionuclides. These pathways were evaluated for the ecological receptors at the P02 Outfall. The HCA at the Cask Car Railroad Tracks is a linear feature in an industrial setting and does not provide habitat, or an exposure scenario, for ecological receptors.

Subsurface soils and building features (e.g., sumps, trenches, pipelines, etc.), that are below the grade (i.e., > 1 ft) of concrete slabs, gravel, or soil offer a potential exposure pathway for a future industrial worker under an excavation scenario. This pathway will be evaluated in the PTSM analysis for each early action unit.

Leaching of contaminants from the contaminated media (concrete, pipeline, soil) to groundwater constitutes a secondary contaminant release mechanism. The potential to leach to groundwater is evaluated in the contaminant migration analysis. Ingestion of groundwater offers a potentially complete pathway for human receptors. However, the groundwater media is not considered within the scope of the PAOU; any groundwater contaminated by the PAOU will be addressed as part of the PRGW OU.

The CSMs for the P-Reactor Building (105-P), PSA-3A, PSA-3B, the P02 Outfall, and the HCA at the Cask Car Railroad Tracks are presented in Figures 5 through 8.

Media Assessment

The Combined Document (WSRC 2008c) contains detailed information and analytical data for all the investigation conducted and samples taken in the media assessment of the PAOU. This document is available in the ARF (see Section III of this document). A summary of significant events relating to the characterization activities for the early action subunits is presented below. All characterization activities that were proposed in the Work Plan (WSRC 2005) have been completed.

Vadose Zone Investigation

Soil-gas, soil, and gravel samples were collected, evaluated, and screened against appropriate regulatory thresholds and protocols to identify constituents of concern that would warrant further remedial action units other than the P-Reactor Building (105-P).

Soil-gas sampling was conducted as an initial screen in detecting the presence of VOCs in the subsurface. Soil-gas data were used as a screening tool to assist in delineating areas that indicate elevated levels of VOCs and if necessary, direct depth-discrete VOC soil sampling to delineate the extent of contamination within the vadose zone.

Soil samples collected were evaluated against a trigger level of 20 and 50 pCi/g for gross alpha and nonvolatile beta, respectively. If a sample exceeded either of these trigger levels, the sample was speciated according to the appropriate analyses for that radionuclide indicator.

For field investigation, radiological instruments were used as a precursor to determining a gross-level of radioactivity in PAOU surface units prior to sampling events. This field activity included the use of sodium iodide (NaI) detectors and other radiological handheld surveying instruments. The detectors/instruments were used at the P02 outfall, as well as the HCA associated with the Cask Car Railroad Tracks.

P-Reactor Building (105-P) Investigation

At the P-Reactor Building (105-P) various assessments were used to determine the overall inventory within the building. Concrete samples were collected throughout the building along with water and sludge samples from the Disassembly Basin. In addition, radiological surveys were also performed. Modeling was used to determine the inventory within the reactor vessel.

Groundwater Investigation

Although groundwater is not included as part of the PAOU, groundwater samples were collected to support conclusions concerning further impact from the vadose zone (PSA-3A and PSA-3B) into the groundwater system and direct future groundwater characterization efforts. The groundwater will be addressed by the PRGW OU.

Media Assessment Results

In summary, the PAOU early action subunits and P-Reactor Building (105-P) were investigated to determine the nature and extent of contamination, the risks to an industrial worker and the environment, the presence of PTSM, and if there are constituents that are of contaminant migration concern. Soil-gas, soil, gravel, concrete, sludge, and groundwater samples were collected, evaluated, and screened against appropriate regulatory thresholds and protocols to identify constituents of concern that would warrant further remedial action. As an outcome of these evaluations, contaminants in surface soil were identified that exceed industrial worker human health risk at the P02 Outfall, and the HCA at the Cask Car Railroad Tracks. In addition, contaminants in surface soil at the P02 Outfall were qualitatively identified that may exceed industrial worker human health risk thresholds. PTSM was also determined to be present at the HCA in gravel and cross ties. VOCs were determined to be a contaminant migration concern at PSAs-3A and -3B. Contaminants were identified in metal components, concrete, and sediment at the P-Reactor Building (105-P) that exceeded industrial worker risk.

Contamination was determined to be present in the groundwater. Earlier investigations had identified the presence of VOCs and tritium in the groundwater. No additional contamination was determined to be present. However, the scope associated with groundwater investigation was limited to the shallow groundwater and defining the nature and extent of contamination as the groundwater will be addressed later under the PRGW OU.

P-Reactor Building (105-P) Media (concrete, metal, sediment)

General radiological levels within the P-Reactor Building (105-P) have been summarized (WSRC 2007), and the process room, Disassembly Basin, purification wing, and minus 20 ft, minus 40 ft, and minus 49.5 ft levels are all classified as radiological contamination areas. The radiation levels in these areas are due to the cumulative effect of residual fission and activation products remaining within the basins, tanks, stainless steel piping, valves, heat exchangers, pumps, instruments etc. Remaining areas within the building are classified as non-radiological. Certain localized regions within the contamination areas were identified in the Hazard Assessment Document (HAD) (Patel and Steiner 2004) as containing highly radioactive sources.

To evaluate the risk presented by the P-Reactor Building (105-P) Complex, the building assessment was divided into the three principal components which were integral to reactor operations and comprise the three principal sources of contamination:

- Reactor Vessel (metal)

- Reactor Disassembly Basin (sediment)
- Reactor building structure and ancillary equipment and structures (concrete)

The Reactor Vessel together with the thermal and biological shielding around the vessel, have been estimated to contain 211,000 Ci of neutron-activated metal and concrete (WSRC 2008b). At the Reactor Vessel, the following four radionuclides exceed the PTSM threshold (1.0E-03) for the industrial worker with a cumulative risk of 1.3E+03: cobalt-60, nickel-63, barium-133, and europium-152. The short-term risk is driven almost exclusively by cobalt-60, which has a half life of 5.27 years. Results of the risk evaluation for the P-Reactor Vessel are presented in Section VII of this document.

The Disassembly Basin is estimated to contain approximately 14,600 Ci of contaminated water, sediment, and activated scrap metal. At the Disassembly Basin, eighteen radiological constituents in sediment exceeded the PTSM threshold of 1.0E-03 and the cumulative risk for the sediment media is 6.3E+00 with the primary risk drivers being cobalt-60, cesium-137, and tritium. In addition the three primary radionuclide risk drivers, one metal, total uranium, exceeds the PTSM threshold (HQ > 10) for noncarcinogens with a HQ = 19. Results of the risk evaluation for the Disassembly Basin are presented in Section VII of this document.

The remainder of the P-Reactor Building (105-P) is estimated to contain approximately 14,200 Ci of contaminated concrete and process related equipment. For the remainder of the reactor building, ancillary equipment, and structures, the following three radiological constituents in concrete at the minus 20 ft exceeded the PTSM threshold of 1.0E-03 with a total cumulative risk of 1.4E-02: cobalt-60, cesium-137, and strontium-90. Cesium-137 exceeded the PTSM threshold in the minus 40 ft level with a total cumulative risk of 1.3E-02. No PTSM is present in the minus 49.5 ft level. However, tritium is present throughout the building, and in some localized areas, tritium activities are elevated. Overall, tritium is responsible for approximately 99% of concrete contamination throughout the building. Results of the risk evaluation for the reactor building structure are presented in Section VII of this document.

The current distribution of radioactivity throughout the P-Reactor Building (105-P) has been detailed extensively (WSRC 2008g) and is summarized in the chart below. Approximately 88% of the radiological inventory is contained within the activated matrix of the stainless steel reactor vessel and concrete biological and thermal shields. The Disassembly Basin contains approximately 6% of the inventory with the remaining 6% distributed throughout the above- and below-grade portion of the P-Reactor Building (105-P) in the form of contaminated concrete and equipment (WSRC 2008g).

A RSER/EE/CA (WSRC 2008d) and an Action Memorandum for the Non-Time Critical Removal Action for disposition of the water (USDOE 2008) have been submitted. Forced evaporation was selected as the preferred alternative. The implementation of this alternative will provide for a protective and cost-effective method for disposition of the Disassembly Basin water and is considered an interim measure that supports final decommissioning of the Reactor Building (105-P).

Distribution of radioactivity throughout P Reactor Building (105-P)

Building Segment	**Total Ci**	**Percentage**
Reactor Vessel	211,000	88
Disassembly Basin	14,637	6
Reactor Building	14,193	6
Total	**239,830**	**100**

Other potentially hazardous non-radiological contamination is known to be present in the P-Reactor Building (105-P) and has been inventoried (WSRC 2008f). Examples are asbestos pipe insulation, lead shielding blocks, paint that contains lead and polychlorinated biphenyls (PCBs) and mercury and some other metals. A total of approximately 67,177 lbs of these hazardous components are present throughout the building.

Lead (78%), iron (20%), and PCBs (1%) constitute 99% of the total hazardous material inventory within the Reactor Building (105-P). Lead is primarily found in the paint, brass parts, and lead bricks and shielding. Iron is found primarily in the sludge within the Disassembly Basin. PCBs are found principally associated with painted surfaces throughout the building. The remaining 1% is made up of other metals present in wiring, switches, sludge, and other system components. This material will remain in the facility as part of ISD. Other hazardous materials such as oil, fuel, and hydraulic fluids have been removed as part of deactivation.

Soil

The P02 Outfall is unique in that no constituents were identified as human health (HH) RCOCs based on the quantitative evaluation using the current set of data. However, cesium-137 and cobalt-60 are qualitatively identified as a HH RCOCs based on a high nonvolatile beta screening result (>500 pCi/g), gamma overflight data which indicated elevated radioactivity in the area, and previous Lower Three Runs IOU sample results from the same location.

Gamma overflight data also indicated a localized area of elevated gamma activity covering about 0.16 acres in the upper reaches of the P02 Outfall. Remediation maybe necessary to reduce risk to the industrial worker from direct exposure to radionuclides. PAOU sampling provided inconclusive data to support the presence of radionuclides in the soil. However, other data support the notion that the shallow soils are contaminated with radionuclides.

The HCA at the Cask Car Railroad Tracks extends over approximately 600 ft^2 (17 ft x 35 ft) and is located on a section of the railroad tracks to the south of the P-Reactor Building (105-P). At the HCA at the P-Reactor Cask Car Railroad Tracks, cobalt-60 and cesium-137 were detected in the surface gravel and crossties with a total media risk of 5.6E-03 to the industrial worker. By establishing a cobalt-60 remedial goal of 0.0596 pCi/g (1.0E-06 risk), cesium-137 would also be addressed by the early action. No other radionuclides were determined in the soil. Remediation is necessary to reduce risk to the industrial worker from direct exposure to radionuclides. Results of the risk evaluation for the HCA are presented in Section VII of this document.

Vadose Zone Soils and Groundwater

The scope associated with groundwater investigation during characterization of the PAOU was limited to collecting a sample from the shallow groundwater. The data collected during PAOU investigation was used to assess the impact from the vadose zone soils on the local groundwater. Defining the nature and extent of contamination in the groundwater is to be addressed later under the PRGW OU.

Because contamination is located in the vadose zone, there is no human health risk or ecological pathway for risk at either PSA-3A or PSA-3B source areas. Data collected from previous investigations and in support of the PAOU have indicated that the groundwater at the PAOU is contaminated with PCE, TCE and tritium which exceed MCLs of 5.0 microgram per liter (µg/L) and 20 picocuries per milliliter (pCi/mL), respectively. The VOC groundwater plumes originate at PSAs-3A and -3B and flows toward Steel Creek. Tritium is present in the groundwater to the west, north, and east of the P-Reactor Building (105-P). The tritium plume that originates from the west and north of the building flows toward Steel Creek. Tritium and TCE are presently discharging in Steel Creek at concentrations above their respective MCLs. The tritium plume to the east of the P-Reactor Building (105-P) is limited in size but has a flow direction towards an unnamed tributary to the east.

Contaminant migration screening indicated that TCE (at PSA-3A) and PCE (at PSA-3B) exceed the contaminant migration remedial goal (RG) of 0.53 mg/kg for soil and have the potential to migrate to groundwater at levels that would exceed the MCL of 5 µg/l. The estimated aerial extent of the TCE source area at PSA-3A is 1.17 acres located at a depth of between 6 to 45 ft bgs. The estimated extent of the PCE plume at PSA-3B is 0.68 acres at a depth of between 10 and 45 ft bgs.

Site Specific Factors

No site-specific factors requiring special consideration that might affect the remedial action for the PAOU are present at the site. The area is undergoing Area Closure with no active facilities or operations present at P Area.

Contaminant Transport Analysis

Contaminant fate and transport analyses were performed to select contaminant migration (CM) COCs on the basis of leaching by infiltrating water and subsequent transport to groundwater. Theses analyses were also used to predict the rate of contaminant migration and to project contaminant concentrations at receptor locations via various transport media. The overall objective of these analyses is to evaluate potential future impact to human health and the environment. The modeling identified PCE (PSA-3B) and TCE (PSA-3A) as CM COCs at the vadose zone subunits which is supported by the data collected as currently indicating impact to the environment.

A Tier 1 level Contaminant Migration Screening Calculation was performed (WSRC 2006c) for the P-Reactor Building (105-P), including the Disassembly Basin. The Contaminant Migration Screening Calculation estimates the maximum contaminant inventory (threshold activity/mass) that the building can contain before the contaminants could impact groundwater greater than a regulatory threshold (i.e., MCL). The Contaminant Migration Screening Calculation indicates that VOCs and semi-VOCs do not represent a significant risk as their maximum quantity limits are high, and their presence within the P-Reactor Building (105-P) is either nonexistent or sparse. Certain radionuclides (i.e., carbon-14, nickel-59, nickel-63, plutonium 239/240, and tritium) were identified as having a potential to migrate to groundwater at levels that exceed regulatory standards unless engineering controls are applied.

The Tier 1 level Contaminant Migration Screening Calculation presents an overly conservative picture of the contaminant release rate to the environment from the building. A more complex model, Tier 2 level, has been developed to perform a more realistic analysis of potential releases from the building source areas (WSRC 2008c). The results of this more complex model will present a more realistic, yet less conservative, estimate of the contamination that can be contained within the P-Reactor Building (105-P) after closure without representing a future threat of groundwater contamination.

VI. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

Land Uses

According to the *Savannah River Site Future Use Project Report* (USDOE 1996), residential uses of SRS land should be prohibited. The Savannah River Site Long Range Comprehensive Plan (USDOE 2000) designated the PAOU as being within the site industrial support area (Figure 9).

Future industrial land use is expected and will be controlled in accordance with the SRS Land Use Control Assurance Plan (LUCAP). An industrial land use scenario is selected as the baseline risk assessment exposure scenario for the protection of human health and the environment.

Groundwater Uses/Surface Water Uses

P-Area shallow groundwater has been impacted by previous reactor operation in the area and will be evaluated under CERCLA for future remedial action. Although there is no anticipated current or future use of the groundwater, SRS procedures, in conjunction with South Carolina regulations, will prevent use of the groundwater without prior approval. These administrative controls will remain in effect until land use controls are established as part of the final CERCLA remedial action for the P-Reactor Groundwater Operable Unit.

VII. SUMMARY OF OPERABLE UNIT RISKS

Baseline Risk Assessment

As a component of the RFI/RI process, a Baseline Risk Assessment (BRA) was performed to evaluate risks associated with the PAOU (WSRC 2008c). The BRA estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The BRA includes human health and ecological risk assessments, fate and transport analysis, and PTSM evaluations. This section of the EAROD summarizes the results of the BRA for the early action subunits and P-Reactor Building (105-P).

Summary of Human Health Risk Assessment

The future industrial worker scenario was chosen to document the analysis of the potential for adverse human health effects. This is a standard USEPA scenario which addresses long-term-risks to workers who are exposed to unit contaminants within an industrial setting. The future industrial worker is an adult who hypothetically works on-unit for the majority of time.

The primary exposure pathways for evaluation relative to the future industrial worker include:

- Exposure to surface (0-1 ft) soil or gravel via incidental ingestion, dermal contact, inhalation of windblown dust, inhalation of volatile organic constituents, and external exposure to radionuclides. These exposure pathways apply to the HCA at the Cask Car Railroad Tracks, and the Outfall P02. In addition, sediment media within the Disassembly Basin was evaluated using the same pathways as soil media.

- Exposure to concrete surface media via the incidental ingestion and external radiation pathways. These exposure pathways apply to the P-Reactor Building (105-P) proper.

- Exposure to metal media via the external radiation pathway. This pathway applies to the Reactor Vessel only, and is considered a conservative evaluation since currently there is not a complete exposure pathway due to access controls and various shielding structures within the facility.

Preliminary remediation goals (PRGs) are risk-based concentrations used to evaluate and clean up contaminated sites. The USEPA Region 9 publishes a table which is the source of PRGs for nonradiological constituents (USEPA 2004); it combines USEPA toxicity values with standard exposure factors to estimate contaminant concentrations in soil that the agency considers protective of humans over a lifetime. USEPA Region 9 PRG concentrations are based on direct contact pathways for which generally accepted methods, models, and assumptions have been developed (i.e., ingestion, dermal contact, and inhalation) for specific land use conditions. More detailed information can be found at the USEPA Region 9 website: http://www.epa.gov/region09/waste/sfund/prg/index.htm.

USEPA does not publish radiological values in a standardized table. However, the agency has issued updated guidance on calculation methods used for determining radionuclide activity screening levels. USEPA's Superfund Radionuclide PRG website provides a database tool to derive risk-based PRGs calculated using default parameters and the latest toxicity values. The database tool also allows the user to modify input parameters to create site-specific PRGs. The USEPA website provides specific details regarding use of the database tool to calculate the PRGs: http://epa-prgs.ornl.gov/radionuclides/.

Selected radionuclides and radioactive decay chain products are designated with the suffix "(+D)" (plus daughter) to indicated that the cancer risk estimates for these radionuclides include contributions from their short-lived decay products, assuming equal activity concentrations (i.e., secular equilibrium) with the principal or parent nuclide in the environment. The "(+D)" indicates that associated decay products with half-lives less than six months are included in the PRG. Decay chains for these radionuclides are described in the USEPA website: http://epa-prgs.ornl.gov/radionuclides.

A streamlined approach using the PRGs derived from these two sources was used to quantify the human health risk estimates at the PAOU. The risk calculation was performed by dividing the exposure point concentration by the appropriate PRG. Carcinogenic constituents with an individual cancer risk $\geq$ 1E-06 and noncarcinogenic constitutes with a hazard quotient (HQ) ≥ 1 were identified as HH COCs. A recommendation of whether or not a HH COC should be carried forward for further remedial evaluation as a HH RCOC was based on a thorough analysis of each COC in an uncertainty evaluation.

Risk Assessment Guidance for Superfund (RAGS) Part D tables are presented for HH RCOCS to support the following human health risk discussion. Table 2 provides a summary of the cancer toxicity data and Table 3 provides a summary of the non-cancer toxicity data. Results of the human health risk assessment (HHRA) for the early action subunits and P-Reactor Building (105-P) are provided below.

P-Reactor Building (105-P) Complex

The P-Reactor Building (105-P) Complex as a whole is comprised of three principal components which were integral to reactor operations. The three components evaluated in the HHRA include the Reactor Vessel, the Disassembly Basin, and the P-Reactor Building (105-P) structure and ancillary equipment and structures (concrete). The human health risk assessment conservatively assumed that currently there are no access or exposure controls in place at this facility.

Reactor Vessel

Table 4 is a summary of the RCOCs and the exposure point concentrations for the Reactor Vessel. Eleven radiological constituents were identified as HH RCOCS: barium-133, carbon-14, cobalt-60, europium-152, europium-154, iron-155, molybdenum-93, nickel-59, nickel-63, niobium-94, and potassium-40.

Table 5 presents the risk characterization summary for these RCOCs. Four radiological constituents exceed a risk of 1E-03. These constituents include barium-133 (risk = 1.8E-02), cobalt-60 (risk = 1.3E+03), europium-152 (risk = 5.3E-03), and nickel-63 (2.2E-03). In addition, seven constituents have a risk estimate greater than 1E-06 but less than 1E-03. These constituents include carbon-14 (risk = 2.8E-05), europium-154 (risk = 4.6E-04), iron-55 (risk = 8.2E-05), molybdenum-93 (risk = 7.3E-06), nickel-59 (risk = 9.3E-06), niobium-94 (6.1E-05), and potassium-40 (risk = 1.1E-05). The total cumulative risk for the Reactor Vessel is 1.3E+03; the primary risk driver is cobalt-60.

Disassembly Basin

Table 6 is a summary of the RCOCs and the exposure point concentrations for sediment in the Disassembly Basin. Forty-nine radiological constituents and five nonradiological constituents were identified as HH RCOCS.

Table 7 presents the risk characterization summary for the carcinogenic RCOCs. Eighteen radiological constituents exceed a risk of 1E-03. These constituents include americium-241 (risk = 6.5E-03), americium-243 (+D) (risk = 7.2E-03), antimony 125 (+D) (risk = 1.5E-03), curium-243/244 (risk = 3.1E-03), curium-245 (risk = 4.3E-03), cobalt 60 (risk = 3.6E+00), cesium-137 (+D) (risk = 5.4E-01), europium-152 (risk = 1.9E-02), europium-154 (risk = 5.2E-02), tritium (risk = 2.0E+00), potassium-40 (risk= 3.0E-03), sodium-22 (risk = 5.6E-03), niobium-94 (risk = 1.2E-02), plutonium-238 (risk = 1.8E-02), plutonium-239/240 (risk = 1.4E-03), radium-228 (+D) (risk = 9.4E-03), thorium-228 (+D) (risk = 1.2E-03), and strontium-90 (+D) (risk = 3.1E-03). The total cumulative risk for the sediment media is 6.3E+00. The primary risk drivers include cobalt-60 (risk = 3.6E+00), cesium-137 (+D) (risk = 5.4E-01), and tritium (risk = 2.0E+00).

Thirty-one constituents have a risk estimate greater than 1E-06 but less than 1E-03 (Table 7). These constituents are also designated as HH RCOCs: arsenic, antimony-124, barium-133, californium-249, californium-251, carbon-14, cerium-141, cerium-144 (+D), curium-246, cobalt-57, cobalt-58, cesium-137 (+D), cesium-135, europium-155, iodine-129, manganese-54, nickel-63, neptunium-237 (+D), promethium-144, promethium-146, plutonium-241, plutonium-242, selenium-79, tin-126, uranium-233, uranium-234, uranium-235 (+D), uranium-238 (+D), yttrium-88, zinc-65 and zirconium-95. The contribution of these constituents to the total cumulative risk value is negligible (i.e., total cumulative risk is 6.3E+00).

Table 8 presents the risk characterization for the nonradiological RCOCs. One constituent (uranium) has a hazard quotient greater than ten (HQ = 19). In addition, three noncarcinogenic constituents have HQs greater than one and are identified as HH RCOCs. These constituents include antimony (HQ = 1.2), iron HQ = 2.7) and lead (HQ = 1.3).

Reactor Building Structure and Ancillary Equipment and Structures

Three levels (minus 20 ft, minus 40 ft, and minus 49.5 ft) were evaluated in the HHRA. Table 9 identifies the HH RCOCs and the exposure point concentrations for the P-Reactor Building (105-P): Aroclor 1254, cesium-137 (+D), cobalt-60, strontium-90 (+D) and uranium-238 (+D).

At the minus 20 ft level, the following constituents were identified as HH RCOCs for surface concrete (Table 10): Aroclor 1254 (risk = 3.2E-05), cesium-137 (+D) (risk = 9.9E-03), cobalt-60 (risk = 4.2E-03), strontium-90 (+D) (risk = 2.6E-05) and uranium-238 (+D) (risk = 6.0E-06): total cumulative risk = 1.4E-02.

At the minus 40 ft level, the following constituents were identified as HH RCOCs for surface concrete (Table 10): Aroclor 1254 (risk = 5.7E-06), cesium-137 (+D) (risk = 1.3E-02), cobalt-60 (risk = 5.7E-05), and strontium-90 (+D) (risk = 6.6E-05): total cumulative risk = 1.3E-02.

At the minus 49.5 ft level, Table 10 identifies cesium-137 (+D) as a HH RCOC for surface concrete (risk = 1.7E-04).

HCA at the Cask Car Railroad Tracks

Table 11 is a summary of the RCOCs and the exposure point concentrations for the HCA at the Cask Car Railroad Tracks subunit. Cesium-137 (+D) and cobalt-60 are HH RCOCs at this subunit. Cesium-137 (+D) exceeds a risk level of 1E-03. Table 12 presents the risk characterization summary for the HH RCOCs: cesium-137 (+D) (risk = 5.6E-03) and cobalt-60 (risk = 9.9E-06); total cumulative risk = 5.6E-03.

Outfall P02

The P02 Outfall is unique in that no constituents were identified as HH RCOCs based on the quantitative evaluation using the current set of data. Therefore RAGS Part D tables are not presented for this subunit. However, cesium-137 (+D) and cobalt-60 are qualitatively identified as a HH RCOCs based on a high nonvolatile beta screening result (>500 pCi/g), gamma overflight data which indicates elevated radioactivity in the area, and previous Lower Three Runs IOU sample results from the same location. Confirmation of the elevated results will be addressed in confirmatory sampling in support of the early action.

Summary of Ecological Risk Assessment

There are no ecological RCOCs identified for any of the subunits associated with this early action.

Summary of the Fate and Transport Analysis

A contaminant migration analysis was performed to identify CM COCs. The constituent is identified as a CM COC if leachability modeling predicts the constituent will leach to groundwater and exceed MCLs or PRGs within 10,000 years. The leachability modeling identified two constituents, PCE and TCE, as CM COCs for PSA-3B (PCE) and PSA-3A (TCE). No additional CM COCs were identified at the PAOU as a result of this evaluation.

Discussion of Principal Threat Source Material

PTSM are those that include or contain hazardous substance, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air that acts as a source for direct exposure. In order to determine whether contaminated source material/soils/sediment should be considered PTSM, a simple quantitative assessment evaluating the toxicity of the source was performed.

The source material is considered to be PTSM if the cumulative risk exceeds one of the following toxicity threshold criteria:

- Carcinogens - greater than 1E-03 industrial worker risk
- Noncarcinogens – industrial worker hazard index (HI) greater than 10

P-Reactor Vessel

Four radiological constituents that exceed the PTSM risk threshold of 1E-03. These constituents include barium-133 (risk = 1.8E-02), cobalt-60 (risk = 1.3E+03), europium-152 (risk = 5.3E-03), and nickel-63 (2.2E-03). The total cumulative risk for the reactor vessel is 1.3E+03; the primary risk driver is cobalt-60. Detailed results of the PTSM/Risk Evaluation for the Reactor Vessel can be found in Table 13.

Disassembly Basin

Eighteen radiological constituents exceed the PTSM risk threshold of 1E-03. These constituents include americium-241 (risk = 6.5E-03), americium-243 (+D) (risk = 7.2E-03), antimony 125 (+D) (risk = 1.5E-03), curium-243/244 (risk = 3.1E-03), curium-245 (risk = 4.3E-03), cobalt 60 (risk = 3.6E+00), cesium-137 (+D) (risk = 5.4E-01), europium-152 (risk = 1.9E-02), europium-154 (risk = 5.2E-02), tritium (risk = 2.0E+00), potassium-40 (risk= 3.0E-03), sodium-22 (risk = 5.6E-03), niobium-94 (risk = 1.2E-02), plutonium-238 (risk = 1.8E-02), plutonium-239/240 (risk = 1.4E-03), radium-228 (+D) (risk = 9.4E-03), thorium-228 (+D) (risk = 1.2E-03), and strontium-90 (+D) (risk = 3.1E-03). The total cumulative risk for the sediment media is 6.3E+00. The primary risk drivers include cobalt-60 (risk = 3.6E+00), cesium-137 (+D) (risk = 5.4E-01), and tritium (risk = 2.0E+00).

In addition, one nonradiological constituent, uranium, has a hazard quotient greater than the PTSM threshold value of 10 (HQ = 19). Detailed results of the PTSM/Risk Evaluation for the Disassembly Basin can be found in Table 14.

P-Reactor Building (general)

Two radiological constituents exceed the PTSM risk threshold of 1E-03; cesium 137 (+D) (risk = 1.3E-02) and cobalt-60 (risk = 4.2E-03) with a total cumulative risk of 1.7E-02. These risk estimates are conservatively based on the maximum detected concentrations. PTSM is present in the minus 20 ft and minus 40 ft levels. No PTSM is present in the minus 49.5 ft level. Detailed results of the PTSM/Risk Evaluation for the P-Reactor Building (105-P) can be found in Table 15.

HCA at the Cask Car Railroad Tracks

Cesium-137 (+D) is identified as a PTSM RCOC for the gravel/soil media at the HCA at the Cask Car Railroad Tracks (risk = 1.8E-02). This risk estimate is conservatively based on the maximum detected concentration. Detailed results of the PTSM/Risk Evaluation for HCA at the Cask Car Railroad Tracks can be found in Table 16.

P02 Outfall

No PTSM is present at these two subunits.

Conclusions

P-Reactor Building (105-P) Complex: P-Reactor Vessel

Eleven radiological constituents are identified as HH RCOCs - four of these constituents exceed the PTSM risk threshold of 1E-03 and the remaining seven constituents have a risk estimate greater than 1E-06 but less than 1E-03. The total cumulative risk for the P-Reactor Vessel is 1.3E+03; the primary risk driver is cobalt-60.

P-Reactor Building (105-P) Complex: P-Reactor Disassembly Basin

Fifty carcinogenic (49 radiological, one nonradiological) constituents are identified as HH RCOCs - eighteen of these constituents exceed the PTSM risk threshold of 1E-03 and the remaining 31 constituents have a risk estimate greater than 1E-06 but less than 1E-03. The total cumulative risk for the sediment media is 6.3E+00. The primary risk drivers include cobalt-60 (risk = 3.6E+00), cesium-137 (+D) (risk = 5.4E-01), and tritium (risk = 2.0E+00).

One nonradiological constituent, uranium, exceeds the PTSM threshold value of ten (HQ = 19). In addition, three noncarcinogenic constituents have HQs greater than one and are also identified as HH RCOCs. These constituents include antimony, iron and lead.

P-Reactor Building Complex(105-P): Reactor Building (105-P)

Two radiological constituents exceed the PTSM risk threshold of 1E-03; cesium 137 (+D) (risk = 1.3E-02) and cobalt-60 (risk = 4.2E-03) with a total cumulative risk of 1.7E-02. These risk estimates are conservatively based on the maximum detected concentrations. PTSM is present in the minus 20 ft and minus 40 ft levels only. No PTSM is present in the minus 49.5 ft level.

At the minus 20 ft level, the following constituents were identified as HH RCOCs for surface concrete: Aroclor 1254 (risk = 3.2E-05), cesium-137 (+D) (risk = 9.9E-03), cobalt-60 (risk = 4.2E-03), strontium-90 (+D) (risk = 2.6E-05) and uranium-238 (+D) (risk = 6.0E-06): total cumulative risk = 1.4E-02.

At the minus 40 ft level, the following constituents were identified as HH RCOCs for surface concrete: Aroclor 1254 (risk = 5.7E-06), cesium-137 (+D) (risk = 1.3E-02) cobalt-60 (risk = 5.7E-05), and strontium-90 (+D) (risk = 6.6E-05): total cumulative risk = 1.3E-02.

At the minus 49.5 ft level, cesium-137 (+D) was identified as a HH RCOC for surface concrete (risk = 1.7E-04).

HCA at the Cask Car Railroad Tracks

Cesium-137 (+D) is identified as a PTSM RCOC for the gravel/soil media at the HCA at the Cask Car Railroad Tracks (risk = 1.8E-02). This risk estimate is conservatively based on the maximum detected concentration.

HH RCOCs at this subunit include cesium-137 (+D) (risk = 5.6E-03) and cobalt-60 (risk = 9.9E-06); total cumulative risk = 5.6E-03.

P02 Outfall

There is no PTSM present at the P02 Outfall.

The P02 Outfall is unique in that no constituents were identified as HH RCOCs based on the quantitative evaluation using the current set of data. However, cesium-137 (+D) and cobalt-60 are qualitatively identified as a HH RCOCs based on a high nonvolatile beta screening result (>500 pCi/g), gamma overflight data which indicates elevated radioactivity in the area, and previous Lower Three Runs IOU sample results from the same location. Confirmation of the elevated results will be addressed in a sampling event in support of the early action.

PSA-3A and PSA-3B

The leachability modeling identified two constituents, PCE and TCE, as CM COCs for PSA-3B (PCE) and PSA-3A (TCE). No additional CM COCs were identified at the PAOU as a result of this evaluation.

VIII. REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOALS

The goals of remedial actions are to protect human health and the environment and to mitigate the effects of contamination. USEPA has established a structured process to identify and evaluate technologies for remedial applications. This process involves developing and screening a range of appropriate remedial options and selecting the most suitable approach (es) for corrective measures and remedial actions.

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) specifies six criteria for developing this range of remedial technologies [40 CFR Part 300.430 (a) (1) (iii) (A)-(F)]:

- Whenever practical, use treatment to address principal threats posed by the unit.
- Use engineering controls for waste that poses a relatively low long-term risk or when treatment is impractical.
- Combine methods (for example, treatment plus engineering controls) to protect human health and the environment.

- Supplement engineering controls with institutional controls to prevent or limit exposure.
- Whenever practical, use innovative technologies.
- Return usable groundwater to beneficial uses or prevent further degradation.

Remedial action objectives (RAOs) are media- or OU-specific objectives for protecting human health and the environment. RAOs usually specify protection of potential receptors, exposure pathways, and are identified during the scoping process once the CSM is understood. The CSM is developed from data gathered during site characterization and includes a description of contaminants that are present and the potential receptors that may be impacted. RGOs are typically identified along with the RAOs, and represent the preliminary media-specific goals that provide a measure that the RAO will achieve for a selected remedial action. RAOs are based on the nature and extent of contamination and the potential for human and environmental exposure for each contaminated environmental medium.

RGOs can be qualitative statements or numerical values often expressed as concentrations in soils or groundwater, or actions that achieve the RAO. RGOs become finalized as remedial goals (RGs) after public comment and approval of the EAPP and are documented in this EAROD. Final RGs will be monitored to determine when the remedial action is complete. The development of final RGs for cleanup actions is intended to protect human health and the environment and to prevent further contaminant migration. Final RGs for the PAOU early action subunits as well as the rationale or basis for selection are summarized in Table 17. Table 18 provides a summary of the cleanup levels for soils at each of the subunits presented in this EAROD. Table 20 does not provide cleanup levels for the P-Reactor Building (105-P). As stated earlier, the EAPP proposes an *in situ* disposal end-state for the P-Reactor Building (105-P) including the Disassembly Basin, the Engine Houses (108-1P and 108-2P), and the Pumphouse (191-P) which will allow subsequent engineering efforts and regulatory decisions to focus only on closure alternatives that are appropriate for the proposed end-state. Therefore, the final RGs for the P-Reactor Building (105-P) will be discussed in the final PAOU ROD.

The Early Action Corrective Measures Implementation/ Remedial Action Implementation Plan (CMI/RAIP) will outline the design strategy for the remedial action (using the selected remedies) documented in this EAROD. The Early Action CMI/RAIP also discusses typical activities to be conducted during construction and implementation of the remedial action and the mechanisms for demonstrating completion.

P-Reactor Building (105-P)

The RAOs for the P-Reactor Building (105-P) are defined as follows:

- Minimize human and ecological exposure to unacceptable risk associated with radiological and hazardous constituents that are or may be present within P-Reactor Building (105-P);
- Prevent migration of radiological and chemical contamination from P-Reactor Building (105-P) to groundwater; and
- Eliminate or control all routes of human exposure to radiological or chemical contamination.

VOC Source Areas

The RAO for the VOC Source Areas is defined as follows:

- Reduce vadose zone concentrations of TCE (PSA-3A) and PCE (PSA-3B) to levels that will not exceed the MCLs in groundwater.

TCE and PCE within the vadose zone at PSA-3A and PSA-3B subunits pose a threat to groundwater quality because of leaching. The RG for both PSAs is 0.53 mg/kg for both TCE and PCE.

P02 Outfall

The RAO for the P02 Outfall is defined as follows:

- Prevent exposure to the industrial worker to levels above background or risk greater than 1.0E-06 at Outfall P02.

At Outfall P02, cobalt-60 is detected with cesium-137 (+D) since both radionuclides originated from the same source. A RGO of 0.0596 pCi/g for cobalt-60 and a RG of 1.0 pCi/g for cesium-137 (+D) were established to address cleanup at the P02 Outfall.

HCA at the Cask Car Railroad tracks

The RAOs for the HCA at the Cask Car Railroad Tracks are defined as follows:

- Prevent industrial worker exposure to contaminated surface gravel/crossties above background or risk greater than 1.0E-06; and
- Remove or treat PTSM to the extent practical within the gravel and/or crossties.

Cobalt-60 and cesium-137 (+D) is also detected at the HCA. A RG of 0.0596 pCi/g for cobalt-60 and a RG of 1.0 pCi/g for cesium-137 (+D) were established to address cleanup at the HCA at the Cask Car Railroad Tracks.

IX. DESCRIPTION OF ALTERNATIVES

Remedial alternatives for the P-Reactor Building (105-P) have been preliminarily evaluated in the *105-P Alternatives Cost Analysis* (WSRC 2008e) and the PAOU subunits have been evaluated in the Combined Document (WSRC 2008c). These detailed analyses were conducted to determine the best set of alternatives for the PAOU early action subunits and the P-Reactor Building (105-P).

While land use controls are expected to be part of the final remedy, unit-specific land use controls for the PAOU early action subunits and P-Reactor Building (105-P) will be determined in the Early Action CMI/RAIP for the PAOU.

Remedy Components, Common Elements, and Distinguishing Features of Each Alternative

For each of the alternatives below, a discount rate of 3.9% and an inflation rate of 0% were used to estimate the present-worth. The present-worth costs include the five-year remedy reviews if included as part of the alternative. The costs for institutional controls for each alternative will be included in the final PAOU Record of Decision. Detailed breakdowns of these cost summaries are included in Appendix B. Present-worth costs for these items are based on an estimated operation time frame of up to 200 years. Applicable or relevant and appropriate requirements (ARARs) for the PAOU early action subunits and P-Reactor Building (105-P) are provided in Section X.

Alternatives for the P-Reactor Building (105-P)

Three alternative end states were developed and screened for this subunit based on effectiveness, implementability, and cost.

<u>Alternative AR-1 - No Action Alternative:</u>

The No Action alternative for the P-Reactor Building (105-P) makes no remedial effort to restrict access to the building, to limit exposure or to reduce contaminant concentrations, volume or mobility beyond those already in place. Institutional controls would be maintained; and monitoring and reporting would be conducted indefinitely. No Action would consist of the building remaining in-place as-is indefinitely, containing the current contaminant inventory. No ongoing building maintenance would be performed, and no additional measures would be taken to preclude water ingress or egress or human and ecological access. The building structure would be allowed to deteriorate. Contaminants would deteriorate naturally, the radionuclides by radioactive decay and the chemical contaminants by natural attenuation. The No Action alternative provides minimal long-term protection for future industrial worker receptors and does not meet the RAOs.

The No Action alternative requires system operation and maintenance (O&M), such as routine surveillance and maintenance of the structure and surrounding area. Some activities associated would be, but not limited to, ensuring access controls and performing inspections and necessary maintenance activities, as needed. This alternative requires no construction costs and can be implemented immediately.

Summary of Costs

Capital:	$0
O&M:	$46,550,000
Present-Worth:	$46,550,000

Alternative AR-2 - In Situ Decommissioning Alternative:

A preliminary evaluation for a range of alternatives for *in situ* decommissioning (ISD) of the P-Reactor Building (105-P) has been made (WSRC 2008e) in order to establish a range of cost estimates for comparing alternatives applied to ISD. These alternatives have been further evaluated against the CERCLA criteria in the Combined Document (WSRC 2008c) and to study the various stages of removal of the above-ground structures and the reactor vessel. In the minimal removal alternative, the structure would remain, the stack would be removed to the plus 55 ft elevation, and all the below-ground equipment including the vessel would remain and be grouted in place. The Disassembly Basin would be demolished above grade, contents grouted in place, and covered. The above-ground portions of the Engine Houses (108-1P and 108-2P) and the Standby Pumphouse (191-P) would be removed, with the remaining below-ground structures being grouted. ISD provides a high-level of long-term protection for receptors and meets the RAOs with minimal cost.

Other alternatives considered for ISD have been evaluated. Each alternative evaluates additional removal of the building, various grouting scenarios, and removal of the reactor vessel. The maximum costs for ISD considers removal of the reactor vessel and the entire building structures above-grade. The remaining spaces below-grade would be stabilized with grout. Regardless of the alternatives evaluated, all above- and below-ground penetrations would be sealed to prevent intrusion. Certain above-grade contaminated process equipment with associated wiring and piping would be removed and/or relocated to be grouted below-grade. These variations associated with the ISD alternatives provide for a range of costs as summarized below.

Overall protection of human health and environment is high since short-term risk is minimized to remedial workers from exposure to contaminated equipment and facilities because this alternative leaves the reactor vessel in place.

This alternative includes an ongoing inspection and monitoring program that would be continued indefinitely for the remaining structure life.

These ISD actions will be subject to further detailed review and revision during the future engineering phase of the project. In addition, details to the specific nature, extent, and costs associated with the final in situ end state will be detailed in the Early Action CMI/RAIP for the PAOU. This ISD alternative provides a high-level of long-term protection for receptors at the lowest cost consistent with meeting the RAOs and can be easily implemented.

Summary of Costs

Capital:	\$31,043,600 - \$142,110,000
O&M:	\$21,497,385 - \$94,147,875
Present-Worth:	\$52,540,985 - \$236,260,000

Alternative AR-3 - Complete Removal Alternative:

This alternative includes dismantlement of all above- and below-grade structures. The reactor tank and internals would be dismantled, removed and relocated elsewhere, together with all equipment and waste.

The complete removal alternative provides a level of long-term protection for human and ecological receptors and meets the RAOs. The Complete Removal alternative requires no surveillance and monitoring costs, but would be difficult to implement as compared to Alternative AR-2 which leaves the waste in place. However, removal and disposal of the building to another location with no reduction of exposure, results in the problem simply transferred elsewhere and not effectively managed. In addition, the risk to workers during removal activities would either result in potentially exposing workers to direct contamination or require work to be conducted remotely. Likewise, the segregation and reduction of waste into manageable sizes for packaging and transport would also require remote operations or result in worker exposure as well. Finally, selection of an appropriate waste repository for disposition of contaminated building and reactor components is limited and complete removal is the most expensive alternative.

<u>Summary of Costs</u>

Capital:	$366,491,000
O&M:	$0
Present-Worth:	$366,491,000

Alternatives for the VOC Source Areas

Three alternatives were developed for early action at the vadose zone PSA-3A and PSA-3B VOC source areas based on effectiveness, implementability, and cost.

<u>Alternative AV-1 - No Action Alternative:</u>

The No Action alternative for the VOC source areas makes no remedial effort to control risks, treat or remove wastes, or reduce toxicity, mobility, or volume of contaminated media. Institutional controls would not be maintained and monitoring reports would not be developed. No resources would be expended in reducing contamination and contaminants would deteriorate by natural processes over an extended time, while continuing to impact groundwater quality. The No Action alternative can be easily implemented.

Contaminant reduction would be achieved in this alternative only though any natural attenuation that may occur.

Summary of Costs

Capital:	$0
O&M:	$0
Present-Worth:	$0

Alternative AV-2 - Conventional SVE at PSA-3B Alternative:

This alternative includes SVE at PSA-3B and comprises the presumptive remedy for sites with VOC contamination. Many VOCs, including TCE and PCE, have a high vapor pressure and readily evaporate when exposed to the atmosphere. SVE takes advantage of this property to extract these solvents from the vadose zone. In this alternative, a series of wells are drilled with screens located in the region of contaminated soil. The wells are connected to a vacuum blower that draws air through the porous soil, which evaporates the solvents. The vapor is transferred to the atmosphere where the TCE and PCE are rapidly destroyed by photolytic degradation. SVE has been proven to be an effective low cost technology and is widely used to remediate a variety of organic compounds in the subsurface.

This alternative of conventional SVE for PSA-3B will ensure long-term protection of human health and the environment by breaking the pathway from the VOC source zones to groundwater.

Summary of Costs

Capital:	$922,500
O&M:	$1,494,733
Present-Worth:	$2,417,233

Alternative AV-3 - SVE with soil fracturing and chemical oxidation at PSA-3A Alternative:

This alternative entails SVE at PSA-3A, enhanced with soil fracturing and chemical oxidation. SVE is somewhat less effective at removing VOCs in soils with low permeability or near or below the water table. Based on data collected at

PSA-3A, the highest concentrations of TCE are located near the water table in a clayey soil zone (low permeability zone) at a depth of around 45 ft bgs. Therefore, this alternative will involve supplementing the SVE by fracturing the soil to improve permeability and injecting an oxidizing chemical that will degrade the TCE to non-hazardous compounds and reduce impact to groundwater.

This alternative of SVE enhanced with soil fracturing and chemical oxidation for PSA-3A will ensure long-term protection of human health and the environment by breaking the pathway from the VOC source zones to groundwater.

This alternative can be implemented immediately.

Summary of Costs

Capital:	$1,793,617
O&M:	$2,098,116
Present-Worth:	$3,891,732

Alternatives for the P02 Outfall

Two alternatives were developed for early action at the P02 outfall based on effectiveness, implementability, and cost.

Alternative AP-1 - No Action Alternative:

The No Action alternative for the P02 Outfall makes no remedial effort to control risks, treat or remove wastes, or reduce toxicity, mobility, or volume of contaminated media. Institutional controls would not be maintained and monitoring reports would not be concluded. No resources would be expended in reducing contaminant concentrations, which would eventually disappear through natural radioactive decay.

The No Action alternative can be easily implemented.

Summary of Costs

Capital:	$0
O&M:	$0

Present-Worth:	$0

<u>Alternative AP-2 - Excavation and Removal Alternative:</u>

During previous Core Team scoping meetings, it was agreed that excavation and removal was the preferred remedy in lieu of *in situ* grouting or capping. In this alternative, radiologically-contaminated surface soil from the outfall would be excavated and placed in containers for removal and disposition at an approved facility. Cleanup of the P02 Outfall would entail removal of contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60. In conjunction with this alternative, confirmatory sampling will be used to determine the extent of radionuclide contamination in the soil. Confirmatory sampling has two purposes; 1) to define the extent of radionuclide contamination prior to excavation; and 2) to confirm removal of contamination. The final decision to the location for waste disposition will be documented in the final PAOU ROD. This alternative is easily implemented.

<u>Summary of Costs for P02 Outfall</u>

Capital:	$1,725,982
O&M:	$172,760
Present-Worth:	$1,898,742

Alternatives for the HCA at the Cask Car Railroad Tracks

Two alternatives were developed for early action at the HCA at the Cask Car Railroad Tracks based on effectiveness, implementability, and cost.

<u>Alternative AC-1 - No Action Alternative:</u>

The No Action alternative for the HCA at the Cask Car Railroad Tracks makes no remedial effort to control risks, treat or remove wastes, or reduce toxicity, mobility, or volume of contaminated media. Institutional controls would not be maintained and monitoring reports would not be developed. No resources would be expended in reducing contaminant concentrations, which would eventually disappear by natural radioactive decay. The No Action alternative can be easily implemented.

Summary of Costs

Capital:	$0
O&M:	$0
Present-Worth:	$0

Alternative AC-2 - Excavation and Removal Alternative:

During previous Core Team scoping meetings, it was agreed that excavation and removal was the preferred remedy in lieu of capping. In this alternative radiologically contaminated railroad bed material would be excavated and placed in containers for removal and disposition. Approximately 40 ft of railroad track is contaminated, including the rails and crossties. At the HCA, cobalt-60 is detected with cesium-137 (+D) since both radionuclides originated from the same source.

Cleanup of the HCA at the Cask Car Railroad Tracks would entail removal of contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60 with subsequent confirmatory sampling. In addition, this risk based concentration would ensure removal of cesium-137 (+D) (RG of 1.0 pCi/g) contaminated media. The final decision of the location for waste disposition will be documented in the Early Action CMI/RAIP for the PAOU. This alternative is easily implemented.

Summary of Costs

Capital:	$461,622
O&M:	$170,867
Present-Worth:	$632,489

X. COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the remedial alternatives was assessed against evaluation criteria to provide the basis for selecting a remedy. The criteria are identified in 40 Code of Federal Regulations (CFR) 300.430(e)(9)(A-I) and are derived from the statutory requirements of CERCLA § 121. The nine criteria are divided into three categories: threshold, primary balancing, and modifying criteria.

Threshold Criteria

Threshold criteria are requirements that each alternative must achieve to be eligible for selection as a permanent remedy under CERCLA. The threshold criteria are:

- Overall protection of human health and the environment; and
- Compliance with ARARs (Tables 18-20).

Primary Balancing Criteria

Primary balancing criteria are factors that identify key trade-offs among alternatives. The primary balancing criteria are:

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

Modifying Criteria

Modifying criteria are also considered during remedy selection. These criteria were assessed formally after the public review and comment period on the EAPP. The modifying criteria are:

- State acceptance; and
- Community acceptance.

Comparative Analysis for the P-Reactor Building (105-P) Subunit

The following sections present a comparative analysis of the three remedial action alternatives (AR-1, AR-2, and AR-3) considered for the P-Reactor Building (105-P). The alternatives are compared based on their relative achievement of NCP-threshold and primary-balancing criteria. This analysis identifies the trade-offs between alternatives. The comparative analysis of alternatives is summarized in Table 21.

Overall Protection of Human Health and the Environment

The No Action (AR-1) alternative is not protective of human health or the environment because no controls are established to preclude water ingress or egress or human and ecological access. The ISD alternative (AR-2) and complete demolition alternative (AR-3) effectively protects human and ecological receptors and achieves RAOs.

Compliance with ARARs

Chemical-Specific ARARs: There are no chemical-specific ARARs associated with the No Action alternative. Implementation of the AR-2 and AR-3 alternatives will require management of hazardous waste to protect human health and the environment that meets SCHWMR, SC R.61-79.

Location-Specific ARARs: There are no location-specific ARARs for the No Action alternative. The design, construction, operation, decontamination, disposal, and closure activities associated with alternatives AR-2 and AR-3 would need to comply with the Radioactive Waste Management and Disposal Practices (DOE Order 435.1 to ensure protection of the public and environment. The standards for protection of groundwater and surface water from South Carolina Regulation, SC R.61-68 (SC Water Classification and Standards) and SC R.61-9 [National Pollutant Discharge and Elimination System (NPDES) Permitting] will be followed to ensure groundwater and surface water protection.

Action-Specific ARARs: There are no action-specific ARARs for the No Action alternative. Implementation of the AR-2 and AR-3 alternatives requires erosion and runoff controls to prevent sediment and contaminant runoff to surface water and wetlands downgradient of the remedial area to meet South Carolina regulations (SC R. 72-300) and Section 401 of the Clean Water Act.

Long-Term Effectiveness and Permanence

The No Action alternative provides no long-term effectiveness or permanence since no controls are established to preclude water ingress or egress or human and ecological access. Alternative AR-2 permanently grouts contaminants from the P-Reactor Building (105-P) in-place and is long-term in nature. Alternatives AR-3 permanently removes contaminants from the P-Reactor Building (105-P) and is also long-term in nature.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative does not reduce the toxicity, mobility, or volume of contaminants. Through the use of ISD (AR-2), the mobility of contaminants would be greatly reduced. Alternative AR-3 permanently removes contaminants from the P-Reactor Building (105-P); thus, reducing the toxicity, mobility, and volume of contaminants.

Short-Term Effectiveness

Implementation of the No Action alternative (AR-1) presents no short-term effectiveness and is not protective of human or ecological receptors.

Alternative AR-2 has a high short-term effectiveness and requires the temporary disturbance of contaminated media during construction activities. Engineering controls and health/safety procedures are implemented to protect remedial workers, on-unit workers, the community, and the environment.

Alternative AR-3 has a low short-term effectiveness. Engineering controls and health/safety procedures are implemented to protect remedial workers, on-unit workers, the community, and the environment.

The No Action alternative does not achieve RAOs, while alternatives AR-2 and AR-3 do achieve RAOs upon completion of implementation.

Implementability

No construction is required for the No Action alternative, so it could be implemented immediately. Implementation of alternatives AR-2 and AR-3 are achieved using construction equipment, materials, and methods that are readily available. The Complete Removal Alternative requires no surveillance and monitoring cost, but would be difficult to implement as compared to Alternative AR-2 which leaves the waste in place.

Cost

The total present-worth costs of the alternatives addressing the P-Reactor Building (105-P) is $46,550,000 for the No Action alternative (which includes O&M costs), $52,540,985 - $236,260,000 for alternative AR-2, and $366,491,010 for alternative AR-3. Detailed breakdowns of the P-Reactor Building (105-P) cost summaries are included in Appendix B.

Comparative Analysis for the PSA-3B Source Area Subunit

The following sections present a comparative analysis of the two remedial action alternatives (AV-1 and AV-2) considered for the VOC Source Area, PSA-3B. The alternatives are compared based on their relative achievement of NCP-threshold and primary-balancing criteria. This analysis identifies the trade-offs between alternatives. The comparative analysis of alternatives is summarized in Table 22.

Overall Protection of Human Health and the Environment

The No Action (AV-1) alternative is not protective of human health or the environment because no controls are established to prevent contact with VOC source area contaminants. Alternative AV-2, conventional SVE, effectively protects human and ecological receptors and achieves RAOs.

Compliance with ARARs

Chemical-Specific ARARs: There are no chemical-specific ARARs associated with the No Action alternative. The numeric criteria for protection of human health from South Carolina Regulation, SC R.61-68 (SC Water Classification and Standards), will be followed in alternative AV-2 to establish MCLs.

Location-Specific ARARs: There are no location-specific ARARs for the PSA-3B Source Area alternatives.

Action-Specific ARARs: There are no action-specific ARARs for the No Action alternative. Implementation of the AV-2 alternative requires storm water management and sediment control for any land disturbance activity to comply with Section 402 of the Clean Air Act. All underground injection systems will be designed and operated in a manner that is protective of groundwater quality and will comply with South Carolina requirements (SC R.61-87). The requirements for installation of monitoring wells will comply with SC R.61-71, South Carolina Well Standards. The disposal and transportation of hazardous waste generated from alternative AV-2 would be handled in accordance with SCHWMR (SC R61-79). The identification of allowable air concentrations and permit requirements for VOC air emissions will comply with South Carolina requirements (SC R.61-62.5).

Long-Term Effectiveness and Permanence

The No Action alternative provides no long-term protection of the environment. Alternative AV-2 permanently removes contaminants from the vadose zone and is long term in nature.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative does not reduce the toxicity, mobility, or volume of contaminants. Conventional SVE (AV-2) will reduce the toxicity, mobility, and volume of PCE and TCE.

Short-Term Effectiveness

The No Action alternative presents no short-term effectiveness and is not protective of human or ecological receptors.

Alternative AV-2 has a low short-term effectiveness and requires the temporary disturbance of contaminated media during construction activities. Engineering controls and health/safety procedures are implemented to protect remedial workers, on-unit workers, the community, and the environment.

The No Action alternative does not achieve RAOs, while alternative AV-2 does achieve RAOs upon completion of construction.

Implementability

No construction is required for the No Action alternative, so it could be implemented immediately. Implementation of alternative AV-2 is achieved using conventional construction equipment, materials, and methods that are readily available.

Cost

The total present-worth costs of the alternatives addressing the PSA-3B VOC Source Area are $0 for the No Action alternative and $2,417,233 for alternative AV-2. A detailed breakdown of the PSA-3B VOC Source Area cost summary is included in Appendix B.

Comparative Analysis for the PSA-3A Source Area Subunit

The following sections present a comparative analysis of the two remedial action alternatives (AV-1 and AV-3) considered for the VOC Source Area PSA-3A. The alternatives are compared based on their relative achievement of NCP-threshold and primary-balancing criteria. This analysis identifies the trade-offs between alternatives. The comparative analysis of alternatives is summarized in Table 22.

Overall Protection of Human Health and the Environment

The No Action (AV-1) alternative is not protective of human health or the environment because no controls are established to prevent contact with VOC source area contaminants. Alternative AV-3, SVE with soil fracturing and chemical oxidation, effectively protects human and ecological receptors and achieves RAOs.

Compliance with ARARs

Chemical-Specific ARARs: There are no chemical-specific ARARs associated with the No Action alternative. The numeric criteria for protection of human health from South Carolina Regulation, SC R.61-68 (SC Water Classification and Standards), will be followed in alternative AV-3 to establish MCLs.

Location-Specific ARARs: There are no location-specific ARARs for the PSA-3A Source Area alternatives.

Action-Specific ARARs: There are no action-specific ARARs for the No Action alternative. Implementation of the AV-3 alternative requires storm water management and sediment control for any land disturbance activity to comply with Section 402 of the Clean Air Act. All underground injection systems will be designed and operated in a manner that is protective of groundwater quality and will comply with South Carolina requirements (SC R.61-87). The requirements for installation of monitoring wells will comply with SC R.61-71, South Carolina Well Standards. The disposal and transportation of hazardous waste generated from alternative AV-3 would be handled in accordance with SCHWMR (SC R61-79). The identification of allowable air concentrations and permit requirements for VOC air emissions will comply with South Carolina requirements (SC R.61-62.5).

Long-Term Effectiveness and Permanence

The No Action alternative provides no long-term protection of the environment. Alternative AV-3 permanently removes contaminants from the vadose zone and is long term in nature.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative does not reduce the toxicity, mobility, or volume of VOCs. The use of SVE with soil fracturing and chemical oxidation (AV-3) reduces the toxicity, mobility, and volume of PCE and TCE.

Short-Term Effectiveness

The No Action alternative has no short-term effectiveness and is not protective of human or ecological receptors.

Alternative AV-3 has a low short-term effectiveness and requires the temporary disturbance of contaminated media during construction activities. Engineering controls and health/safety procedures are implemented to protect remedial workers, on-unit workers, the community, and the environment.

The No Action alternative does not achieve RAOs while alternative AV-3 does achieve RAOs upon completion of construction.

Implementability

No construction is required for the No Action alternative, so it could be implemented immediately. Implementation of alternative AV-3 is achieved using construction equipment, materials, and methods that are readily available.

Cost

The total present-worth costs of the alternatives addressing the PSA-3A VOC Source Area are $0 for the No Action alternative and $3,891,732 for alternative AV-3. A detailed breakdown of the PSA-3A VOC Source Area cost summary is included in Appendix B.

Comparative Analysis for the P02 Outfall Subunit

The following sections present a comparative analysis of the two remedial action alternatives (AP-1 and AP-2) considered for the P02 Outfall. The alternatives are compared based on their relative achievement of NCP-threshold and primary-balancing criteria. This analysis identifies the trade-offs between alternatives. The comparative analysis of alternatives is summarized in Table 23.

Overall Protection of Human Health and the Environment

The No Action (AP-1) alternative is not protective of human health or the environment because no controls are established to prevent contact with soil - related contaminants. Alternative AP-2, Excavation and Removal, effectively protects human and ecological receptors and achieves RAOs.

Compliance with ARARs

Chemical-Specific ARARs: There are no chemical-specific ARARs associated with the No Action alternative. Implementation of the AP-2 alternative will require management of hazardous waste to protect human health and the environment that meets SCHWMR, SC R.61-79.

Location-Specific ARARs: There are no location-specific ARARs for the No Action alternative. The standards for protection of groundwater and surface water from South Carolina Regulation, SC R.61-68 (SC Water Classification and Standards) and SC R.61-9 (NPDES Permitting) will be followed to ensure groundwater and surface water protection.

Action-Specific ARARs: There are no action-specific ARARs for the No Action alternative. Implementation of the AP-2 alternative requires erosion and runoff controls to prevent sediment and contaminant runoff to surface water and wetlands downgradient of the remedial area to meet South Carolina regulations (SC R. 72-300) and Section 401 of the Clean Water Act.

Long-Term Effectiveness and Permanence

The No Action alternative provides no long-term protection of the environment. Alternative AP-2 permanently removes contaminated media from the P02 Outfall and is long-term in nature.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative does not reduce the toxicity, mobility, or volume of contaminants. The implementation of alternative AP-2 removes contaminated media from the P02 Outfall and reduces the toxicity, mobility, and volume of contaminants.

Short-Term Effectiveness

The No Action alternative has no short-term effectiveness and is not protective of human or ecological receptors.

Alternative AP-2 has a high short-term effectiveness and is a well proven soil remediation remedy that poses minimal risk to workers, the community, or the environment (e.g., air emissions) during implementation.

The No Action alternative does not achieve RAOs while alternative AP-2 does achieve RAOs upon completion of construction.

Implementability

No construction is required for the No Action alternatives, so they could be implemented immediately. Implementation of alternative AP-2 is achieved using construction equipment, materials, and methods that are readily available.

Cost

The total present-worth costs of the alternatives addressing the P02 Outfall is $0 for the No Action alternative (AP-1) and $1,898,742 for alternative AP-2. Detailed breakdowns of the P02 Outfall cost summary is included in Appendix B.

Comparative Analysis for the HCA at the Cask Car Railroad Tracks Subunit

The following sections present a comparative analysis of the two remedial action alternatives (AC-1 and AC-2) considered for the HCA for the Cask Car Railroad Tracks. The alternatives are compared based on their relative achievement of NCP-threshold and primary-balancing criteria. This analysis identifies the trade-offs between alternatives. The comparative analysis of alternatives is summarized in Table 24.

Overall Protection of Human Health and the Environment

The No Action (AC-1) alternative is not protective of human health or the environment because no controls are established to prevent contact with soil-related contaminants. Alternative AC-2, Excavation and Removal, effectively protects human and ecological receptors and achieves RAOs.

Compliance with ARARs

Chemical-Specific ARARs: There are no chemical-specific ARARs associated with the No Action alternative. Implementation of the AC-2 alternative will require management of hazardous waste to protect human health and the environment that meets SCHWMR, SC R.61-79.

Location-Specific ARARs: There are no location-specific ARARs for the No Action alternative. The standards for protection of groundwater and surface water from South Carolina Regulation, SC R.61-68 (SC Water Classification and Standards) and SC R.61-9 (NPDES Permitting) will be followed to ensure groundwater and surface water protection.

Action-Specific ARARs: There are no action-specific ARARs for the No Action alternative. Implementation of the AC-2 alternative requires erosion and runoff controls to prevent sediment and contaminant runoff to surface water and wetlands downgradient of the remedial area to meet South Carolina regulations (SC R. 72-300) and Section 401 of the Clean Water Act.

Long-Term Effectiveness and Permanence

The No Action alternative provides no long-term protection of the environment. Alternative AC-2 permanently removes contaminated media and is long term in nature.

Reduction of Toxicity, Mobility, or Volume through Treatment

The No Action alternative does not reduce the toxicity, mobility, or volume of contaminants. The use of alternative AC-2 reduces toxicity, mobility, and volume of contaminants.

Short-Term Effectiveness

The No Action alternative has no short-term effectiveness and is not protective of human or ecological receptors.

Alternative AC-2 has a high short-term effectiveness and is a well proven soil remediation remedy and poses minimal risk to workers, the community, or the environment (e.g., air emissions) during implementation.

The No Action alternative does not achieve RAOs, while alternative AC-2 does achieve RAOs upon completion of construction.

Implementability

The No Action alternative requires no effort to implement. No construction is required for the No Action alternatives, so they could be implemented immediately. Implementation of alternative AC-2 is achieved using construction equipment, materials, and methods that are readily available.

Cost

The total present-worth costs of the alternatives addressing the HCA for the Cask Car Railroad Tracks are $0 for the No Action alternative and $632,489 for alternative AC-2. Detailed breakdowns of the HCA for the Cask Car Railroad Tracks cost summaries are included in Appendix B.

XI. THE SELECTED REMEDY

Detailed Description of the Selected Remedy

The PAOU remedial summary is provided in Table 25. The table identifies the media, land use, remedy and regulatory mechanism for each of the early action subunits and for the P-Reactor Building (105-P).

Based on the detailed evaluation of alternatives performed in the Combined Document (WSRC 2008c), the selected remedy for final remedial action for the early action subunits of the PAOU and the final end-state decision of the P-Reactor Building (105-P) are described in this section.

P-Reactor Building (105-P)

Alternative AR-2 – In situ Decommissioning: This alternative involves ISD of the radiological waste associated with the P-Reactor Building (105-P). Although this alternative is the preferred end-state, details to the specific nature, extent, and costs associated with the final in situ end state will be detailed in the final ROD for the PAOU. ISD provides a high level of long-term protection for receptors the lowest cost consistent with meeting the RAOs. The exact nature of ISD for the P-Reactor Building (105-P) is evaluated in the Combined Document for PAOU (WSRC 2008c) and will be established through the final ROD for the area. This end-state also provides for consolidation of remediation waste from other cleanup actions within P Area, but does not require those wastes to be consolidated therein if more cost-effective means of disposal are available.

The current land use for the PAOU is industrial with USDOE maintaining control of the land in perpetuity. In the long-term, if the property is ever transferred to nonfederal ownership, the United States Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Unit-specific land use controls for the P-Reactor Building (105-P) will be determined in the final ROD for the PAOU.

PSA-3A VOC Source Area

Alternative AV-2 – Operation of SVE: This alternative involves operating an SVE system until the vadose zone RAOs are achieved. This alternative has been selected because it effectively removes VOCs from the vadose zone and protects groundwater by depleting the source.

Over the years, USEPA has conducted numerous remedial actions at sites with VOC contamination. This experience has allowed USEPA to identify three preferred technologies for treatment of VOC-contaminated soils based on a comprehensive ROD analysis (USEPA 1993). These treatment methods include SVE and comprise the presumptive remedy for sites with VOC contamination. SVE is recommended as a presumptive remedy by USEPA (USEPA 1993).

SRS believes that it is important to review all of the monitoring data, including VOC concentrations in soil, soil gas extracted by the SVE system, and groundwater concentrations when determining the effectiveness of a particular SVE technology in achieving RAOs. USDOE, USEPA, and SCDHEC have agreed to jointly decide on significant changes in the operation of the SVE system (typically transitioning from active to passive extraction) taken to maintain the efficiency of the remedial system. This process for transitioning the SVE system from active to passive SVE technology will be discussed in detail in the Early Action CMI/RAIP.

The SVE process will be optimized by matching the specific technology applied to each well to the amount of mobile contaminant present. Initially each well will be tested using a portable SVE unit capable of producing air flows of up to 100 standard cubic feet per minute (scfm) and vacuum levels of up to 15 inches of mercury. By monitoring the applied vacuum, air flow and contaminant concentration in the exhausted soil gas, estimates can be made about the permeability of the formation and the extent and mobility of the soil contamination. This information will guide the selection of the specific equipment to be installed at each well. The mass removal efficiency from the vadose zone depends on a variety of site-specific soil conditions and the type and amount of contaminant mass present. SVE performance is commonly monitored by the exhaust gas contaminant concentration over time.

PSA-3A VOC Source Area

Alternative AV-3 – SVE with soil fracturing and chemical oxidation: This alternative involves operating an SVE system, enhanced with soil fracturing and chemical oxidation until the vadose zone RAOs are achieved. This alternative has been selected because it effectively removes VOCs from the vadose zone and protects groundwater by depleting the source.

In geologic formations containing silt, clay, or tight bedrock, *in situ* treatment is more difficult due to the characteristics of low permeability and high adsorption potential of these geologic materials. Thus, soil fracturing coupled with another technology can enhance remediation of contaminated soil by creating more surface area and allowing a more effective distribution of the extractive air throughout the soil. The technology is an enhancement process designed for integration with primary, *in situ* treatment technologies such as vapor extraction, bioremediation, or thermal treatment.

Soil Fracturing will be used in conjunction with SVE to improve permeability and an oxidizing chemical will be injected that will degrade the TCE to non-hazardous compounds in near saturated soils. SVE is used to remove VOCs from the vadose zone. Vadose zone remediation using SVE reduces/removes the VOC source and is typically performed to manage the release of VOCs to groundwater. The groundwater is contaminated with VOCs above the MCL and the concentrations within the vadose zone are elevated enough to threaten groundwater. SVE is expected to meet the established RG of 0.53 mg/kg; thus, improving groundwater conditions by reducing the further migration of VOCs to the groundwater.

The effect of VOC soil contamination on the groundwater depends on multiple factors, including both concentration and mobility. Thus recognized, RGs may not be the sole indicator used to determine when the degradation to groundwater has been halted and/or the threat to groundwater has been eliminated. Additional data and information may be used by the Core Team to establish these conditions.

SRS believes that it is important to review all of the monitoring data, including VOC concentrations in soil, soil gas extracted by the SVE system, and groundwater concentrations when determining the effectiveness of a particular SVE technology in achieving RAOs. USDOE, USEPA, and SCDHEC have agreed to jointly decide on significant changes in the operation of the SVE system (typically transitioning from active to passive extraction) taken to maintain the efficiency of the remedial system.

The SVE process will be optimized by matching the specific technology applied to each well to the amount of mobile contaminant present. Initially each well will be tested using a portable SVE unit capable of producing air flows of up to 100 scfm and vacuum levels of up to 15 inches of mercury. By monitoring the applied vacuum, air flow and contaminant concentration in the exhausted soil gas, estimates can be made about the permeability of the formation and the extent and mobility of the soil contamination. This information will guide the selection of the specific equipment to be installed at each well.

P02 Outfall Area

Alternative AP-2 – Excavation and Removal: This alternative involves the excavation and removal of radiologically contaminated surface soil. In conjunction with this alternative, confirmatory sampling will be used to determine the extent of radionuclide contamination in the soil. Confirmatory sampling has two purposes; 1) to define the extent of radionuclide contamination prior to excavation; and 2) to confirm removal of contamination. At the Outfall P02, cobalt-60 is detected with cesium-137 (+D). Because cobalt-60 is easily detected in a laboratory setting, exhibits high energy signature, and is not detected in SRS background, establishing a cobalt-60 risk based concentration of 0.0596 pCi/g would address cleanup at the outfall for cesium-137 (+D) and cobalt-60. Implementation of the selected remedy would entail removal of contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60. In addition, this risk-based concentration would ensure removal of cesium-137 (+D) contaminated media. The final decision to the location for waste disposition will be documented in the final ROD for the PAOU.

The rationale for selecting alternative AP-2, excavation and removal of the contaminated media, over the other alternative includes the following:

- The selected alternative for the PAOU Outfall (P02) provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria;
- The removal of the contaminated media at the P02 Outfall results in the overall protection of human health and environment;
- The implementation of the selected remedy meets compliance with ARARs;
- The removal of the contaminated media results in a more short-term risk to the community than the proposed alternative; and
- The selected remedy offers a higher reduction of toxicity, mobility, and volume.

The selected remedy achieves the RAOs by removing the cesium-137 (+D) and cobalt-60 contaminants from the soil at levels above background or risk greater than 1.0E-06. The excavated area within the P02 Outfall will be backfilled, graded and vegetated to minimize erosion. Surface water drainage adjacent to the Outfall area will be protected during construction activities by placement of erosion control measures.

HCA at the Cask Car Railroad Tracks

Alternative AC-2 – Excavation and Removal: This alternative involves the excavation of removal of radiologically contaminated railroad bed material. At the HCA at the Cask Car Railroad Tracks, cobalt-60 is detected with cesium-137 (+D). Because cobalt-60 is easily detected in a laboratory setting, exhibits high energy signature, and is not detected in SRS background, establishing a cobalt-60 risk based concentration of 0.0596 pCi/g would address cleanup along the HCA at the Cask Car Railroad Tracks for cesium-137 (+D) and cobalt-60. Implementation of the selected remedy would entail removal of contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60. In addition, this risk-based concentration would ensure removal of cesium-137 (+D) contaminated media. The final decision to the location for waste disposition will be documented in the final PAOU ROD.

The rationale for selecting alternative AC-2, excavation and removal of the contaminated media, over the other alternative includes the following:

- The selected alternative for the HCA at the Cask Car Railroad Tracks provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria;
- The removal of the contaminated media at the HCA results in the overall protection of human health and environment;
- The implementation of the selected remedy meets compliance with ARARs;
- The removal of the contaminated media results in a more short-term risk to the community than the proposed alternative; and
- The selected remedy offers a higher reduction of toxicity, mobility, and volume.

The selected remedy achieves the RAOs by removing the cesium-137 (+D) and cobalt-60 contaminants from the soil at levels above background or risk greater than 1.0E-06. The excavated areas within the HCA at the Cask Car Railroad Tracks will be backfilled, graded and vegetated to minimize erosion. Surface water drainage adjacent to the HCA will be protected during construction activities by placement of erosion control measures.

The selected remedies for the PAOU early action subunits and the P-Reactor Building (105-P) leave hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. While land use controls are expected to be part of the final remedy, this EAROD does not select any specific LUCs. LUCs as elements of the remedy will be selected in the final PAOU ROD.

Cost Estimate for the Selected Remedy

The information in the cost estimate summary tables are based on the best available information regarding the anticipated scope of the remedial alternative. Detailed breakdowns of these cost summaries are included in Appendix B. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record File, an explanation of significant difference (ESD), or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to –30 percent of the actual project cost.

P-Reactor Building (105-P)

<u>Alternative AR-2 – In situ Decommissioning:</u>

<u>Summary of Costs</u>

Capital:	\$31,043,600 – \$142,110,000
O&M:	\$21,497,385 – \$94,147,875
Present-worth:	\$52,540,985 – \$236,257,875

Estimated costs associated with the selected remedy on the 3.9% discount rate over a 200-year period are summarized in the table above.

PSA-3B VOC Source Area

Alternative AV-2 – Operation of SVE:

Summary of Costs

Capital:	$922,500
O&M:	$1,494,733
Present-worth:	$2,417,233

Estimated costs associated with the selected remedy on the 3.9% discount rate over a 30-year period are summarized in the table above.

PSA-3A VOC Source Area

Alternative AV-3 – SVE with soil fracturing and chemical oxidation:

Summary of Costs

Capital:	$1,793,617
O&M:	$2,098,116
Present-worth:	$3,891,732

Estimated costs associated with the selected remedy on the 3.9% discount rate over a 30-year period are summarized in the table above.

P02 Outfall

Alternative AP-2 – Excavation and Removal (P02):

Summary of Costs

Capital:	$1,725,982
O&M:	$172,760
Present-worth:	$1,898,742

Estimated costs associated with the selected remedy on the 3.9% discount rate over a 30-year period are summarized in the table above.

HCA for the Cask Car Railroad Tracks

Alternative AC-2 – Excavation and Removal:

Summary of Costs

Capital:	\$461,622
O&M:	\$170,867
Present-worth:	\$632,489

Estimated costs associated with the selected remedy on the 3.9% discount rate over a 30-year period are summarized in the table above.

Estimated Outcomes of Selected Remedy

The expected condition after the preferred alternatives are implemented is that the SVE will prevent future leaching of CM COCs to groundwater above MCLs and excavation and removal of contaminated media in addition to ISD of P-Reactor Building (105-P) would eliminate exposure for human and ecological receptors. After implementation of the remedial actions, the PAOU would be available for SRS use as an industrial area with land use restrictions.

Except for the P-Reactor Building (105-P), the PAOU early action units should be available for industrial use in approximately 3-5 years after the remedial action start.

The selected remedy for P-Reactor Building (105-P) will meet RAOs through the following means:

- Preventing migration of radiological and chemical contamination from P-Reactor to groundwater;
- Preventing exposure of ecological receptors to radiological or chemical contamination; and
- Preventing human exposure to unacceptable risk associated with radiological or chemical contamination present within P-Reactor Building (105-P).

The selected remedy for VOC Source Areas will meet RAOs through the following means:

- Preventing migration of TCE contamination of soil to groundwater at a concentration above its MCL (PSA-3A Source Area); and
- Preventing migration of PCE contamination of soil to groundwater at a concentration above its MCL (PSA-3B Source Area).

The soils cleanup level for both PSAs is 0.53 mg/kg for both TCE and PCE which is based on the contaminant migration to groundwater analysis.

The selected remedy for the P02 Outfall will meet RAOs through the following means:

- Preventing exposure of industrial workers to soils containing unacceptable levels of cesium-137 (+D) and cobalt-60; and
- Preventing exposure of ecological receptors to elevated levels of cesium-137 (+D) and cobalt-60 in soils.

The cleanup of the P02 Outfall will remove contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60 and 1.0 pCi/g cesium-137 (+D), which is based on a 1E-06 excess cancer risk to a future industrial worker.

The selected remedy for the HCA at the Cask Car Railroad Tracks will meet RAOs through the following means:

- Preventing exposure of industrial workers to surface gravel/crossties and soils containing unacceptable levels of cesium-137 (+D) and cobalt-60.

Cleanup of the HCA at the Cask Car Railroad Tracks with subsequent confirmatory sampling will remove contaminated media that exceeds a risk-based concentration of 0.0596 pCi/g for cobalt-60 and 1.0 pCi/g for cesium-137 (+D), which is based on a 1E-06 excess cancer risk to a future industrial worker.

Waste Disposal and Transport

Based on available documentation for the PAOU subunits, the origin for the VOC contamination cannot be concluded. Therefore, it is assumed that the contamination found in the vadose zone and groundwater is not from a listed RCRA hazardous waste source. RCRA requirements do not apply provided the waste generated during the remedial action does not exhibit a hazardous waste characteristic. However, consistent with USEPA policy, environmental media designated for land application will be evaluated against Health-Based Levels to ensure protection of human health and the environment. Unless otherwise noted in this EAROD or in the post-EAROD documents, waste will be managed consistent with the current, approved *Investigation-Derived Waste Management Plan* (WSRC 2006a).

XII. STATUTORY DETERMINATIONS

Based on the unit Combined Document (WSRC 2008c), the PAOU poses a threat to human health and the environment. Therefore, ISD at P-Reactor Building (105-P), conventional SVE at PSA-3B, SVE with soil fracturing and chemical oxidation at PSA-3A, excavation and disposal of contaminated media at the HCA at the Cask Car Railroad Tracks and Outfall P02, have been selected as the early action remedies for the PAOU. The future land use of the PAOU is assumed to be industrial land use.

Because the remedies will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is and will continue to be protective of human health and the environment.

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action (unless justified by a waiver), are cost-effective, and utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment).

The selected remedies for the PAOU early action subunits and P-Reactor Building (105-P) leave hazardous substances in place that pose a potential future risk and will require land use restrictions for an indefinite period of time. While land use controls are expected to be part of the final remedy, this EAROD does not select any specific LUCs. LUCs as elements of the remedy will be selected in the final PAOU ROD.

XIII. EXPLANATION OF SIGNIFICANT CHANGES

Because the EAROD Revision 0 submittal period overlapped with the EAPP public comment period, additional comments received during the 30 day public comment period are included in Appendix A. The remedies selected in this EAROD do not contain any significant changes from the preferred alternatives (s) presented in the EAPP.

Based on confirmatory soil sampling results associated with the early action for the P007 Outfall, it has been determined that the estimated volume of contaminated soil/ash located in the outfall is significantly larger than previously estimated. The three-fold increase (0.9 acres to 2.8 acres) in volume of contaminated media, significantly expands the scope and cost for the remedial action selected. Therefore, the proposed early action for the P007 Outfall has been removed from this Early Action ROD in order to adequately assess the additional scope and the preferred remedial alternative for the P007 Outfall, and will be addressed as part of the SB/PP and the final ROD for the PAOU.

XIV. RESPONSIVENESS SUMMARY

The Facilities Disposition and Site Remediation Committee of the SRS Citizens Advisory Board (CAB) formally issued recommendation #248 at the July 23-24, 2006 meeting, which requested DOE to hold public workshops to discuss selection of the P-Reactor end state. In response to this request, USDOE held two workshops for the Aiken area: the first on October 16, 2007, and the second on February 28, 2008. An additional public workshop was held in Savannah, GA on May 19, 2008. These workshops were well publicized and included representatives from the USEPA Region 4 and SCDHEC.

The Responsiveness Summary, which includes responses to public comments received during the three public workshops, is included as Appendix A of this document.

XV. POST-ROD DOCUMENT SCHEDULE AND DESCRIPTION

A detailed schedule for the Early Action Post-ROD activities is shown in Appendix C.

The forecast schedule for the post-ROD documentation is provided below:

- SRS submittal of Revision 0 Early Action CMI/RAIP/ Land Use Controls and Implementation Plan (LUCIP) is scheduled for December 8, 2008;
- USEPA and SCDHEC will receive 60 calendar days for review of the Revision 0 Early Action CMI/RAIP/LUCIP;
- The SRS revision of the Early Action CMI/RAIP/LUCIP will be completed 45 calendar days after receipt of all regulatory comments on each of the documents;
- USEPA and SCDHEC will receive 30 calendar days for final review and approval of the Early Action CMI/RAIP/LUCIP; and
- The projected Early Action Remedial Action start date is December 2, 2009.

XVI. REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site,* Administrative Docket No. 89-05-FF (Effective Date: August 16, 1993)

Patel S.M., and Steiner M.L., 2004. *Hazards Assessment Document for P-Reactor Facility (U)*, S-HAD-P-00001, Revision 2, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

USDOE, 1996. SRS Future Use Project Report, Stakeholder Preferred Recommendations for SRS Land Use Facilities, United States Department of Energy, Savannah River Operations Office, Aiken, SC

USDOE, 2000. *Long Range Comprehensive Plan*, United States Department of Energy, Savannah River Operations Office, Aiken, SC

USDOE, 2008. *Submittal of the Action Memorandum for the Non-Time Critical Removal Action (NTCR) for Disposition of Water in the 105-P Disassembly Basin*, ARF#15483, June 16, 2008, United Stated Department of Energy, Savannah River Operation Office, Aiken, SC.

USEPA, 1993. Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils, EPA-540-F-93-048, September 1993, United States Environmental Protection Agency

WSRC, 2006a. *Savannah River Site Investigation-Derived Waste Management Plan*, WSRC-RP-94-1227, Revision 8, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006b. *Remedial Investigation (RI) Work Plan for P-Area Operable Unit (U)*, WSRC-RP-2005-4081, Rev. 1.1, Washington Savannah River Company, Savannah River Site, Aiken, SC.

WSRC, 2006c. *P-Reactor Contaminant Migration Screening Calculation (U)*, ERD-EN-2006-0055, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2006d. *Savannah River Site Federal Facility Agreement Community Involvement Plan (U),* WSRC-RP-96-120, Revision 4, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2007. *Scoping Summary for the P Area Operable Unit (U)*, ERD-EN-2005-0172, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008a. *Early Action Proposed Plan for the P Area Operable Unit (U)*, WSRC-RP-2007-4064, Revision 1.1 Redline, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008b. *Evaluation of Activation Products in Remaining P-Reactor Structures (U),* WSRC-TR-00491, Revision 0, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008c. *RCRA Facility Investigation/Remedial Investigation with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for P Area Operable Unit (U)*, WSRC-RP-2007-4032, Revision 1 Redline, Washington Savannah River Company, Savannah River Site, Aiken, SC.

WSRC, 2008d. *Disposition of Water in the 105-P Disassembly Basin – Removal Site Evaluation and Cost Analysis (RSER/EE/CA)*, V-ESR-P-00002, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC.

WSRC, 2008e. *105-P Alternatives Cost Analysis (U),* SDD-2008-00003, Revision 0, Site Deactivation and Decommissioning, February 7, 2008, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008f. *Hazards Location Study Research and Data Summary Building (105-P),* SDD-2008-00010, Revision 0, Site Deactivation and Decommissioning, February 14, 2008, Washington Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2008g. *Curie Location Study, Research and Data Summary Building 105-P (U)*, SDD-2006-00593, Revision 3, Site Deactivation and Decommissioning, February 14, 2008, Washington Savannah River Company, Savannah River Site, Aiken, SC

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ARF # 15839

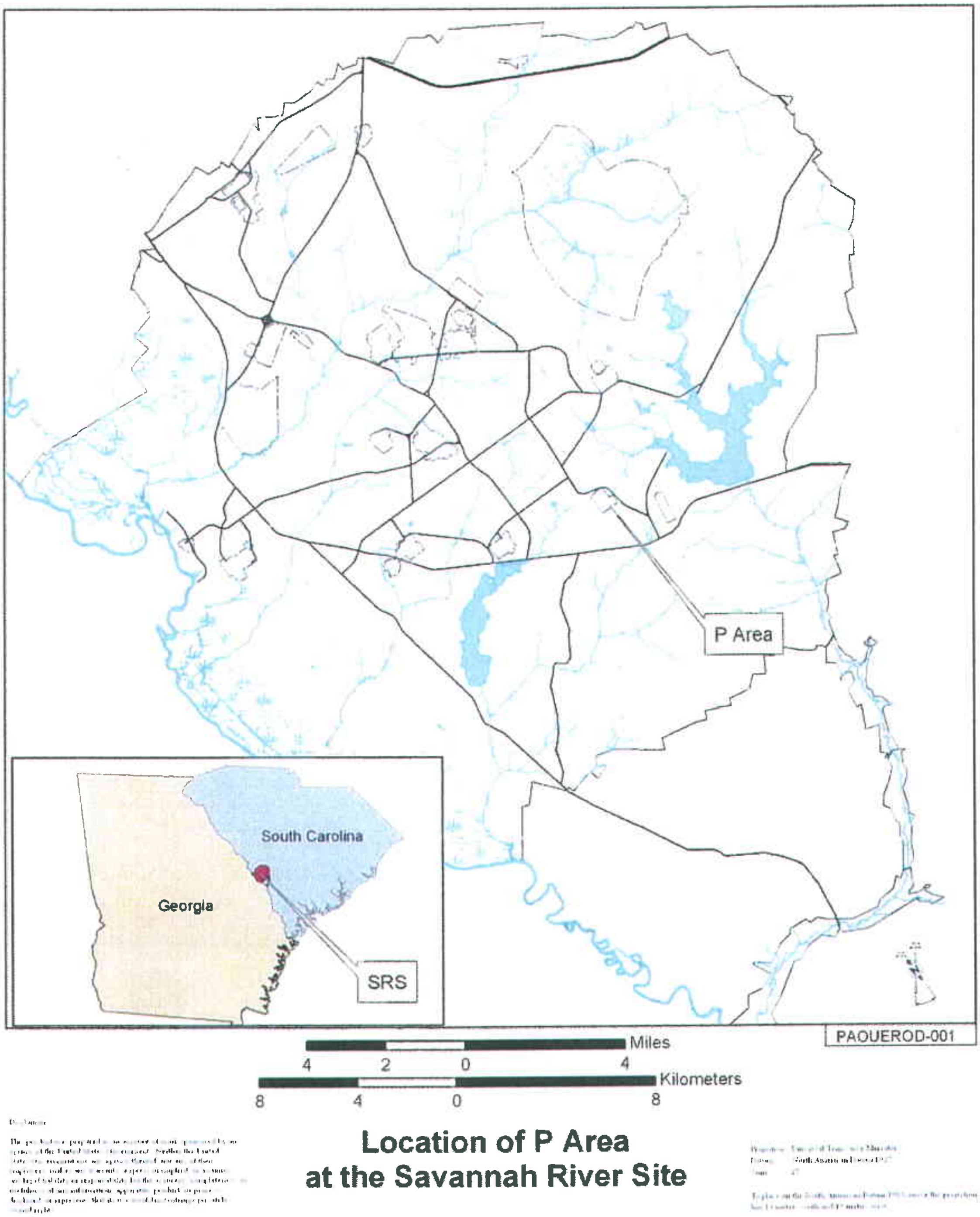

Figure 1. Location of the PAOU within the Savannah River Site.

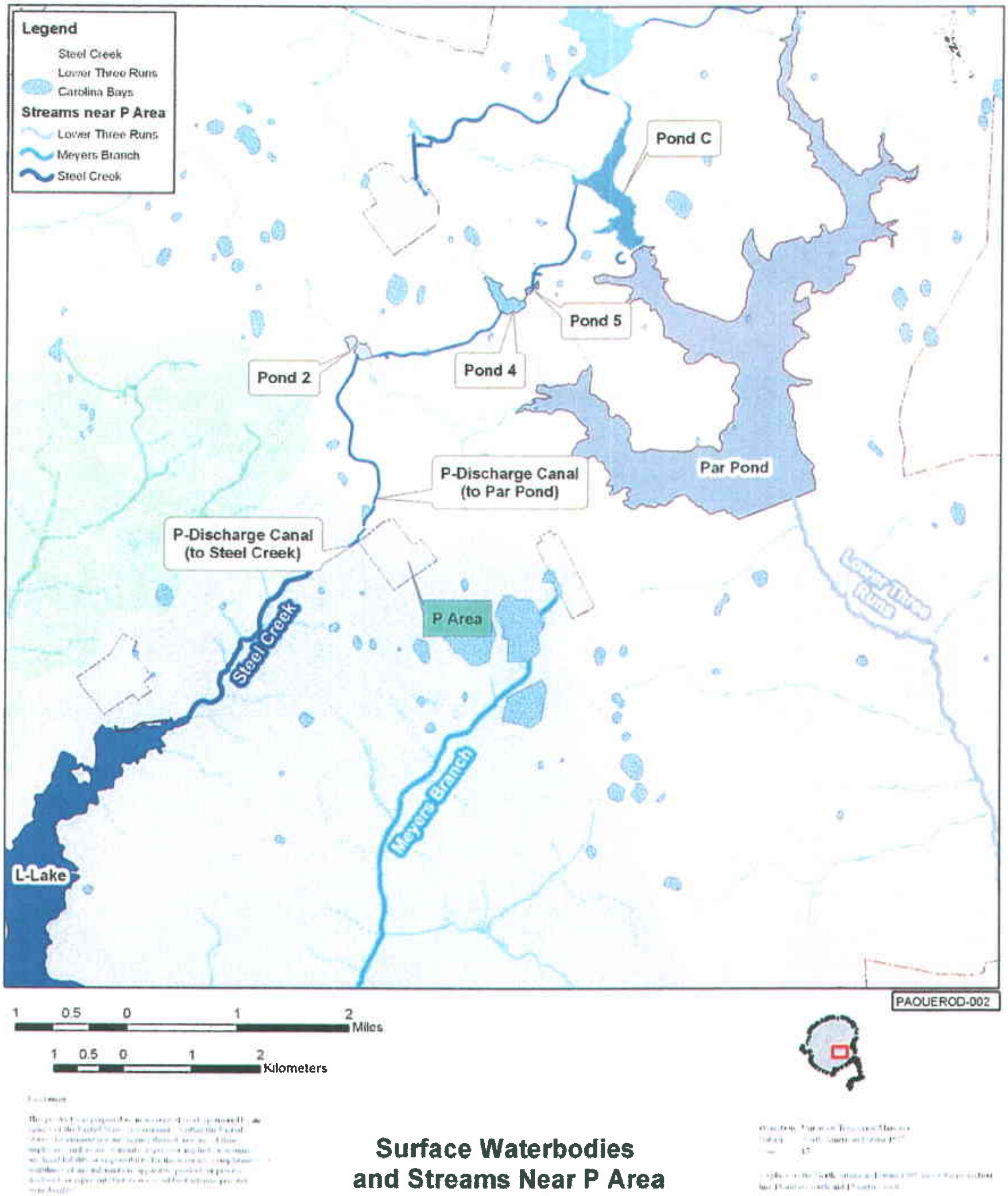

Figure 2. Layout of P Area within the Steel Creek and Lower Three Runs Watersheds.

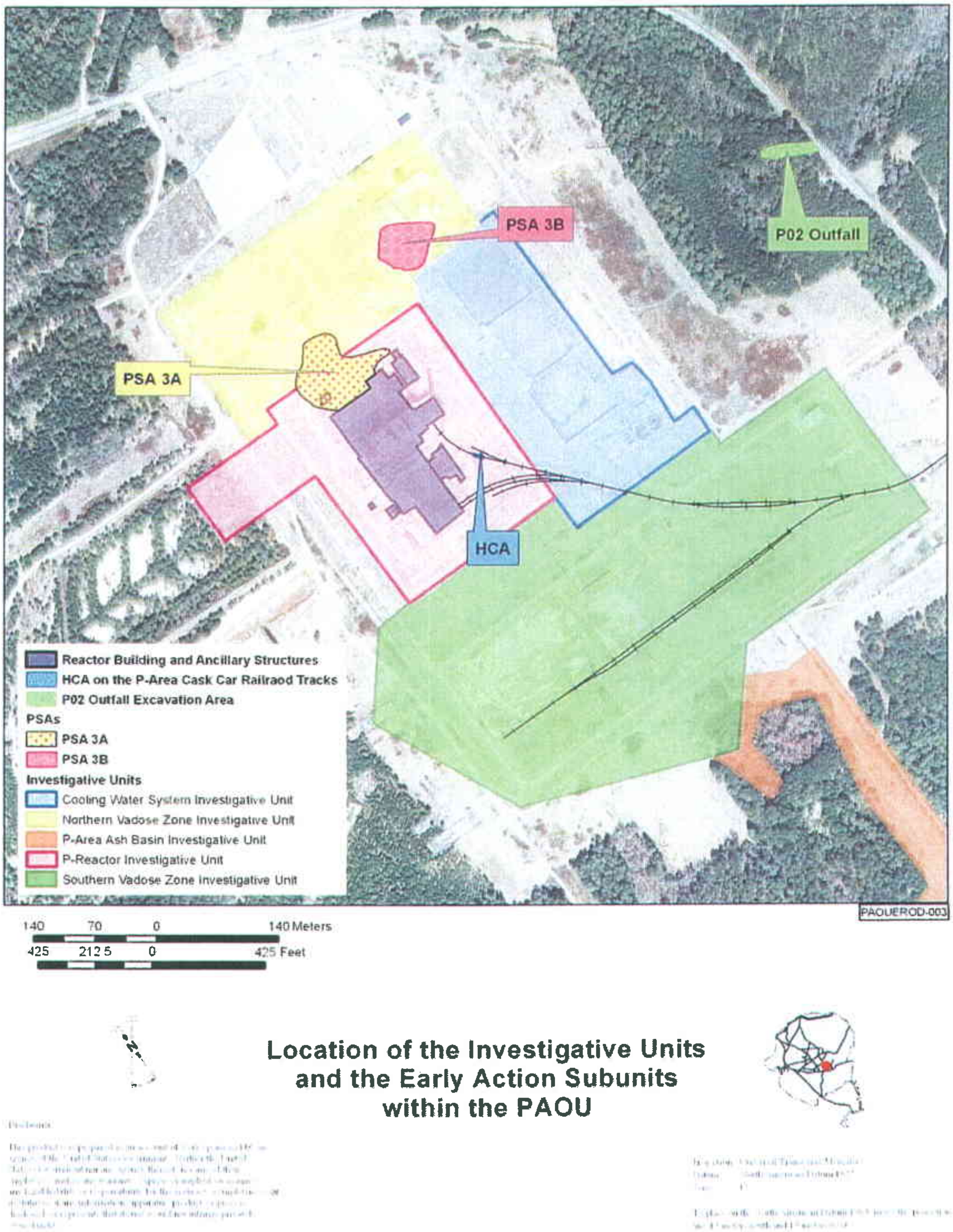

Figure 3. Location of the Investigative Units and the Early Action Subunits within the PAOU

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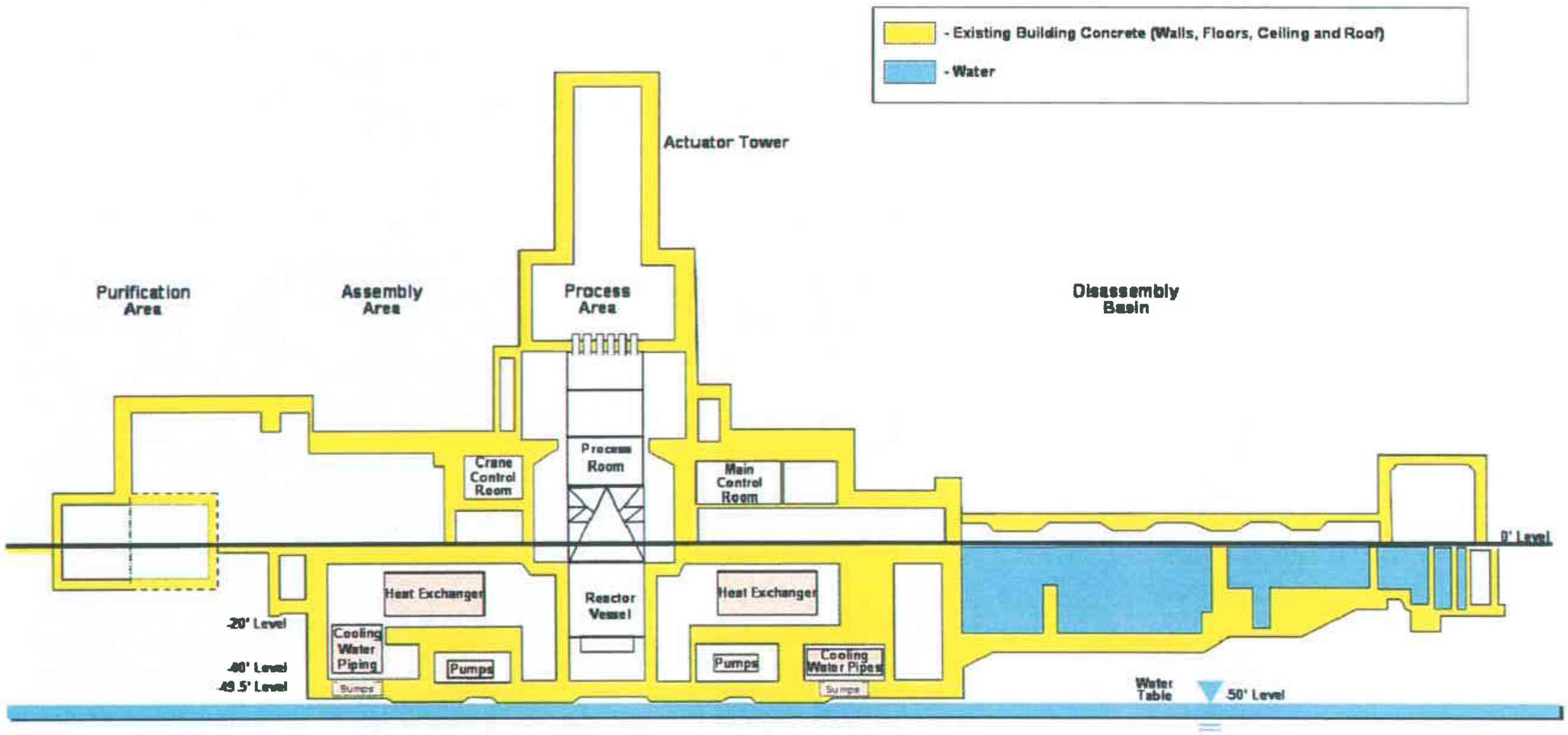

Figure 4. **Longitudinal Cross Section through the P-Reactor Building (105-P) (current condition)**

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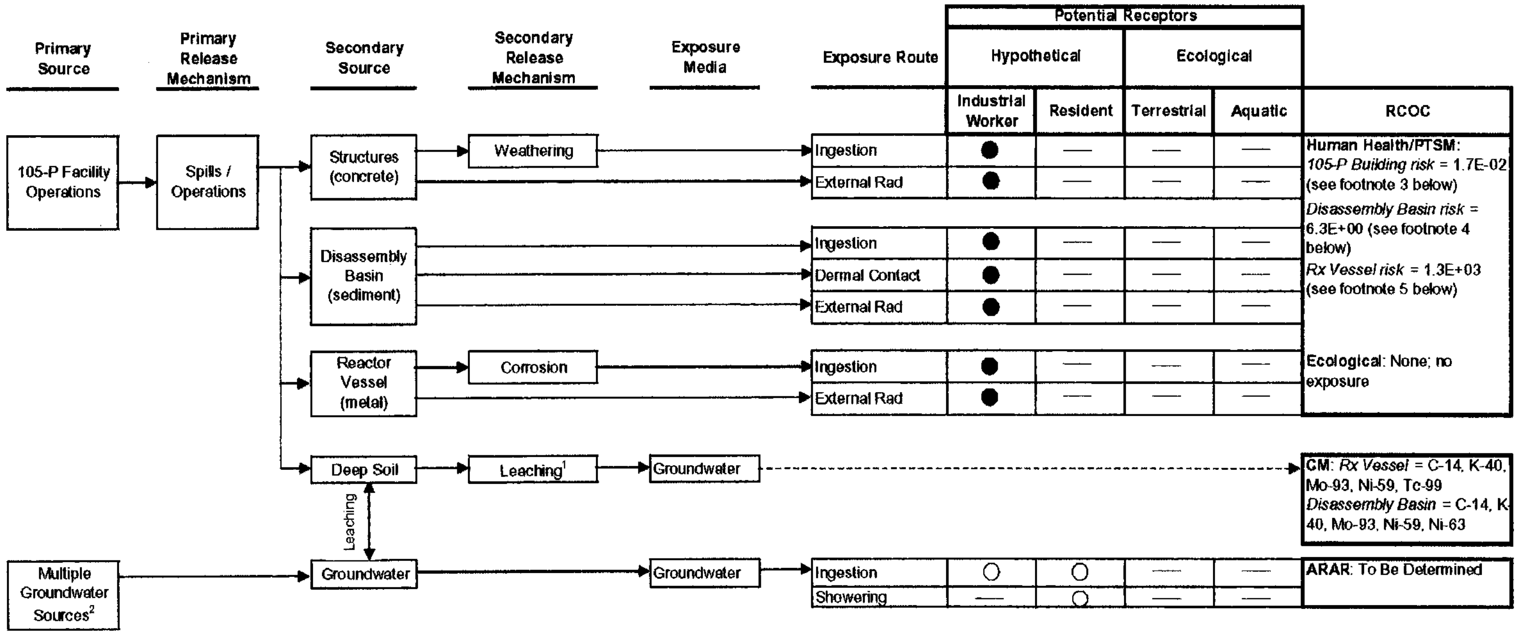
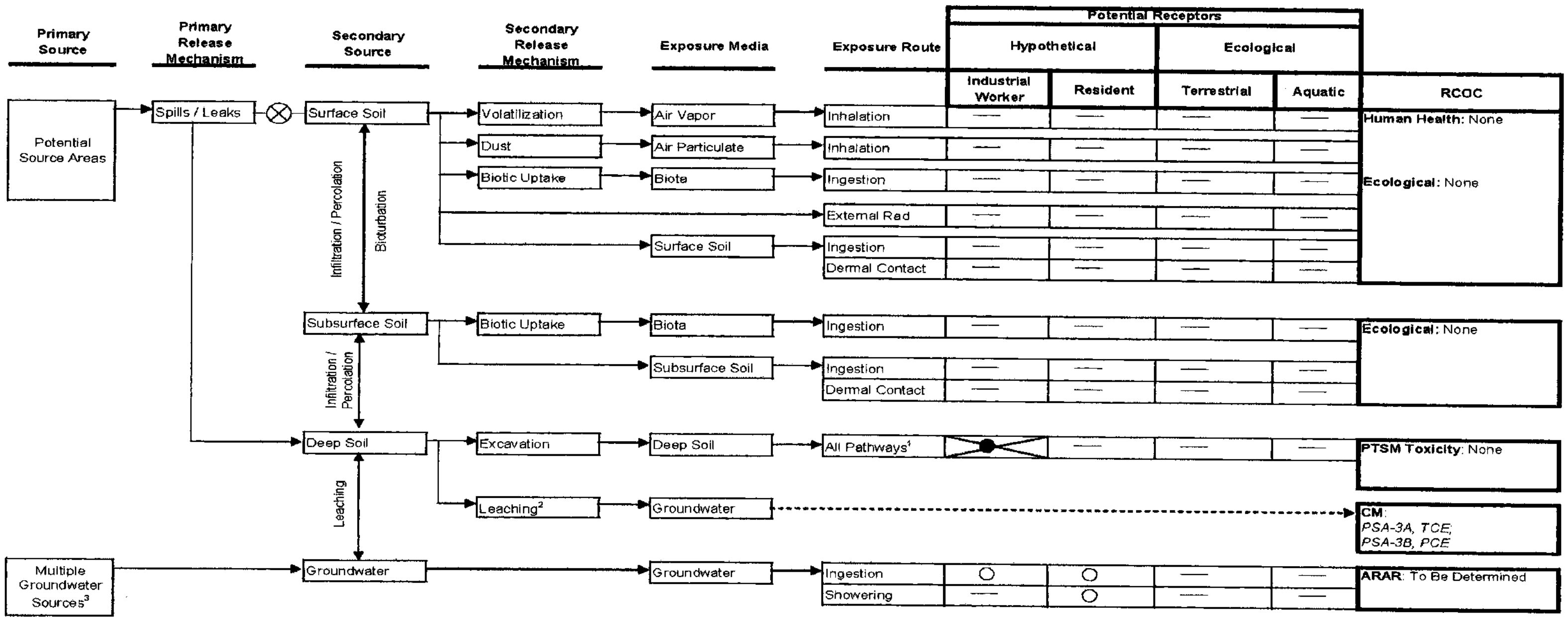


→	Pathways: current, historic, and future assuming no access/exposure controls are in place.
●	Complete exposure pathway for quantitative evaluation, RCOCs identified.
○	Complete exposure pathway for qualitative evaluation.
—	Incomplete exposure pathway
- - →	Contaminant migration analysis
1	Leaching represents the potential of a contaminant in deep soil to migrate to groundwater above MCLs per the contaminant migration (CM) analysis and does not represent a human or ecological exposure route. (Will be evaluated as part of the P-Reactor Investigative Unit.)
2	Groundwater has been impacted by multiple sources within P Area and will be addressed under the P-Area Groundwater Operable Unit.
3	PTSM RCOCs = Cs-137(+D) (risk = 1.3E-02) and Co-60 (risk = 4.2E-03), total cumulative risk = 1.7E-02. *Minus 20 ft level:* HH RCOCs = Aroclor 1254, Cs-137(+D) Co-60, Sr-90 (+D) and U-238(+D); total cumulative risk = 1.4E-02. *Minus 40 ft Level* HH RCOCs = Aroclor 1254, Cs-137(+D), Co-60, Sr-90(+D); total cumulative risk = 1.3E-02; *Minus 49.5 ft level* HH RCOCs = Cs-137(+D), risk = 1.7E-04.
4	PTSM RCOCs = Am-241, Am-243(+D), Sb-125(+D), Cm-243/244, Cm-245, Co-60, Cs-137(+D), Eu-152, Eu-154, H-3, K-40, Na-22, Nb-94, Pu-238, Pu-239/240, Ra-228(+D), Th-228(+D), Sr-90(+D), Uranium, total cumulative risk = 6.3E+00, HQ=19. HH RCOCs = the PTSM RCOCs are the major risk drivers and are also identified as HH RCOCs; 31 other radiological constituents have a risk <1E-03 but > 1E-06 and are considered HH RCOCs.
5	PTSM RCOCs = Ba-133, Co-60, Eu-152, Ni-63, total cumulative risk = 1.3E+03. HH RCOCs = Ba-133, C-14, Co-60, Eu-152, Eu-154, Fe-155, Mo-93, Ni-59, Ni-63, Nb-94, K-40; total cumulative risk = 1.3E+03.

Figure 5. Conceptual Site Model for the P-Reactor Building (105-P)



Incomplete pathway
Pathways: current, historic, and future
Complete exposure pathway for quantitative evaluation, no RCOCs identified
Complete exposure pathway for qualitative evaluation
Complete exposure pathway for qualitative evaluation, no RCOCs identified
Incomplete exposure pathway
Contaminant migration analysis

1 All pathways represents ingestion, inhalation, dermal contact, and external radiation exposure for principal threat source material (PTSM) evaluation for toxicity.

2 Leaching represents the potential of a contaminant in deep soil to migrate to groundwater above MCLs per the contaminant migration (CM) analysis and does not represent a human or ecological exposure route.

3 Groundwater has been impacted by multiple sources within P Area and will be addressed under the P-Area Groundwater Operable Unit.

Figure 6. **Conceptual Site Model for the Potential Source Areas (PSA-3A and PSA-3B)**

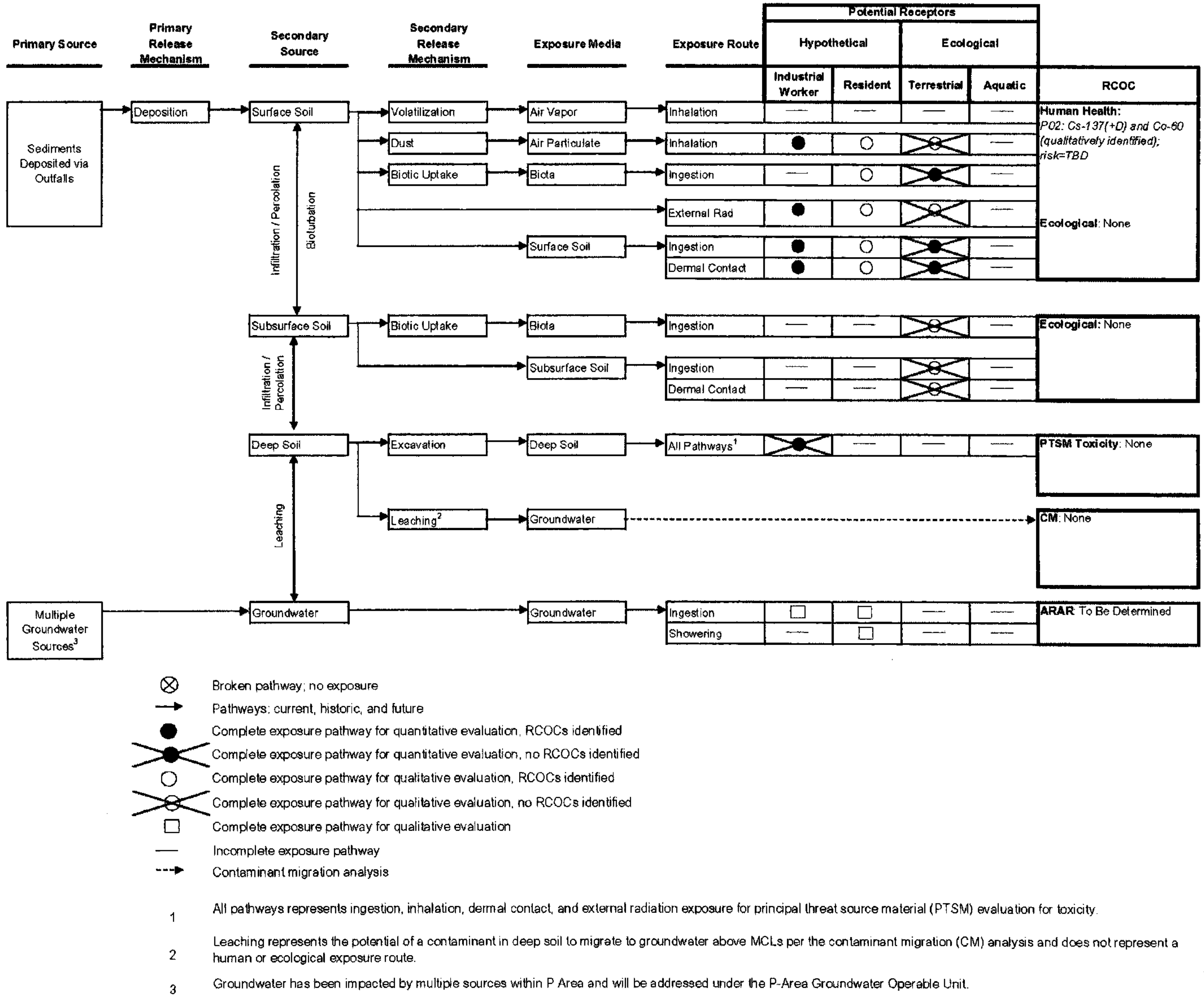
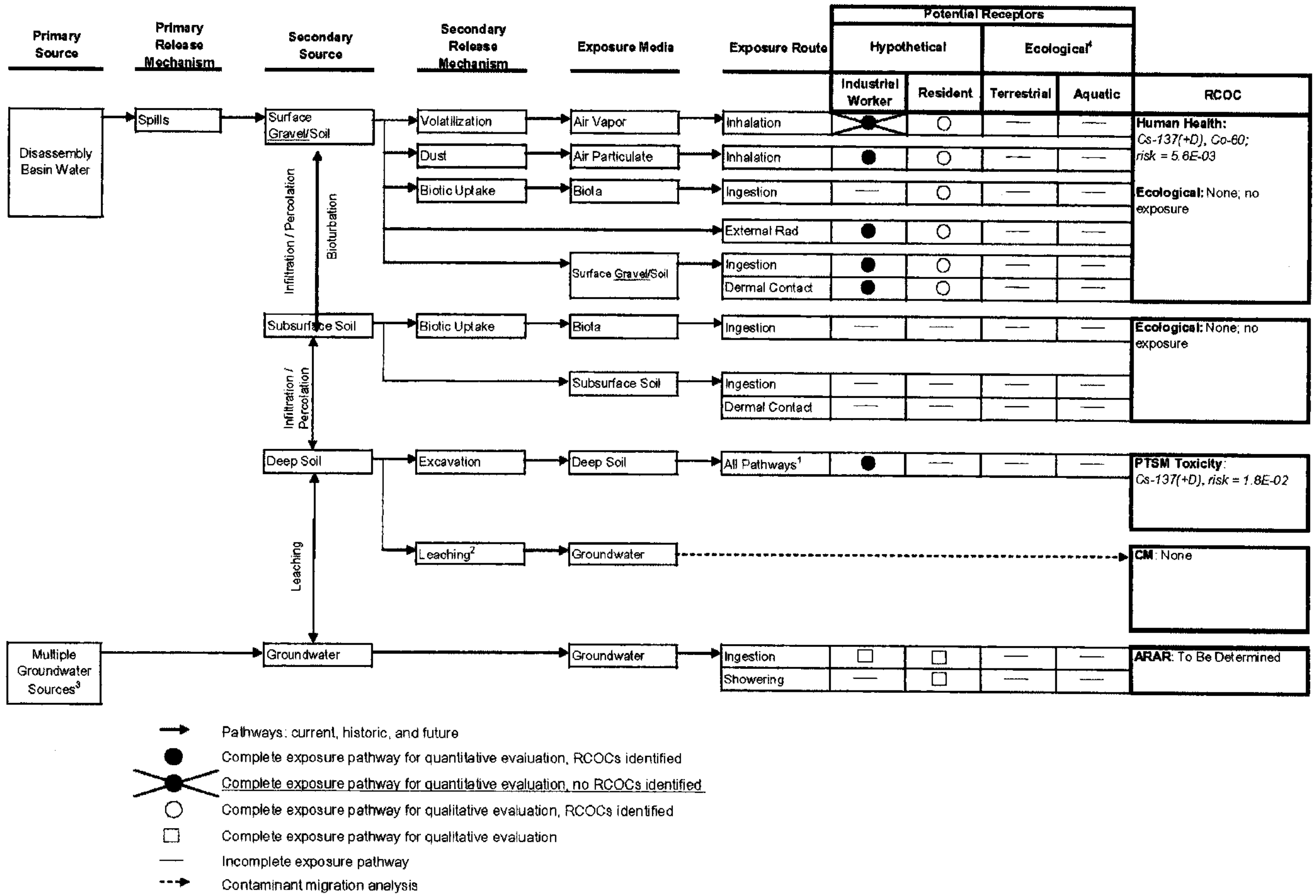


Figure 7. Conceptual Site Model for the P-Area Outfall (P02)



1 All pathways represents ingestion, inhalation, dermal contact, and external radiation exposure for principal threat source material (PTSM) evaluation for toxicity.

2 Leaching represents the potential of a contaminant in deep soil to migrate to groundwater above MCLs per the contaminant migration (CM) analysis and does not represent a human or ecological exposure route. (Will be evaluated as part of the P-Reactor Investigative Unit.)

3 Groundwater has been impacted by multiple sources within P Area and will be addressed under the P-Area Groundwater Operable Unit.

4 The P-Area Cask Car Railroad Track is a linear feature in an industrial setting and does not provide habitat, nor an exposure scenario, for ecological receptors.

Figure 8. Conceptual Site Model for the HCA at the P-Area Cask Car Railroads Tracks

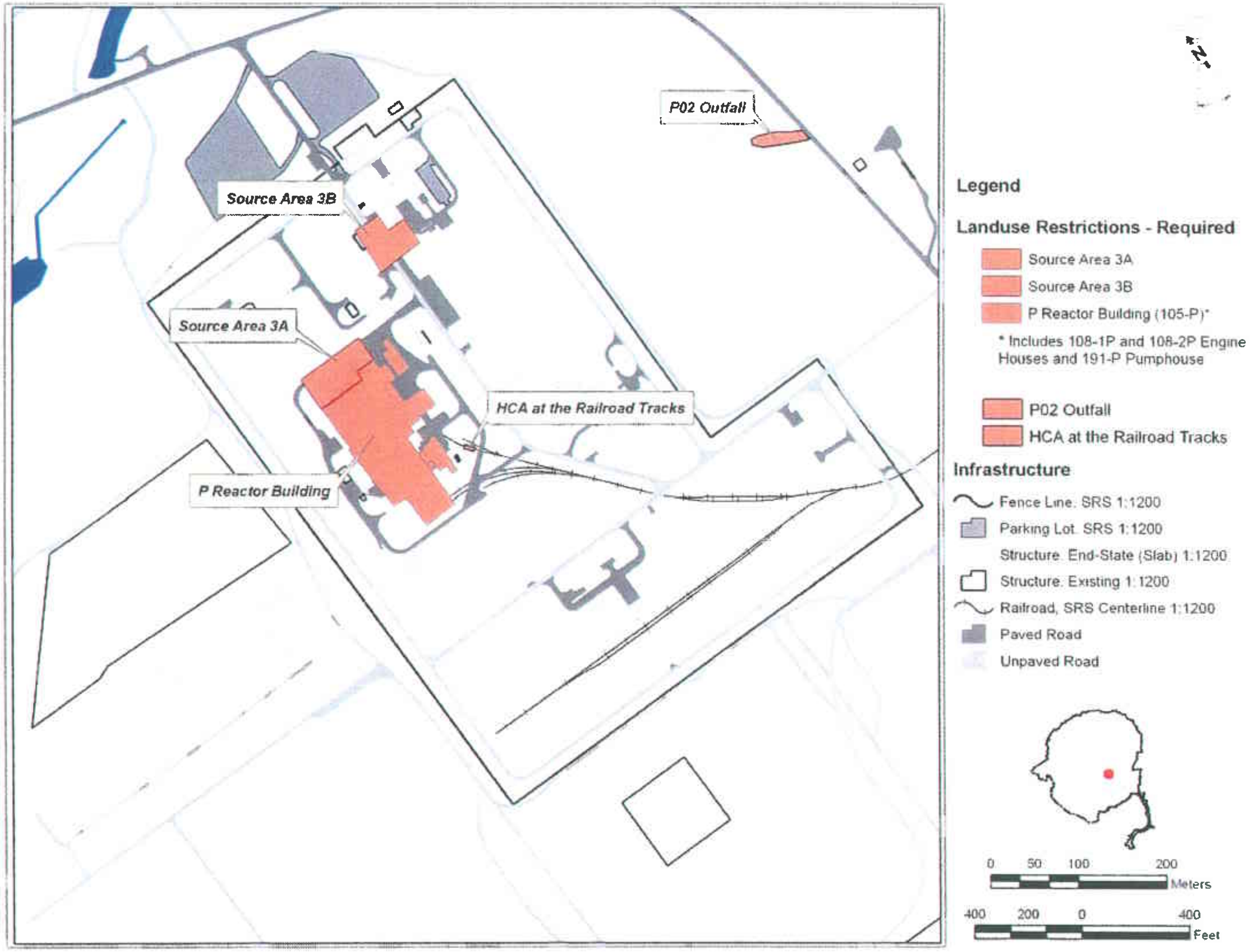


Figure 9. Land Use Map for PAOU.

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Table 1. Status of Subunits per Investigative Unit

Investigative Unit	Subunit	Type(1)	Early Action Proposed
Southern Vadose Zone	Process Sewer Lines As Abandoned (portions)	FFA	No
	PSA-5 – Two localized areas in the southwestern part of P Area	PSA	No
Ash Basin	P-Area Ash Basin (188-0P)	FFA	No
Cooling Water System	Potential Release from Reactor Cooling Water System (186/190-P)	FFA	No
	Process Sewer Lines As Abandoned (portions)	FFA	No
Northern Vadose Zone	PSA-2 – Area around the Cooling Water Effluent Sumps (107/107-1P)	PSA	No
	PSA-3B – West of the Administrative/ Maintenance slab	PSA	Yes
	Primary Substation (High Voltage 115/13.8) (151-1P)	D&D Subunit	No
P-Reactor	Potential Release from P-Area Disassembly Basin (105-P)	FFA	No
	P-Area Cask Car Railroad Tracks as Abandoned (NBN), including railroad tracks within P Area and the HCA	FFA	Yes
	Process Sewer Lines As Abandoned (portions)	FFA	No
	PSA-1 – Emergency Cooling Water Retention Basin (904-86G)	PSA	No
	PSA-3A – Area near the northern end of the P-Reactor Building (105-P)	PSA	Yes
	PSA- 4 – Area east of the P-Reactor Building (105-P)	PSA	No
	P-Reactor Building (105-P) including Engine Houses (108-1P and 108-2P), and Standby Pumphouse (191-P)	D&D Subunit	Yes
	Process Water Storage Tank (106-P)	D&D Subunit	No
	Process Water Storage Basin (109-P)	D&D Subunit	No
	Four Additional D&D Building Slabs(2)	D&D Subunit	No
Other	Outfall P02	Outfall	Yes
	Outfall P007	Outfall	No
	Telephone Exchange Building (702-P)	D&D Subunit	No

(1) FFA: Operable Unit identified in the Federal Facility Agreement
(2) The four additional D&D Building Slabs include the Containment Tank within the Emergency Cooling Water Retention Basin (904-86G); the Pipe Fabrication Building (717-9P); the Radiological Zone Storage Building (710-P); and the No. 2 & 5 Basin Deionizers Pad (105-1P).
PSA: Potential Source Area

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Table 2. Cancer Toxicity Data Summary **Pathway: Ingestion, Inhalation, Dermal**[1]

Constituent of Concern	Oral Cancer Slope Factor	Inhalation Cancer Slope Factor	Slope Factor Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (Year)
As	1.50E+00	1.51E+01	1/(mg/kg-d)	A	IRIS	2004
PCB 1254	2.00E+00	2.00E+00	1/(mg/kg-d)	B2	IRIS	2004
Am-241	9.10E-11	2.81E-08	risk/pCi	A	HEAST	2003
Am-243 (+D)	2.15E-12	2.70E-08	risk/pCi	A	HEAST	2003
Sb-124	6.03E-12	2.43E-11	risk/pCi	A	HEAST	2003
Sb-125 (+D)	NA	1.93E-11	risk/pCi	A	HEAST	2003
Ba-133	4.37E-12	1.16E-11	risk/pCi	A	HEAST	2003
Cf-249	1.14E-10	3.40E-08	risk/pCi	A	HEAST	2003
Cf-251	1.17E-10	3.40E-08	risk/pCi	A	HEAST	2003
C-14	1.38E-12	7.07E-12	risk/pCi	A	HEAST	2003
Ce-141	1.89E-12	1.14E-11	risk/pCi	A	HEAST	2003
Ce-144 (+D)	NA	1.10E-10	risk/pCi	A	HEAST	2003
Cm-243/244	7.84E-11	2.69E-08	risk/pCi	A	HEAST	2003
Cm-245	9.14E-11	2.77E-08	risk/pCi	A	HEAST	2003
Cm-246	9.03E-11	2.77E-08	risk/pCi	A	HEAST	2003
Co-57	4.85E-13	2.09E-12	risk/pCi	A	HEAST	2003
Co-58	1.57E-12	5.99E-12	risk/pCi	A	HEAST	2003
Co-60	7.33E-12	3.58E-11	risk/pCi	A	HEAST	2003
Cs-134	4.48E-11	1.65E-11	risk/pCi	A	HEAST	2003
Cs-135	4.70E-12	1.86E-12	risk/pCi	A	HEAST	2003
Cs-137 (+D)	3.17E-11	1.19E-11	risk/pCi	A	HEAST	2003
Eu-152	2.96E-12	9.10E-11	risk/pCi	A	HEAST	2003
Eu-154	4.74E-12	1.15E-10	risk/pCi	A	HEAST	2003
Eu-155	8.07E-13	1.48E-11	risk/pCi	A	HEAST	2003
Fe-155	5.18E-13	7.99E-13	risk/pCi	A	HEAST	2003
I-129	1.14E-10	6.07E-11	risk/pCi	A	HEAST	2003
K-40	1.51E-11	1.03E-11	risk/pCi	A	HEAST	2003
Mn-54	1.48E-12	5.88E-12	risk/pCi	A	HEAST	2003
Mo-93	3.38E-12	1.27E-12	risk/pCi	A	HEAST	2003
Na-22	7.47E-12	3.89E-12	risk/pCi	A	HEAST	2003
Nb-94	3.89E-12	3.77E-11	risk/pCi	A	HEAST	2003
Ni-59	1.44E-13	4.66E-13	risk/pCi	A	HEAST	2003

Table 2. Cancer Toxicity Data Summary (*Continued*)

Pathway: Ingestion, Inhalation, Dermal[1]						
Constituent of Concern	**Oral Cancer Slope Factor**	**Inhalation Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (Year)**
Ni-63	3.50E-13	1.64E-12	risk/pCi	A	HEAST	2003
Np-237 (+D)	4.92E-11	1.77E-08	risk/pCi	A	HEAST	2003
Pm-144	1.86E-12	2.76E-11	risk/pCi	A	HEAST	2003
Pm-146	2.00E-12	5.40E-11	risk/pCi	A	HEAST	2003
Pu-238	1.17E-10	3.36E-08	risk/pCi	A	HEAST	2003
Pu-239/240	1.21E-10	3.33E-08	risk/pCi	A	HEAST	2003
Pu-241	1.73E-12	3.34E-10	risk/pCi	A	HEAST	2003
Pu-242	1.15E-10	3.13E-08	risk/pCi	A	HEAST	2003
Ra-226 (+D)	2.95E-10	1.16E-08	risk/pCi	A	HEAST	2003
Ra-228 (+D)	6.70E-10	5.23E-09	risk/pCi	A	HEAST	2003
Se-79	5.29E-12	3.33E-12	risk/pCi	A	HEAST	2003
Th-228 (+D)	1.62E-10	1.43E-07	risk/pCi	A	HEAST	2003
Sn-126	1.17E-11	9.95E-08	risk/pCi	A	HEAST	2003
H-3 (organic)	NA	1.99E-13	risk/pCi	A	HEAST	2003
Sr-90 (+D)	5.92E-11	1.13E-10	risk/pCi	A	HEAST	2003
U-233	5.22E-11	1.16E-08	risk/pCi	A	HEAST	2003
U-234	5.11E-11	1.14E-08	risk/pCi	A	HEAST	2003
U-235 (+D)	5.03E-11	1.01E-08	risk/pCi	A	HEAST	2003
U-238 (+D)	5.62E-11	9.35E-09	risk/pCi	A	HEAST	2003
Y-88	2.40E-12	1.70E-11	risk/pCi	A	HEAST	2003
Zn-65	8.95E-12	5.81E-12	risk/pCi	A	HEAST	2003
Zr-95	2.16E-12	1.65E-11	risk/pCi	A	HEAST	2003
Pathway: External (Radiation)						
Constituent of Concern	**Cancer Slope or Conversion Factor**	**Exposure Route**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (Year)**
As	NA	External exposure	NA	NA	NA	NA
PCB 1254	NA	External exposure	NA	NA	NA	NA
Am-241	2.76E-08	External exposure	risk/yr per pCi/g	A	HEAST	2003
Am-243 (+D)	6.36E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Sb-124	8.89E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Sb-125 (+D)	1.81E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ba-133	1.44E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cf-249	1.37E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cf-251	3.76E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003

Table 2. Cancer Toxicity Data Summary (*Continued*)

Pathway: External (Radiation)						
Constituent of Concern	**Cancer Slope or Conversion Factor**	**Exposure Route**	**Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date (Year)**
C-14	7.83E-12	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ce-141	2.27E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ce-144 (+D)	2.44E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cm-243/244	4.19E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cm-245	2.38E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cm-246	4.57E-11	External exposure	risk/yr per pCi/g	A	HEAST	2003
Co-57	3.55E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Co-58	4.48E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Co-60	1.24E-05	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cs-134	7.10E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cs-135	2.36E-11	External exposure	risk/yr per pCi/g	A	HEAST	2003
Cs-137 (+D)	2.55E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Eu-152	5.30E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Eu-154	5.83E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Eu-155	1.24E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Fe-155	0.00E+00	External exposure	risk/yr per pCi/g	A	HEAST	2003
I-129	6.10E-09	External exposure	risk/yr per pCi/g	A	HEAST	2003
K-40	7.97E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Mn-54	3.89E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Mo-93	2.17E-10	External exposure	risk/yr per pCi/g	A	HEAST	2003
Na-22	1.03E-05	External exposure	risk/yr per pCi/g	A	HEAST	2003
Nb-94	7.29E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ni-59	0.00E+00	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ni-63	0.00E+00	External exposure	risk/yr per pCi/g	A	HEAST	2003
Np-237 (+D)	7.97E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pm-144	6.90E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pm-146	3.29E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pu-238	7.22E-11	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pu-239/240	2.00E-10	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pu-241	4.11E-12	External exposure	risk/yr per pCi/g	A	HEAST	2003
Pu-242	6.25E-11	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ra-226 (+D)	8.49E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Ra-228 (+D)	4.53E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Se-79	1.10E-11	External exposure	risk/yr per pCi/g	A	HEAST	2003
Th-228 (+D)	7.76E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003

Table 2. Cancer Toxicity Data Summary (*Continued/End*)

Pathway: External (Radiation)						
Constituent of Concern	Cancer Slope or Conversion Factor	Exposure Route	Units	Weight of Evidence/ Cancer Guideline Description	Source	Date (Year)
Sn-126	9.96E-08	External exposure	risk/yr per pCi/g	A	HEAST	2003
H-3 (organic)	NA	External exposure	risk/yr per pCi/g	A	HEAST	2003
Sr-90 (+D)	1.96E-08	External exposure	risk/yr per pCi/g	A	HEAST	2003
U-233	9.82E-10	External exposure	risk/yr per pCi/g	A	HEAST	2003
U-234	2.52E-10	External exposure	risk/yr per pCi/g	A	HEAST	2003
U-235 (+D)	5.43E-10	External exposure	risk/yr per pCi/g	A	HEAST	2003
U-238 (+D)	1.14E-07	External exposure	risk/yr per pCi/g	A	HEAST	2003
Y-88	1.37E-05	External exposure	risk/yr per pCi/g	A	HEAST	2003
Zn-65	2.81E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003
Zr-95	3.40E-06	External exposure	risk/yr per pCi/g	A	HEAST	2003

Key

1: For nonradiological constituents, dermal cancer slope factors obtained by using the oral cancer slope factor and applying an oral-to-dermal adjustment factor.

IRIS: Integrated Risk Information System. Nonradiological PRGs are industrial worker soil values from the USEPA Region 9 Preliminary Remediation Goals Table, USEPA (October 2004): www.epa.gov/region09/waste/sfund/prg/index.htm. Nonradiological PRGS for concrete media are ten times (10x) the Region 9 values published for soil media.

HEAST: Health Effects Assessment Summary Table USEPA; values used in the USEPA Radcalculator website http://epa-prgs.ornl.gov/radionuclides. Radiological PRGs for soil media are industrial worker values from Radionuclide Preliminary Remediation Goals, Engineering Calculation K-CLC-G-00077, Rev. 1, Washington Savannah River Company (July 2003). Radiological PRGs for concrete media are industrial worker values from Radionuclide Preliminary Remediation Goals for Concrete Media, Engineering Calculation K-CLC-G-00086, Rev. 0, Washington Savannah River Company (November 2005).

B2: Probable human carcinogen -indicates sufficient evidence in animals and inadequate or no evidence in humans

A: Human Carcinogen

Table 3. Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Constituent of Concern	Chronic/ Subchronic	Oral RfD[1]	Oral RfD Units	Dermal RfD[2]	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates (M/D/Y)[3]
Antimony	Chronic	4.00E-04	mg/kg/day	---	---	blood	1000	IRIS	2004
Iron	Chronic	3.00E-01	mg/kg/day	---	---	liver	1	NCEA	2004
Lead	Chronic	None[4]	---	---	---	---	---	---	2004
Uranium	Chronic	2.00E-04	mg/kg/day	---	---	---	---	NCEA	2004

Pathway: Inhalation

Constituent of Concern	Chronic/ Subchronic	Inhalation RfC[3]	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfC: Target Organ	Dates (M/D/Y)[3]
Antimony	---	none	---	---	---	---	---	---	2004
Iron	---	none	---	---	---	---	---	---	2004
Lead	---	none	---	---	---	---	---	---	2004
Uranium	---	none	---	---	---	---	---	---	2004

Key

---: no information available

IRIS: Integrated Risk Information System, USEPA

NCEA: National Center for Environmental Assessment

RfDs: reference dose

RfC: reference concentration

1 - RfD as documented in EPA Region 9 Table.

2 - Dermal cancer slope factors obtained by using oral cancer slope factors and applying an oral-to-dermal adjustment factor.

3 - Latest version of *USEPA Region 9 Preliminary Remediation Goals Table*, United States Environmental Protection Agency, San Francisco, CA (October 2004).

4 - Lead PRG derived using USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model as documented in EPA Region 9 Table.

www. epa.gov/superfund/programs/lead/ieubk.htm

Table 4. Summary of Refined Constituents of Concern and Medium-Specific Exposure Point Concentrations for the Reactor Vessel

Scenario Timeframe: Current/Future
Medium: Metal
Exposure Medium: Reactor Vessel

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection[a]	Exposure Point Concentration (EPC)	EPC Units	Statistical Measure
		Min	Max					
Reactor Vessel	Barium-133	5.59E+03	5.59E+03	pCi/g	1/1	5.59E+03	pCi/g	NA
	Carbon-14	2.43E+05	2.43E+05	pCi/g	1/1	2.43E+05	pCi/g	NA
	Cobalt-60	7.71E+07	7.71E+07	pCi/g	1/1	7.71E+07	pCi/g	NA
	Europium-152	3.92E+02	3.92E+02	pCi/g	1/1	3.92E+02	pCi/g	NA
	Europium-154	3.92E+01	3.92E+01	pCi/g	1/1	3.92E+01	pCi/g	NA
	Iron-55	1.82E+07	1.82E+07	pCi/g	1/1	1.82E+07	pCi/g	NA
	Molybdenum-93	6.22E+03	6.22E+03	pCi/g	1/1	6.22E+03	pCi/g	NA
	Nickel-59	1.14E+06	1.14E+06	pCi/g	1/1	1.14E+06	pCi/g	NA
	Niobium-94	1.84E+00	1.84E+00	pCi/g	1/1	1.84E+00	pCi/g	NA
	Potassium-40	3.13E+00	3.13E+00	pCi/g	1/1	3.13E+00	pCi/g	NA

Key

a: Statistical evaluation of the dataset was not performed; concentrations used in the risk assessment from Estimate of Residual Radionuclides within the 105-P Reactor Vessel, SDD-2008-0004, Rev. 0.

pCi/g: picoCuries per gram

NA: not applicable

Table 5. Risk Characterization Summary - Carcinogens for the Reactor Vessel

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Reactor Vessel	Metal	External Radiation	Barium-133	NC	NA	NA	NC	1.8E-02
			Carbon-14	NC	NA	NA	NC	2.8E-05
			Cobalt-60	NC	NA	NA	NC	1.3E+03
			Europium-152	NC	NA	NA	NC	5.3E-03
			Europium-154	NC	NA	NA	NC	4.6E-04
			Iron-155	NC	NA	NA	NC	8.2E-05
			Molybdenum-93	NC	NA	NA	NC	7.3E-06
			Nickel-59	NC	NA	NA	NC	9.3E-06
			Nickel-63	NC	NA	NA	NC	2.2E-03
			Niobium-94	NC	NA	NA	NC	6.1E-05
			Potassium-40	NC	NA	NA	NC	1.1E-05
							Total Cumulative Risk =	1.3E+03

Key
NA = Not applicable.
NC = Not calculated. Risk was not calculated separately for each exposure pathway. Instead, the PRG value that was used to calculate risk is a risk-based concentration that is derived from standardized equations and combines all of the exposure pathways and assumptions with USEPA toxicity data. Use of the PRG provides an exposure routes total risk estimate for each constituent. Radiological PRGs are industrial worker values from *Radionuclide Preliminary Remediation Goals for Concrete Media*, Engineering Calculation K-CLC-G-00086, Rev. 0, Washington Savannah River Company (November 2005).

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Table 6. Summary of Refined Constituents of Concern and Medium-Specific Exposure Point Concentrations for the Disassembly Basin

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Disassembly Basin

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection[a]	Exposure Point Concentration (EPC)	EPC Units	Statistical Measure
		Min	Max					
Disassembly Basin	Antimony	4.97E+02	4.97E+02	mg/kg	1/1	4.97E+02	pCi/g	NA
	Arsenic	2.80E+01	2.80E+01	mg/kg	1/1	2.80E+01	pCi/g	NA
	Iron	2.72E+05	2.72E+05	mg/kg	1/1	2.72E+05	pCi/g	NA
	Lead	1.05E+03	1.05E+03	mg/kg	1/1	1.05E+03	pCi/g	NA
	Uranium	3.88E+03	3.88E+03	mg/kg	1/1	3.88E+03	pCi/g	NA
	Americium-241	3.71E+04	1.82E+07	pCi/g	1/1	1.82E+07	pCi/g	NA
	Americium-243 (+D)	2.47E+03	6.22E+03	pCi/g	1/1	6.22E+03	pCi/g	NA
	Antimony-124	2.98E+02	1.14E+06	pCi/g	1/1	1.14E+06	pCi/g	NA
	Antimony-125 (+D)	1.14E+03	1.84E+00	pCi/g	1/1	1.84E+00	pCi/g	NA
	Barium-133	1.33E+02	3.13E+00	pCi/g	1/1	3.13E+00	pCi/g	NA
	Californium-249	1.41E+02	1.41E+02	pCi/g	1/1	1.41E+02	pCi/g	NA
	Californium -251	5.35E+02	5.35E+02	pCi/g	1/1	5.35E+02	pCi/g	NA
	Carbon-14	1.80E+05	1.80E+05	pCi/g	1/1	1.80E+05	pCi/g	NA
	Cerium-141	1.99E+02	1.99E+02	pCi/g	1/1	1.99E+02	pCi/g	NA
	Cerium -144 (+D)	4.93E+02	4.93E+02	pCi/g	1/1	4.93E+02	pCi/g	NA
	Curium-243/244	2.07E+03	2.07E+03	pCi/g	1/1	2.07E+03	pCi/g	NA
	Curium -245	3.71E+03	3.71E+03	pCi/g	1/1	3.71E+03	pCi/g	NA
	Curium -246	6.14E+03	6.14E+03	pCi/g	1/1	6.14E+03	pCi/g	NA
	Cobalt-57	8.76E+02	8.76E+02	pCi/g	1/1	8.76E+02	pCi/g	NA
	Cobalt-58	1.95E+02	1.95E+02	pCi/g	1/1	1.95E+02	pCi/g	NA
	Cobalt-60	2.15E+05	2.15E+05	pCi/g	1/1	2.15E+05	pCi/g	NA
	Cesium-134	2.34E+02	2.34E+02	pCi/g	1/1	2.34E+02	pCi/g	NA
	Cesium-135	4.41E+02	4.41E+02	pCi/g	1/1	4.41E+02	pCi/g	NA
	Cesium-137 (+D)	6.00E+04	6.00E+04	pCi/g	1/1	6.00E+04	pCi/g	NA
	Europium-152	1.37E+03	1.37E+03	pCi/g	1/1	1.37E+03	pCi/g	NA

Key

a: Statistical evaluation of the dataset was not performed; concentrations used in the risk assessment from Remedial Investigation Work Plan for the P-Area Operable Unit, Rev. 1.1, WSRC-RP-2005-4081.

pCi/g: picoCuries per gram

NA: not applicable

Table 6. Summary of Refined Constituents of Concern and Medium-Specific Exposure Point Concentrations for the Disassembly Basin (*Continued/End*)

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Disassembly Basin

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection[a]	Exposure Point Concentration	EPC Units	Statistical Measure
		Min	Max					
Disassembly Basin	Europium-154	4.45E+03	4.45E+03	pCi/g	1/1	4.45E+03	pCi/g	NA
	Europium -155	5.68E+02	5.68E+02	pCi/g	1/1	5.68E+02	pCi/g	NA
	Iodine-129	2.38E+01	2.38E+01	pCi/g	1/1	2.38E+01	pCi/g	NA
	Potassium-40	8.22E+02	8.22E+02	pCi/g	1/1	8.22E+02	pCi/g	NA
	Manganese-54	3.46E+02	3.46E+02	pCi/g	1/1	3.46E+02	pCi/g	NA
	Sodium-22	7.84E+02	7.84E+02	pCi/g	1/1	7.84E+02	pCi/g	NA
	Niobium-94	3.45E+02	3.45E+02	pCi/g	1/1	3.45E+02	pCi/g	NA
	Nickel-63	1.80E+06	1.80E+06	pCi/g	1/1	1.80E+06	pCi/g	NA
	Neptunium-237 (+D)	1.57E+02	1.57E+02	pCi/g	1/1	1.57E+02	pCi/g	NA
	Praseodymium-144	1.21E+02	1.21E+02	pCi/g	1/1	1.21E+02	pCi/g	NA
	Praseodymium-144	1.61E+02	1.61E+02	pCi/g	1/1	1.61E+02	pCi/g	NA
	Plutonium-238	2.98E+05	2.98E+05	pCi/g	1/1	2.98E+05	pCi/g	NA
	Plutonium-239/240	1.97E+04	1.97E+04	pCi/g	1/1	1.97E+04	pCi/g	NA
	Plutonium -241	1.35E+05	1.35E+05	pCi/g	1/1	1.35E+05	pCi/g	NA
	Plutonium -242	8.90E+02	8.90E+02	pCi/g	1/1	8.90E+02	pCi/g	NA
	Radium-228 (+D)	1.40E+03	1.40E+03	pCi/g	1/1	1.40E+03	pCi/g	NA
	Selenium-79	7.51E+03	7.51E+03	pCi/g	1/1	7.51E+03	pCi/g	NA
	Thorium-228 (+D)	3.13E+02	3.13E+02	pCi/g	1/1	3.13E+02	pCi/g	NA
	Tritium	8.58E+06	8.58E+06	pCi/g	1/1	8.58E+06	pCi/g	NA
	Tin-126	5.96E+02	5.96E+02	pCi/g	1/1	5.96E+02	pCi/g	NA
	Stronium-90 (+D)	3.27E+04	3.27E+04	pCi/g	1/1	3.27E+04	pCi/g	NA
	Uranium-233	1.32E+02	1.32E+02	pCi/g	1/1	1.32E+02	pCi/g	NA
	Uranium -234	1.18E+02	1.18E+02	pCi/g	1/1	1.18E+02	pCi/g	NA
	Uranium -235 (+D)	1.09E+01	1.09E+01	pCi/g	1/1	1.09E+01	pCi/g	NA
	Uranium -238 (+D)	5.38E+01	5.38E+01	pCi/g	1/1	5.38E+01	pCi/g	NA
	Ytterium-88	7.35E+01	7.35E+01	pCi/g	1/1	7.35E+01	pCi/g	NA
	Zinc-65	5.20E+02	5.20E+02	pCi/g	1/1	5.20E+02	pCi/g	NA
	Zirconium-95	3.29E+02	3.29E+02	pCi/g	1/1	3.29E+02	pCi/g	NA

Key

a: Statistical evaluation of the dataset was not performed; concentrations used in the risk assessment from Remedial Investigation Work Plan for the P-Area Operable Unit, Rev. 1.1, WSRC-RP-2005-4081.

pCi/g: picoCuries per gram

NA: not applicable

Table 7. Risk Characterization Summary - Carcinogens for the Disassembly Basin

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk: Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Disassembly Basin	Sediment	Ingestion, Inhalation, Dermal Contact, External Radiation	Arsenic	NC	NC	NC	NA	1.80E-05
			Americium-241	NC	NC	NA	NC	6.50E-03
			Americium-243 (+D)	NC	NC	NA	NC	7.20E-03
			Antimony-124	NC	NC	NA	NC	1.20E-04
			Antimony-125 (+D)	NC	NC	NA	NC	1.50E-03
			Barium-133	NC	NC	NA	NC	4.40E-04
			Californium-249	NC	NC	NA	NC	8.80E-04
			Californium -251	NC	NC	NA	NC	9.60E-04
			Carbon-14	NC	NC	NA	NC	1.50E-04
			Cerium-141	NC	NC	NA	NC	1.10E-06
			Cerium -144 (+D)	NC	NC	NA	NC	2.50E-05
			Curium-243/244	NC	NC	NA	NC	3.10E-03
			Curium -245	NC	NC	NA	NC	4.30E-03
			Curium -246	NC	NC	NA	NC	3.10E-04
			Cobalt-57	NC	NC	NA	NC	6.20E-05
			Cobalt-58	NC	NC	NA	NC	4.50E-05
			Cobalt-60	NC	NC	NA	NC	3.60E+00
			Cesium-134	NC	NC	NA	NC	9.10E-04
			Cesium -135	NC	NC	NA	NC	1.20E-06
			Cesium -137 (+D)	NC	NC	NA	NC	5.40E-01
			Europium-152	NC	NC	NA	NC	1.90E-02
			Europium -154	NC	NC	NA	NC	5.20E-02
			Europium -155	NC	NC	NA	NC	9.00E-05
			Iodine-129	NC	NC	NA	NC	2.20E-06
			Potassium-40	NC	NC	NA	NC	3.00E-03
			Manganese-54	NC	NC	NA	NC	3.10E-04
			Sodium-22	NC	NC	NA	NC	5.60E-03
			Niobium-94	NC	NC	NA	NC	1.20E-02

Table 7. Risk Characterization Summary – Carcinogens for the Disassembly Basin (*Continued/End*)

Scenario Timeframe: Future

Receptor Population: Industrial Worker

Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Disassembly Basin	Sediment	Ingestion, Inhalation, Dermal Contact, External Radiation	Nickel-63	NC	NC	NA	NC	3.20E-04
			Neptunium-237 (+D)	NC	NC	NA	NC	5.80E-04
			Praseodymium-144	NC	NC	NA	NC	2.20E-04
			Praseodymium-146	NC	NC	NA	NC	7.50E-04
			Plutonium-238	NC	NC	NA	NC	1.80E-02
			Plutonium -239/240	NC	NC	NA	NC	1.40E-03
			Plutonium -241	NC	NC	NA	NC	7.80E-05
			Plutonium -242	NC	NC	NA	NC	5.80E-05
			Radium-228 (+D)	NC	NC	NA	NC	9.40E-03
			Selenium-79	NC	NC	NA	NC	2.30E-05
			Thorium-228 (+D)	NC	NC	NA	NC	1.20E-03
			Tritium	NC	NC	NA	NC	2.00E+00
			Tin-126	NC	NC	NA	NC	2.80E-04
			Strontium-90 (+D)	NC	NC	NA	NC	3.10E-03
			Uranium-233	NC	NC	NA	NC	4.50E-06
			Uranium -234	NC	NC	NA	NC	3.50E-06
			Uranium -235 (+D)	NC	NC	NA	NC	2.80E-05
			Uranium -238 (+D)	NC	NC	NA	NC	3.00E-05
			Yttrium-88	NC	NC	NA	NC	7.90E-05
			Zinc-65	NC	NC	NA	NC	2.60E-04
			Zirconium-95	NC	NC	NA	NC	5.20E-05
							Total Cumulative Risk =	6.30E+00

Key

NA = Not applicable.

NC = Not calculated. Risk was not calculated separately for each exposure pathway. Instead, the PRG value that was used to calculate risk is a risk-based concentration that is derived from standardized equations and combines all of the exposure pathways and assumptions with USEPA toxicity data. Use of the PRG provides an exposure routes total risk estimate for each constituent. Radiological PRGs are industrial worker soil values from *Radionuclide Preliminary Remediation Goal*, Engineering Calculation K-CLC-G-00077, Rev. 1, Washington Savannah River Company (July 2003). Nonradiological PRGs are industrial worker soil values from the *USEPA Region 9 Preliminary Remediation Goals Table*, United States Environmental Protection Agency, San Francisco, CA (October 2004).

Table 8. Risk Characterization Summary – Non-Carcinogens for the Disassembly Basin

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Primary Target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Disassembly Basin	Sediment	Ingestion, Inhalation, Direct Contact	Antimony	blood	NC	NC	NC	1.2
			Iron	liver	NC	NC	NC	2.7
			Lead	---	NC	NC	NC	1.3
			Uranium	---	NC	NC	NC	19.0
							Soil Hazard Index Total =	24.2

Key:

NC = Not calculated. Risk was not calculated separately for each exposure pathway. Instead, the PRG value that was used to calculate risk is a risk-based concentration that is derived from standardized equations and combines all of the exposure pathways and assumptions with USEPA toxicity data. Use of the PRG provides an exposure routes total risk estimate for each constituent. Nonradiological PRGs are industrial worker soil values from the *USEPA Region 9 Preliminary Remediation Goals Table*, United States Environmental Protection Agency, San Francisco, CA (October 2004).

Table 9. Summary of Refined Constituents of Concern and Medium-Specific Exposure Point Concentrations for the Reactor Building (general)

Scenario Timeframe: Current/Future

Medium: concrete

Exposure Medium: Reactor Building (general)

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Reactor Building minus 20 ft level	PCB-1254	1.82E-02	2.40E+02	mg/kg	3/3	2.40E+02	mg/kg	MAX
	Cs-137 (+D)	ND	1.12E+03	pCi/g	2/3	1.12E+03	pCi/g	MAX
	Co-60	ND	2.53E+02	pCi/g	2/3	2.53E+02	pCi/g	MAX
	Sr-90 (+D)	ND	3.75E+02	pCi/g	1/3	3.75E+02	pCi/g	MAX
	U-238 (+D)	1.14E+00	1.14E+01	pCi/g	3/3	1.14E+01	pCi/g	MAX
Reactor Building minus 40 ft level	PCB-1254	1.24E-02	4.20E+01	mg/kg	6/6	4.20E+01	mg/kg	MAX
	Cs-137 (+D)	2.56E+00	1.41E+03	pCi/g	7/7	1.41E+03	pCi/g	MAX
	Co-60	3.45E-02	5.09E+00	pCi/g	7/7	3.40E+00	pCi/g	95% UCL
	Sr-99 (+D)	ND	9.50E+02	pCi/g	4/7	9.50E+02	pCi/g	MAX
Reactor Building minus 49.5 ft level	Cs-137 (+D)	1.97E+01	1.97E+01	pCi/g	1/1	1.97E+01	pCi/g	MAX

Key

MAX: maximum detected concentration

95 % UCL: 95 % upper confidence limit on the mean concentration

mg/kg: milligrams per kilogram

pCi/g: picoCuries per gram

ND: nondetect

Table 10. Risk Characterization Summary – Carcinogens for the Reactor Building (general)

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Reactor Building minus 20 ft level	Concrete	Ingestion, External Radiation	PCB-125	NC	NA	NA	NA	3.2E-05
			Cs-137 (+D)	NC	NA	NA	NC	9.9E-03
			Co-60	NC	NA	NA	NC	4.2E-03
			Sr-90 (+D)	NC	NA	NA	NC	2.6E-03
			U-238 (+D)	NC	NA	NA	NC	6.0E-06
Total Cumulative Risk (minus 20 ft level) =								1.4E-02
Reactor Building minus 40 ft level	Concrete	Ingestion, External Radiation	PCB-1254	NC	NA	NA	NC	5.7E-06
			Cs-137 (+D)	NC	NA	NA	NC	1.3E-02
			Co-60	NC	NA	NA	NC	5.7E-05
			Sr-90 (+D)	NC	NA	NA	NC	6.6E-05
Total Cumulative Risk (minus 40 ft level) =								1.3E-02
Reactor Building minus 49.5 ft level	Concrete	Ingestion, External Radiation	Cs-137 (+D)	NC	NA	NA	NC	1.7E-04
Total Cumulative Risk (minus 49.5 ft level) =								1.7E-04

Key
NA = Not applicable.
NC = Not calculated. Risk was not calculated separately for each exposure pathway. Instead, the PRG value that was used to calculate risk is a risk-based concentration that is derived from standardized equations and combines all of the exposure pathways and assumptions with USEPA toxicity data. Use of the PRG provides an exposure routes total risk estimate for each constituent. Radiological PRGs are industrial worker values from *Radionuclide Preliminary Remediation Goals for Concrete Media*, Engineering Calculation K-CLC-G-00086, Rev. 0, Washington Savannah River Company (November 2005). Nonradiological PRGs are ten times (10x) the industrial worker soil values from the *USEPA Region 9 Preliminary Remediation Goals Table*, United States Environmental Protection Agency, San Francisco, CA (October 2004).

Table 11. Summary of Refined Constituents of Concern and Medium-Specific Exposure Point Concentrations for the HCA at the Cask Car Railroad Tracks

Scenario Timeframe: Current/Future
Medium: Surface Gravel (0-1 ft)
Exposure Medium: HCA at the Cask Car Railroad Tracks Surface Gravel

Exposure Route	Constituent of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Surface Gravel HCA at the Cask Car Railroad Tracks	Cs-137 (+D)	2.1	2030	pCi/g	17/17	626	pCi/g	95% UCL
	Cobalt-60	ND	0.9	pCi/g	4/17	0.6	pCi/g	95% UCL

Key

ND: nondetect
95% UCL: 95% Upper Confidence Limit
pCi/g: picoCuries per gram

Table 12. Risk Characterization Summary – Carcinogens for the HCA at the Cask Car Railroad Tracks

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Route	Constituent of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total
Gravel/ Soil	Surface Gravel, Soil, Dust	Surface Gravel/Soil Onsite-Ingestion, Inhalation, External Radiation	Cs-137 (+D)	NC	NC	NA	NC	5.6E-03
			Co-60	NC	NC	NA	NC	9.9E-06
							Total Cumulative Risk (gravel/soil) =	5.6E-03

Key
NA = Not applicable.
NC = Not calculated. Risk was not calculated separately for each exposure pathway. Instead, the PRG value that was used to calculate risk is a risk-based concentration that is derived from standardized equations and combines all of the exposure pathways and assumptions with USEPA toxicity data. Use of the PRG provides an exposure routes total risk estimate for each constituent. Radiological PRGs are industrial worker values from *Radionuclide Preliminary Remediation Goals*, Engineering Calculation K-CLC-G-00077, Rev. 1, Washington Savannah River Company (July 2003).

Table 13. PTSM/Risk Evaluation for Metal Media Reactor Vessel

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Radionuclides (pCi/g)					
Argon-39	3.51E+02	---	---	3.80E+02	9.24E-07
Barium-133	5.59E+03	---	---	3.06E-01	1.83E-02
Beryllium-10	5.49E-02	---	---	2.80E+02	1.96E-10
Calcium-41	4.4E+02	---	---	5.49E+04	8.09E-09
Carbon-14	2.43E+05	---	---	8.83E+03	2.75E-05
Chlorine-36	4.72E-01	---	---	1.24E+02	3.81E-09
Cobalt-60	7.71E+07	---	---	6.02E-02	1.28E+03
Europium-152	3.92E+02	---	---	7.37E-02	5.32E-03
Europium-154	3.92E+01	---	---	8.58E-02	4.57E-04
Iron-55	1.82E+07	---	---	2.21E+05	8.24E-05
Molybdenum-93	6.22E+03	---	---	8.47E+02	7.34E-06
Nickel-59	1.14E+06	---	---	1.23E+05	9.27E-06
Nickel-63	1.24E+08	---	---	5.55E+04	2.23E-03
Niobium-93m	3.98E+03	---	---	9.12E+03	4.36E-07
Niobium-94	1.84E+00	---	---	3.00E-02	6.13E-05
Potassium-40	3.13E+00	---	---	2.74E-01	1.14E-05
Silicon-32	6.55E-02	---	---	5.54E+03	1.18E-11
Sodium-22	5.49E-04	---	---	1.42E-01	3.87E-09
Tecnhicium-99	1.08E+03	---	---	2.24E+03	4.82E-07
Tin-121m	6.47E-02	---	---	2.84E+02	2.28E-10
Tritium	4.39E+02	---	---	NA	NA
		Hazard Index	**0.00E+00**	Cumulative Risk	1.28E+03
		PTSM?[5]	**NO**	PTSM?[6]	**YES**

1. EPC = Estimated decayed radionuclides in SRS reactor vessel materials (WSRC 2008b).
2. Radiological PRGs are industrial worker values for concrete media from *Radionuclide Preliminary Remediation Goals for Concrete Media,* Engineering Calculation K-CLC-G-00086, Rev. 0, 11/05.
3. Hazard Estimated = exposure point concentration / PRG concentration
4. Risk Estimate = (exposure point concentration / PRG concentration) x 1E-06
5. Subunit potentially has PTSM if HI ≥10 for noncarcinogenic constituents.
6. Subunit potentially has PTSM if cumulative risk ≥1E-03 for carcinogenic constituents.

NA = not applicable

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Table 14. PTSM/Risk Evaluation for Sediment Media Disassembly Basin

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	5.91E+04	1.00E+05	5.91E-01	---	---
Antimony	4.97E+02	4.09E+02	1.22E+00	---	---
Arsenic	2.80E+01	---	---	1.59E-00	1.76E-05
Barium	1.71E+02	6.66E+04	2.57E-03	---	---
Beryllium	8.22E+00	---	---	1.94E-03	4.24E-09
Baron	4.45E+01	1.00E+05	4.45E-04	---	---
Cadmium	6.57E+01	4.51E+02	1.45E-01	---	---
Calcium	654E+03	EN	NA	---	---
Chromium	3.89E+02	---	---	4.48E+02	8.68E-07
Cobalt	1.43E+01	---	---	1.92E+03	7.43E-09
Copper	5.51E+02	4.09E+04	1.35E-02	---	---
Iron	2.72E+05	1.00E+05	2.72E+00	---	---
Lead	1.05E+03	8.00E+02	1.31E-00	---	---
Magnesium	7.88E+02	EN	NA	---	---
Manganese	2.14E+03	1.95E+04	1.10E-01	---	---
Mercury	4.88E-01	3.07E+02	1.59E-03	---	---
Molybdenum	3.31E+02	5.11E+03	6.48E-02	---	---
Nickel	4.43E+02	2.04E+04	2.17E-02	---	---
Potassium	1.58E+03	EN	NA	---	---
Selenium	1.25E+01	5.11E+03	2.45E-03	---	---
Silver	2.03E+01	5.11E+03	3.98E-03	---	---
Sodium	3.04E+02	EN	NA	---	---
Strontium	8.97E+02	1.00E+05	8.97E-03	---	---
Tin	4.60E+02	1.00E+05	4.60E-03	---	---
Titanium	2.49E+03	1.00E+05	2.49E-02	---	---
Uranium	3.88E+03	2.04E+02	1.90E+01	---	---
Vanadium	8.75E+01	1.02E+03	8358E-02	---	---
Thallium	1.26E+01	6.75E+01	1.87E-01	---	---
Zinc	7.01E+03	1.00E+05	7.01E-02	---	---
Radionuclides (pCi/g)					
Amercium-241	3.71E+04	---	---	5.71E+00	6.50E-03
Amercium-243 (+D)	2.47E+05	---	---	3.41E-01	7.24E-03
Antimony-124	2.98E+02	---	---	2.56E+00	1.16E-04
Antimony-125 (+D)	1.14E+03	---	---	7.50E-01	1.52E-03
Barium-133	1.33E+02	---	---	3.03E-01	4.39E-04
Beryllium-10	1.14E+02	---	---	1.60E-01	8.81E-04
Californium-249	5.35E+02	---	---	5.60E-01	9.55E-04
Californium-251	1.80E+05	---	---	1.23E+03	1.456E-04
Carbon-14	1.99E+02	---	---	1.85E+02	1.08E-06
Cerium-144 (+D)	4.93E+02	---	---	1.98E+01	2.49E-05
Curium-243/244	2.07E+03	---	---	6.74E-01	3.07E-03
Curium-245	3.71E+03	---	---	8.70E-01	4.26E-03

Table 14. PTSM/Risk Evaluation for Sediment Media Disassembly Basin ***(Continued)***

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Radionuclides (pCi/g) ***(Continued)***					
Curium-246	6.14E+03	---	---	1.96E+01	3.13E-04
Cobalt-57	8.76E+02	---	---	1.42E+01	6.17E-05
Cobalt-58	1.95E+02	---	---	4.32E+00	4.51E-05
Cobalt-60	2.15+05	---	---	5.96E-02	3.61E+00
Cesium-134	2.34E+02	---	---	2.56E-01	9.14E-04
Cesium-135	441E+02	---	---	3.63E+02	1.21E-06
Cesium-135m	4.41E+02	---	---	5.05E+03	8.73E-08
Cesium-137 (+D)	6.00E+04	---	---	1.12E-01	5.36E-01
Europium-152	1.37E+03	---	---	7.31E-02	1.87E-02
Europium-154	4.45E+03	---	---	8.50E-02	5.24E-02
Europium-155	5.68E+02	---	---	6.29E+00	9.03E-5
Iodine-129	2.38E+01	---	---	1.08E+01	2.20E-06
Pottassium-40	8.22E+02	---	---	2.71E-01	3.03E-03
Manganese-54	3.46E+02	---	---	1.12E+00	3.09E-04
Sodium-22	7.84E+02	---	---	1.40E-01	5.60E-03
Niobium-94	3.45E+02	---	---	2.97E-02	1.16E-02
Nickel-59	4.89E+03	---	---	1.23E+04	3.98E-07
Nickel-63	1.80E+06	---	---	5.55E+03	3.24E-04
Neptunium-237(+D)	1.57E+02	---	---	2.70E-01	5.81E-04
Neptunium-239	5.49E+02	---	---	1.07E+03	5.13E-07
Promethium-144	1.21E+02	---	---	5.47E-01	2.21E-04
		Hazard Index	**2.56E+01**	Cumulative Risk	**6.33E+00**
		PTSM?[7]	**YES**	PTSM?[8]	**YES**

1. EPC = mean concentration from Tables 3-3 and 3-4 of the RI Work Plan for PAOU (WSRC-RP-2005-4081).
2. Nonradiological PRGs are industrial worker soil values from the *EPA Region 9 PRGs Table,* USEPA, San Francisco, CA (October, 2004). Radiological PRGs are industrial worker soil values from *Radionuclide Preliminary Remediation Goals*, Engineering Calculation K-CLC-G-00077, Rev. 1, 7/03.
3. Hazard Estimate = exposure point concentration / PRG concentration
4. Risk Estimate = (exposure point concentration / PRG concentration) x 1E-06
5. Activity of Ac-228 used to estimate activity of Ra-228 since these constituents are in secular equilibrium. The Ra-228 (+D) is then used in the screening comparison.
6. Activity of Pb-212 used to estimate activity of Th-228 since these constituents are in secular equilibrium. The Th-228 (+D) is then used in the screening comparison.
7. Subunit potentially has PTSM if HI $\geq$ 10 for noncarcinogenic constituents.
8. Subunit potentially has PTSM if cumulative risk $\geq$ 1E-03 for carcinogenic constituents.

EN = essential nutrient NA = not applicable

ARF # 15839

Table 15. PTSM Evaluation for Concrete Media P-Reactor Building (105-P) and Ancillary Structures

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	4.67E+04	1.00E+06	4.67E-02	----	----
Antimony	2.73E+01	4.09E+03	6.67E-03	----	----
Arsenic	9.91E+00	----	----	1.59E+01	6.23E-07
Barium	2.20E+02	6.66E+05	3.30E-04	----	----
Beryllium	1.07E+00	----	-----	1.94E+04	5.52E-11
Cadmium	1.02E+01	4.51E+03	2.26E-03	----	----
Calcium	1.49E+05	EN	NA	----	----
Chromium	3.36E+02	----	----	4.48E+03	7.50E-08
Cobalt	4.23E+01	----	----	1.92E+04	2.20E-09
Copper	1.17E+03	4.09E+05	2.86E-03	----	----
Iron	6.48E+04	1.00E+06	6.48E-02	----	----
Lead	1.12E+03	8.00E+03	1.40E-01	----	----
Magnesium	1.35E+04	EN	NA	----	----
Manganese	9.49E+02	1.95E+05	4.87E-03	----	----
Mercury	7.97E-02	3.07E+03	7.36E-02	----	----
Nickel	2.26E+02	2.04E+05	6.91E-02	----	----
Potassium	1.41E+04	EN	NA	----	----
Selenium	3.17E+01	5.11E+04	6.20E-04	----	----
Silver	1.72E+01	5.11E+04	3.37E-04	----	----
Sodium	5.42E+06	EN	NA	----	----
Thallium	5.81E+00	6.75E+02	8.61E-03	----	----
Vanadium	1.42E+02	1.02E+04	1.39E-02	----	----
Zinc	1.19E+03	1.00E+06	1.19E-03	----	----
Organics/Pesticides/PCBs (mg/kg)					
1,1,1-Trichloethane	1.31E-01	1.23E+04	1.07E-05	----	----
1,2-Dichloroebenzene	5.19E-04	6.00E+03	8.65E-08	----	----
1,4- Dichloroebenzene	3.70E-04	----	----	7.87E+01	4.70E-12
2-methylnaphthalene	5.71E+00	1.88E+03	3.04E-03	----	----
Acenaphthene	5.57E-02	2.94E+05	1.89E-07	----	----
Acetone	7.41E-01	5.43E+05	1.36E-06	----	----
Aroclor 1016	6.88E-02	----	----	2.12E+02	3.25E-10
Aroclor 1248	2.96E-01	----	----	7.44E+00	3.98E-08
Aroclor 1254	2.40E+02	----	----	7.44E+00	3.23E-05
Aroclor 1260	4.58E-01	----	----	7.44E+00	6.16E-08
Benzaldehyde	8.84E-01	6.16E+05	1.44E-06	----	----
Benzo[a]anthracene	1.57E-02	----	----	2.11E+01	7.44E-10
Benzo[b]fluoranthene	1.77E-02	----	----	2.11E+01	8.39E-10
Bis(2-ethylhexyl) phthalate	5.18E+00	----	----	1.23E+03	4.21E-09

Table 15. PTSM Evaluation for Concrete Media P-Reactor Building (105-P) and Ancillary Structures *(Continued)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Carbon disulfide	1.65E-03	7.20E+03	2.29E-07	----	----
Carbon tetrachloride	1.84E-01	----	----	5.49E+00	3.35E-08
Chloroform	4.38E-04	----	----	4.70E+00	9.32E-11
Chrysene	1.18E-02	----	----	2.11E+03	5.59E-12
DDD	4.42E-02	----	----	9.95E+01	4.44E-10
DDE	1.99E-01	----	----	7.02E+01	2.83E-09
DDT	6.10E-01	----	----	7.02E+01	8.69E-09
Dichloromethane (Methylene chloride)	4.50E-03	----	----	2.05E+02	2.20E-11
Di-N-butyl phthalate	1.60E+00	6.16E+05	2.60E-06	----	----
Endrin	9.08E-03	1.85E+03	4.91E-06	----	----
Endrin aldehyde[6]	7.02E-03	1.85E+03	3.79E-06	----	----
Ethylebenzene	5.56E-04	3.95E+03	1.41E-07	----	----
Fluoranthene	3.17E-02	2.20E+05	1.44E-07	----	----
gamma-Chlordane	1.88E-02	----	----	6.47E+01	2.91E-10
Lindane	1.23E-01	----	----	1.74E+01	7.07E-09
Methyl ethyl ketone	2.79E-03	1.13E+06	2.47E-09	----	----
Methyl tertiary butyl ether (MTBE)	2.02E-04	----	----	7.00E+02	2.89E-13
Naphthalene	7.16E-01	1.88E+03	3.81E-04	----	----
o-Cresol (2-Methylphenol)	6.01E+00	3.08E+05	1.95E-05	----	----
Phenanthrene[7]	2.16E-02	2.91E+05	7.42E-08	----	----
Phenol	9.71E-01	1.00E+06	9.71E-07	----	----
Pyrene	1.41E-02	2.91E+05	4.85E-08	----	----
Styrene	1.31E-03	1.70E+04	7.71E-08	----	----
Tetrachloroethylene (PCE)	1.11E-03	----	----	1.31E+01	8.47E-11
Toluene	1.30E+00	5.20E+03	2.50E-04	----	----
Trichloroethylene (TCE)	9.56E-02	----	----	1.15E+00	8.31E-08
Xylenes	2.53E-03	4.20E+03	6.02E-07	----	----
Radionuclides (pCi/g)					
Americium-241	6.83E-01	----	----	7.76E+00	8.80E-08
Americium -243 (+D)	5.03E-01	----	----	3.44E-01	1.46E-06
Carbon-14	2.01E+01	----	----	8.83E+03	2.28E-09
Cesium-137 (+D)	1.41E+03	----	----	1.13E-01	1.25E-02
Cobalt-60	2.53E+02	----	----	6.02E-02	4.20E-03
Europium-152	5.81E-01	----	----	7.37E-02	7.88E-06
Nickel-63	8.00E+02	----	----	5.55E+04	1.44E-08
Plutonium-238	9.20E+00	----	----	1.59E+02	5.79E-08
Plutonium -239/240	1.69E-01	----	----	1.30E+02	1.30E-09

Table 15. PTSM Evaluation for Concrete Media P-Reactor Building (105-P) and Ancillary Structures *(Continued)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate: Industrial PRG[2]	Noncarcinogenic Hazard Estimate: Industrial Hazard Quotient (HQ) Estimate[3]	Carcinogenic Risk Estimate: Industrial PRG[2]	Carcinogenic Risk Estimate: Industrial Risk Estimate[4]
Potassium-40	1.88E+01	----	----	2.74E-01	6.86E-05
Radium-226 (+D)[8]	1.59E+00	----	----	2.59E-02	6.14E-05
Bismuth-214	1.59E+00	----	----	NA	NA
Radium -228 (+D)[9]	2.53E+00	----	----	1.53E-01	1.65E-05
Actinium-228	2.53E+00	----	----	NA	NA
Strontium-90 (+D)	9.50E+02	----	----	1.43E+01	6.65E-05
Thorium-228 (+D)[10]	2.33E+00	----	----	2.55E-01	9.14E-06
Bismuth -212	1.52E+00	----	----	NA	NA
Lead-212	2.33E+00	----	----	NA	NA
Thallium-208	9.20E-01	----	----	NA	NA
Thorium-232	2.51E+00	----	----	1.58E+02	1.59E-08
Tritium	6.67E+06	----	----	NA	NA
Uranium-232	2.88E-01	----	----	6.81E+01	4.23E-09
Uranium-233/234	3.93E+00	----	----	1.35E+02	2.91E-08
Uranium-235 (+D)	6.27E-01	----	----	4.02E-01	1.56E-06
Uranium-238 (+D)	1.14E+01	----	----	1.90E+00	6.00E-06
		Hazard Index	**4.40E-01**	Cumulative Risk	**1.70E-02**
		PTSM?[11]	**NO**	PTSM?[12]	**YES**

1 - EPC = maximum detected concentration from all sample results for the -20 ft, -40 ft and -49.5 ft portions of the 105-P Building.

2 - Nonradiological PRGs are ten times (10X) industrial worker soil values from the *EPA Region 9 Preliminary Remediation Goals Table*, USEPA, San Francisco, CA (October, 2004). Radiological PRGs are industrial worker values for concrete media from *Radionuclide Preliminary Remediation Goals for Concrete Media*, Engineering Calculation K-CLC-G-00086, Rev. 0, 11/05.

3 - Hazard Estimate = exposure point concentration / PRG concentration

4 - Risk Estimate = (exposure point concentration / PRG concentration) x 1E-06

5- PRG for naphthalene used as a surrogate

7- PRG for pyrene used as a surrogate

8 - Activity of Bi-214 used to estimate activity of Ra-226 since these constituents are in secular equilibrium. The Ra-226 (+D) is then used in the screening comparison.

9 - Activity of Ac-228 used to estimate activity of Ra-228 since these constituents are in secular equilibrium. The Ra-228 (+D) is then used in the screening comparison.

10 - Activity of Pb-212 used to estimate activity of Th-228 since these constituents are in secular equilibrium. The Th-228 (+D) is then used in the screening comparison.

11 - Subunit potentially has PTSM if HI $\geq$ 10 for noncarcinogenic constituents.

12 - Subunit potentially has PTSM if cumulative risk $\geq$ 1E-03 for carcinogenic constituents.

NA= not applicable

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Table 16. PTSM Evaluation for Gravel/Soil Media HCA at the Cask Car Railroad Tracks

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Industrial PRG[2]	Industrial Hazard Quotient (HQ) Estimate[3]	Industrial PRG[2]	Industrial Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	3.34E+04	1.00E+05	3.34E-01	----	----
Antimony	6.93E-01	4.09E+02	1.69E-03	----	----
Arsenic	2.30E+01	----	----	1.59E+00	1.45E-05
Barium	1.79E+01	6.66E+04	2.69E-04	----	----
Beryllium	9.08E-01	----	-----	1.94E+03	4.68E-10
Cadmium	5.95E-01	4.51E+02	1.32E-03	----	----
Calcium	4.60E+02	EN	NA	----	----
Chromium	1.80E+02	----	----	4.48E+02	4.02E-07
Cobalt	2.55E+00	----	----	1.92E+03	1.33E-09
Copper	1.94E+01	4.09E+04	4.74E-04	----	----
Iron	7.18E+04	1.00E+05	7.18E-01	----	----
Lead	1.72E+01	8.00E+02	2.15E-02	----	----
Magnesium	3.15E+02	EN	NA	----	----
Manganese	9.61E+01	1.95E+04	4.93E-03	----	----
Mercury	5.52E-02	3.07E+02	1.80E-04	----	----
Nickel	7.09E+00	2.04E+04	3.48E-04	----	----
Potassium	1.95E+02	EN	NA	----	----
Selenium	6.84E+00	5.11E+03	1.34E-03	----	----
Silver	1.18E-01	5.11E+03	2.31E-05	----	----
Sodium	3.60E+01	EN	NA	----	----
Vanadium	1.46E+02	1.02E+03	1.43E-01	----	----
Zinc	2.61E+01	1.00E+05	2.61E-04	----	----
Radionuclides (pCi/g)					
Cesium-137 (+D)	2.03E+03	----	----	1.12E-01	1.81E-02
Cobalt-60	9.00E-01	----	----	5.96E-02	1.51E-05
Potassium-40	4.22E+01	----	----	2.71E-01	1.56E-04
Radium-226 (+D)[5]	7.00E+00	----	----	2.55E-02	2.75E-04
Bismuth-214	6.70E+00	----	----	NA	----
Lead-214	7.00E+00	----	----	NA	-----
Radium-228 (+D)[6]	2.50E+00	----	----	1.49E-01	1.68E-05
Actinium-228	2.50E+00	----	----	NA	----
Thorium-228 (+D)[7]	3.10E+00	----	----	2.52E-01	1.23E-05
Bismuth-212	2.70E+00	----	----	NA	----
Lead-212	3.10E+00	----	----	NA	----
Uranium-235 (+D)	8.00E-01	----	----	3.94E-01	2.03E-06
		Hazard Index	**1.23E+00**	Cumulative Risk	**1.86E-02**
		PTSM?[8]	**NO**	PTSM?[9]	**YES**

1 - EPC = maximum detected concentration.
2 - Nonradiological PRGs are industrial worker soil values from the *EPA Region 9 Preliminary Remediation Goals Table*, United States Environmental Protection Agency, San Francisco, CA (October, 2004). Radiological PRGs are industrial worker soil values from *Radionuclide Preliminary Remediation Goals*, Engineering Calculation K-CLC-G-00077, Rev. 1, 7/03.
3 - Hazard Estimate = exposure point concentration / PRG concentration
4 - Risk Estimate = (exposure point concentration / PRG concentration) x 1E-06
5 - Activity of Bi-214 and Pb-214 can be used to estimate the activity of Ra-226 since these constituents are in secular equilibrium. The most conservative (i.e., highest activity) of these constituents is then used in the screening comparison.
6 - Activity of Ac-228 can be used to estimate the activity of Ra-228 since these constituents are in secular equilibrium. The most conservative (i.e., highest activity) of these constituents is then used in the screening comparison.
7 - Activity of Bi-212, Pb-212 and Tl-208 can be used to estimate the activity of Th-228 since these constituents are in secular equilibrium. The most conservative (i.e., highest activity) of these constituents is then used in the screening comparison.
8 - Subunit potentially has PTSM if HI ≥ 10 for noncarcinogenic constituents.
9 - Subunit potentially has PTSM if cumulative risk ≥ 1E-03 for carcinogenic constituents.
EN = essential nutrient
NA = not applicable

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Table 17. Summary of Remedial Action Objectives and Remedial Goals for PAOU Early Action Subunits

Area/Media of Concern	Refined COCs	ARAR/ PTSM	CM	HH	ECO	Final Remedial Goal (*)	Final Remedial Goal Basis
HCA at the Cask Car Railroad Tracks **Remedial Action Objectives:** ▪ Prevent human exposure to refined COCs that present a risk to future industrial workers ▪ Remove or treat PTSM to the extent practical within the gravel and/or crossties	Cesium-137 (+D)	X		X		1.00E+00 pCi/g (**)	EAPP – WSRC 2008a
	Cobalt- 60			X		5.96E-02 pCi/g	EAPP – WSRC 2008a
P02 Outfall **Remedial Action Objectives:** ▪ Prevent human exposure to refined COCs that present a risk to future industrial workers	Cesium-137 (+D)			X		1.00E+00 pCi/g (**)	EAPP – WSRC 2008a
	Cobalt- 60			X		5.96E-02 pCi/g	EAPP – WSRC 2008a
PSA-3A and PSA-3B **Remedial Action Objectives:** ▪ Prevent migration of TCE (PSA-3A) and PCE (PSA-3B) contamination in soil to groundwater at a concentration above its MCL	Trichloroethylene		X			5.30E-01 mg/kg (***)	EAPP – WSRC 2008a
	Tetrachloroethylene		X			5.30E-01 mg/kg (***)	EAPP – WSRC 2008a

* Human health PRGs and RGOs are based on a risk level of 1E-06 for the future industrial worker.

** Core Team agreed that the 95th % SRS background concentration is technically unachievable; a concentration of 1.0 pCi/g was established based on Core Team agreement.

*** RGO is identified as the lowest contaminant migration RGO for each constituent.

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Table 18. ARAR Table for In situ Decommissioning of P Reactor.

Citation	Status	Requirement	Reason for Inclusion	Remedial Alternative		
				No Action	In situ Decommissioning.	Complete Demolition
SC Water Classifications and Standards (SC 61-68)	Relevant and Appropriate	Establishes standards for protection of groundwater and surface water	Potential future releases may impact groundwater standards	Yes	Yes	Yes
SC Hazardous Waste Management Regulation (SC 61-79)	Relevant and Appropriate	Ensure hazardous waste is managed to protect human health and the environment	Potential hazardous material will remain in the reactor building	No	Yes	Yes
Toxic Substances Control Act (TSCA) 40 CFR Part 761	Relevant and Appropriate	Management of polychlorinated biphenyl (PCB) waste	Establishes cleanup standards for PCBs	No	Yes	Yes

Table 19. ARAR Table for Remediation of the VOC Source Areas .

Citation	Status	Requirement	Reason for Inclusion	Remedial Alternative		
				No Action	SVE	SVE with Fracturing/ Chemical Oxidation
SC Hazardous Waste Management Regulation (SC 61-79). RCRA 40 CFR 260, 261, and 268	Applicable, Relevant & Appropriate	Ensure IDW hazardous waste is managed to protect human health and the environment	Management of hazardous waste	No	Yes	Yes
SC R 61-68 SC Water Classification and Standards - Section 401 of the Clean Water Act	Relevant & Appropriate	Provides numeric criteria for protection of human health and aquatic life	Establishes water quality standards (MCLs)	No	Yes	Yes
SC R.61-62.5 - Clean Air Act 40 CFR 50 Air Quality Standards	Applicable, Relevant & Appropriate	Identifies allowable air concentrations and permit requirements for air emissions of toxic chemicals from new and existing sources	Applicable for VOC air emissions	No	Yes	Yes
SC R.61-87 Underground Injection Control Permitting	Applicable, Relevant & Appropriate	Provides authority for permits to ensure that all underground injections systems are designed and operated in a manner that is protective of groundwater quality	Applicable for subsurface injection	No	Yes	Yes
SC R.72-300 - Section 402 of the Clean Air Act	Applicable, Relevant & Appropriate	Storm water management and sediment control	Applicable for any land disturbance activity	No	Yes	Yes
SC R.61-71 South Carolina Well Standards	Applicable, Relevant & Appropriate	Requirements for installation of monitoring wells	Applicable for groundwater monitoring	No	Yes	Yes

Table 20. ARAR Table for Remediation of Radiologically Contaminated Subunits

Citation	Status	Requirement	Reason for Inclusion	Remedial Alternative	
				No Action	**Excavate and Remove**
SC R.72-300 - Section 402 of the Clean Air Act	Applicable, Relevant & Appropriate	Storm water management and sediment control	Applicable for any land disturbance activity	No	Yes
Section 401 of the Clean Water Act SC R.61-9 NPDES Permitting	Applicable, Relevant & Appropriate	Establishes requirements for discharges to surface water and wetlands	Applicable for discharges that may impact surface water quality	No	Yes
Section 404 of the Clean Water Act SC R 61-68 SC Water Classification and Standards	Relevant and Appropriate	Establishes requirements for protection of wetlands	Applicable for protection of wetlands	No	Yes

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Table 21. Comparative Analysis of Alternatives for P-Reactor Building (105-P)

Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implementability	Cost
					Risk to Implement Alternative		
AR-1	No	No	Poor	Poor	None	N/A	$46,550,000
AR-2	Yes	Yes	Good	Medium	High	Easy	$52,540,985 - $236,260,000
AR-3	Yes	Yes	Good	High	Low	Difficult	$366,491,010

Table 22. Comparative Analysis of Alternatives for the VOC Source Areas (PSA-3A and PSA-3B)

Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short Term Effectiveness	Implementability	Cost
					Risk to Implement Alternative		
AV-1	No	No	Poor	Poor	None	N/A	$0
AV-2	Yes	Yes	Good	High	Low	Easy	$2,417,233
AV-3	Yes	Yes	Good	High	Low	Easy	$3,891,732

Table 23. Comparative Analysis of Alternatives for the P02 Outfall

Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short Term Effectiveness Risk to Implement Alternative	Implementability	Cost
AP-1	No	No	Poor	Low	None	N/A	$0
AP-2	Yes	Yes	Good	High	High	Easy	$1,898,742 (P02)

Table 24. Comparative Analysis of Alternatives for the HCA at the Cask Car Rail Road Tracks

Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long Term Effectiveness	Reduction of Toxicity, Mobility, or Volume	Short Term Effectiveness Risk to Implement Alternative	Implementability	Cost
AC-1	No	No	Poor	Low	None	N/A	$0
AC-2	Yes	Yes	Good	High	High	Easy	$632,489

Table 25. Remedial Summary for PAOU

Unit	Media	Land Use*	Remedy	Regulatory Mechanism
P-Reactor Building Complex: - 105-P Reactor Vessel - 105-P Reactor Disassembly Basin - 105-P Reactor Building	- Metal - Sludge - Concrete	Industrial	ISD End State	EAPP for P-Area Operable Unit (U) (WSRC 2008a)
PSA-3A VOC Source Area	Vadose Zone Soil	Industrial	SVE with soil fracturing and chemical oxidation	EAPP for P-Area Operable Unit (U) (WSRC 2008a)
PSA-3B VOC Source Area	Vadose Zone Soil	Industrial	Conventional SVE	EAPP for P-Area Operable Unit (U) (WSRC 2008a)
P02 Outfall	Surface Soil	Industrial	Excavation and Disposal of contaminated media; confirmatory sampling	EAPP for P-Area Operable Unit (U) (WSRC 2008a)
HCA at the Cask Car Railroad Tracks	Surface Soil, Surface Gravel and Crossties	Industrial	Excavation and Disposal of contaminated media; confirmatory sampling	EAPP for P-Area Operable Unit (U) (WSRC 2008a)

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APPENDIX A
RESPONSIVENESS SUMMARY

Appendix A.1
Response to Public Comments from Public Workshop on October 16, 2007

Appendix A.2
Response to Public Comments from Public Workshop on February 28, 2008

Appendix A.3
Response to Public Comments from Public Workshop on May 19, 2008

Appendix A.4
Response to Public Comments for the Early Action Proposed Plan for the PAOU

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ARF # 15839

APPENDIX A.1 –
RESPONSES TO PUBLIC COMMENTS FROM PUBLIC WORKSHOP ON OCTOBER 16, 2007

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Comments from the First Public Meeting - October 16, 2007 – Held at Aiken Technical College Aiken, S.C.

1. What areas at SRS have had final end state decisions determined?

Response: T-Area has had its final end state determined. Other Areas at SRS currently working toward a final end state are: P, R, M, and D areas

2. Will the PAOU end state include institutional controls; will there be restrictions on future use of PAOU for the public?

Response: Specific land use controls are generally established in the LUCIP which is developed after the Record of Decision (ROD). However, based on the current Core Team agreement, the area surrounding the 105-P Reactor and other areas within the scope of the PAOU will be managed as industrial land use. Therefore, institutional controls (IC) will be established to deter future use of the PAOU by the general public. These institutional controls will most likely include deed restriction and physical structures such as signs and fences. Also, site inspection would be required for any IC to ensure they are maintained and effective in controlling the final land use.

3. Have the changes in the environment in the next 10,000 years been considered in the proposed reactor building/reactor vessel/P-Area disposition?

Response: Changes in the climate over the next 10,000 are not predictable by any known probabilistic method. However, input parameters associated with the more robust modeling will be adjusted to account for climatic variability in a probabilistic uncertainty and sensitivity analysis.

4. What happens in the vadose zone to the contaminants when they are released?

Response: Migration of contaminants from soil to groundwater can be envisioned as a two stage process: 1) dissolution of contaminants by infiltrating groundwater to form a soil leachate, and 2) transport of the contaminant through the underlying soil and aquifer to a receptor well. Contaminants move with the infiltrating water at different rates based upon the properties of the chemical and the properties of the soil in the vadose zone. Dispersion, decay, and sorption mechanisms are processes that play a role in the final estimated concentration that reaches groundwater.

5. It appears the Tier I screening model is too conservative and may trigger action when it really may not be needed.

Response: USEPA Soil Screening Guidance EPA/540/R-95/128 was followed for the Tier I screening as part of the CERCLA Program with input of

critical model parameters provided by decisions made by the Core Team. The Tier I screening is conservative by design to represent a worst case scenario. Soil Screening Guidance is a phased approach which allows the use of a more sophisticated model to more realistically address site-specific conditions for a less conservative treatment of the scenario.

6. Why has it been a problem in determining the nickel concentration in the reactor vessel stainless steel; isn't there other site reactor operations information/analysis that could identify the concentrations of nickel? What is the half life of the two types of Ni you are dealing with?

Response: The latest 105-P Reactor Vessel Evaluation provided a calculated bounding estimate for Ni59 and Ni63 based on neutron activated metals using standard industry computer codes, P-Reactor operations history, and information from later Savannah River Site reactor tank metallurgical studies.

The half-life of Ni59 is 76,000 years and for Ni63 it is 100 years.

7. If the reactor was modeled to account for stainless steel degradation and nickel isotopic release over time, then nickel isotopes would not be an impact to drinking water standards.

Response: This is probably true but the Tier I Screening Model required by USEPA guidance does not allow for incremental releases of an isotope attributable to corrosion assumptions. Additionally, the Core Team required the receptor well to be located at the edge of the reactor facility which increased the conservatism of the model output. The corrosion scenario would be built into a more sophisticated model in a Tier II evaluation under the graded approach. It should be recognized that the Tier I model did not calculate concentrations in groundwater, but used the maximum allowable groundwater concentration in the aquifer to back calculate a maximum allowable concentration in soil and establish a threshold.

8. Why are you using a 500 year time frame? You should use an engineering analysis on the structural integrity and longevity of the reactor building.

Response: The 500 year time frame is an assumption of containment for modeling agreed to by the Core Team. This is the same period of time being used for the performance assessment associated with the tank farms.

9. Consider/evaluate the effect of water infiltration, into the reactor building, on the grout encapsulating the remaining contaminants.

Response: See response to number 3. The infiltration rate for the backfilled sub-floors of the facility will be evaluated when determining the effectiveness of the remedy.

10. Will the public know how much waste will go into P Reactor? Why restrict the use of P-reactor to just P-Area waste. Why not other SRS site waste?

Response: The public can find out how much waste has been consolidated into the P-Reactor building by reading the regulatory documents disseminated to the public reading rooms throughout the State. The South Carolina Department of Health and Environmental Control has determined that only waste from P-Area on a case-by-case will be allowed to be consolidated in the reactor building.

11. Where does cost consideration enter in?

Response: Cost will be evaluated in the Feasibility Study for the reactor and is one of the primary criteria for comparing and evaluating remedial alternatives.

12. If you fill the reactor building (below grade level) with grout, will the ground under the building support the weight of the building or will it begin to sink into the soil?

Response: This is an item that is being evaluated for the Feasibility Study currently being developed.

13. The project is vulnerable to anti-nuke criticism because the project is not taking the same approach (Performance Assessment) as the Tank Farms.

Response: DOE Performance Assessments and CERCLA Baseline Risk Assessments both provide information about risk to human health and the environment, but often address fundamentally different problems (intent for disposal of waste in purpose-built facilities versus risks from existing contamination that may require remediation).

The DOE Performance Assessment process is implemented in a graded and iterative manner consistent with national and international best practices. The level of complexity of the modeling required is determined largely by the source term, facility configuration, and Hydrogeological conditions being considered. Site and facility-specific information will determine the significance of a given source term in a given facility at a given site. For relatively simple source terms with short-lived radionuclides and low concentrations of longer-lived radionuclides, it is often possible to use a generic screening approach. For more complex source terms, the level of

effort required can increase substantially as it becomes necessary to take credit for site-, facility-, and/or waste form-specific processes that affect the rate at which radionuclides migrate to a receptor. Certain radionuclides that cannot be screened out with generic modeling, are then subject to the more detailed analysis in which credit for additional mitigating conditions, such as barriers, can be included. In this manner, resources for a detailed analysis are focused on the radionuclides of greatest concern and modeling parameters that would provide the most reasonable prediction for the specific radionuclide.

The CERCLA baseline risk assessment process is also implemented in a graded manner, but typically does not allow consideration of mitigating conditions such as future barriers, caps, and land use restrictions. The Baseline Risk Assessment evaluates whether the facility or unit, in its current condition, poses a risk to human health and the environment that warrants remedial action. Once there is a risk established, alternatives for remediation are developed to be protective and compared against each other and the CERCLA Nine Criteria. All remedies have to meet applicable and relevant and appropriate requirements (ARARs) or waive them in accordance with the National Contingency Plan. All remedies must also insure that the risk is within or greater than the CERCLA risk range of 1 x 10E-4 to 1 x 10E-6.

Under the area closure concept, all operational areas will undergo investigation and remediation under CERCLA to address risks posed by toxic, radioactive, and hazardous substances. The risk assessment modeling will use analytical data from the contaminated structure and equipment, groundwater data, survey results and soils data to determine whether the current inventory of toxic, radioactive and hazardous substances pose a risk to the worker, trespasser, and the environment and whether remedial action is necessary under CERCLA. P-Area Operable Unit is currently in the early stages of the CERCLA process. This risk, and as well as remedial options, will be assessed through the "Combined Document" which includes: the RCRA Facility Investigation/Remedial Investigation/Baseline Risk Assessment/Correctives Measure Study/Feasibility Study. This effort culminates with a Proposed Plan that will be provided to the public for review and comment. The Proposed Plan will discuss the risks and provide alternatives that will address the risks. All remedies selected will have to meet ARARs and be protective of human health and the environment.

The Tank Farm is conducting a DOE-O-435.1 and NRC Part 61 Performance Assessment (PA) to understand risk posed by the remaining inventory of radionuclides in the tank after they have been emptied and the long-term performance of the grouted tank after closure. PAs are designed as an analysis tool to assess performance of waste disposal units for radioactive material. The PA process often involves consideration of more

radionuclide specific information and mitigating factors of construction or closure due to the nature of waste being disposed. However, PAs start with conservative screening models similar to CERCLA approaches to reduce the scope of the detailed analysis. In many basic models, radionuclides are assumed to be immediately available for release, when in reality radionuclides are typically released slowly from activated metal as the metal corrodes. This effectively reduces the peak doses due to those radionuclides at any given time, when compared to a case where after a given amount of time they are assumed to be instantly available for release and migration via soil and groundwater pathways.

Both CERCLA and the DOE PA process aim to protect the public, groundwater, and the environment. However, the PA often involves consideration of waste forms and barriers in determining whether radionuclides pose a threat, while the CERCLA Baseline Risk Assessment requires an evaluation before remediation occurs and uses a conservative screening model. Many other DOE facilities utilize the CERCLA process for decommissioning and remediation of reactors.

14. Why can't the reactor vessel be removed from the building, placed on a barge, floated down the Savannah River and deposited in one of the deep trenches in the Atlantic Ocean?

Response: The United States regulates disposal at sea under the Marine Protection Research and Sanctuaries Act of 1972. In specific instances, the USEPA may allow dumping of low level waste if disposal would not endanger human health or the marine environment or its economic potential. However, this method for disposal of radioactive material is environmentally unsound. Additionally, on November of 1993 the United States entered the 1972 London Convention on the Prevention of Marine Pollution by the Dumping of Wastes and other Material which effectively prohibits all sea dumping of radioactive waste.

15. How can we (the Public) be sure that the Government is doing the right thing by leaving contaminants in the ground that may effect future generations? How do we know the government will retain control of the property until the hazards no longer exist? What prevents the Government from selling the property with the hazards still present?

Response: A) This is the purpose of the risk analysis that DOE is performing under EPA and SCDHEC oversight in order to understand what those effects would be over time, and whether they need to be prevented, mitigated, or managed. Contaminants will only be left behind if the risk associated with them is very low, and appropriate controls can be relied upon to keep it low over time. Under CERCLA, if contaminants are left onsite and access

restrictions are required, a review of the remedy must be performed every 5 years. This review ensures that the remedy is still protective and functioning as designed. This 5 year review is approved by the EPA and the State, and is available to the public. B) Under CERCLA 120 (h), DOE remains responsible for remediation of any hazard that warrants response action, even if the property is transferred. Every comprehensive plan published by DOE-Savannah River states that the U.S. Government will continue to own and control the Savannah River Site (SRS); this has been endorsed by the stakeholders. C) DOE has no intention of ever releasing any of the current SRS property. CERCLA 120 (h) restricts the government's ability to transfer property with remaining hazards.

ARF # 15839

APPENDIX A.2 -
Response to Public Comments from Public Workshop on February 28, 2008

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Comments from the Second Public Meeting - February 28, 2008- Held at Aiken Technical College Aiken, S.C.

1. Can the contaminant rate of decay for each of the three zones (Reactor Vessel, Disassembly Basin, and building) due to different contaminants and amount of contaminant, be identified?

Response: The relative distribution of radioactivity between the three zones is summarized in the following table:

Principal Source	Total Curies	%
Reactor		
Vessel	2.11E+05	87.8
Biological shield	7.57E+00	<0.01
Disassembly Basin		
water (full)	4.05E+03	1.70
sediment, sand filters, structure and activated metal	1.06E+04	4.40
above ground structure	3.50E-01	<0.01
Building (excl. Disassembly Basin)		
below grade structure and equipment	1.40E+04	6.0
above grade structure, equipment and stack	1.93E+02	<0.01
Total	2.40E+05	100

Reactor Vessel

The stainless steel reactor vessel contains the largest inventory of radioactivity in the 105-P building and is almost entirely in the form of activated metal. The following activation products have been calculated present in the reactor vessel inventory as of 2008:

Radionuclide	Inventory (Curies)	Half life (years)
Carbon-14	2.32E+02	5,730
Iron-55	1.74E+04	2.73
Nickel-59	1.09E+03	76,000
Cobalt-60	7.36E+04	5.27
Nickel-63	1.19E+05	101

Trace radionuclides are also present in the stainless steel and concrete biological shield, but comprise less that 1% of the radionuclide inventory in the reactor vessel.

Disassembly Basin/Balance of Building

Contamination in the disassembly basin water is 99% tritium (half life 12.3 years). Contamination in the disassembly basin sludge comprises 62% tritium with other fission products i.e. mainly nickel-63, cesium-137 (half life 30.1 years) and plutonium-238 (half life 87.7 years). There is also a quantity of activated metal components present in the disassembly basin consisting of activated stainless steel with a similar isotopic distribution in the above table. The building concrete structure contains small quantities of tritium and cesium-137.

2. Is there any Plutonium contamination in the Disassembly Basin?

Response: From a 2004 characterization program, the disassembly basin sludge is estimated to contain 1.72 curies of plutonium-238, 0.423 curies of plutonium 239/240, 0.765 curies of plutonium 241 and 0.0024 curies of plutonium 242. The disassembly basin water contains trace quantities of the same plutonium isotopes.

3. Do you have any contingency budget for the project?

Response: No contingency budget currently exists for the project at this time.

4. The term "Long Term Risk Reduction" is confusing. Could different wording be used that is less confusing?

Response: The terms used in the presentation are typical terminology used in the CERCLA evaluation process. However, the terms used in the presentation have been revised to represent something more user friendly to the general public.

5. Can an analysis to identify the long term effects of the different in-situ alternatives, be performed?

Response: In the alternatives evaluation section of the PAOU RFI/RI/CMS/FS with BRA, an analysis has been performed to estimate the decay in radionuclide inventory, with the corresponding decline in human health risk and contaminant migration to groundwater over time for each alternative. The results are very complex, but basically the radionuclide inventory within the 105-P building declines to a small fraction (around 1% or less) of the present inventory by the first 1,000 years due to decay of the short-lived isotopes (half-lives of less than 100 years). After 1,000 years the

inventory declines more slowly due to the presence of long-lived nickel-59. The decline in risk follows a similar pattern but is more pronounced. The short-lived radionuclides are much more radioactive and present a higher risk than the long-lived radionuclides which typically emit low energy radiation.

6. Does DNFSB have any input to the in-situ determination?

Response: The project team has not received any input from the DNFSB regarding the in situ determination but can provide input should they desire to do so.

7. Is there a plan, or is there a need, to implement seismic controls for the remaining structure and grout?

Response: SRS will conduct a structural evaluation of the remaining structure and grout, which has a preliminary seismic "performance category" of "PC-2". (See Department of Energy standard DOE-STD-1021, "Natural Phenomena Hazards Performance Guidelines for Structures, Systems and Components" for additional information regarding performance categories.) The structural evaluation will determine the integrity of the remaining structure and grout over time and will consider "earthquake loads" as defined by the International Building Code (IBC). Note that a performance category of PC-2 corresponds to Seismic Use Group III, Design Category D within the IBC.

8. If the chosen in-situ alternative is considered protective of human health and the environment, why spend the money to revisit its effectiveness every five years?

Response: The in-situ closure of the 105-P Facility will leave residual hazardous material in the building. Therefore, DOE is required by law, that if a remedial action is selected that results in a hazardous substance remaining at the site then a review of the remedy must be conducted at least every five years. This regular checkup, called a five-year remedy review, assesses each site to make sure the remedy (physical barriers, administrative controls, etc.) continues to protect people and the environment. Upon completion of the assessment a report is written documenting any findings and a determination is made on whether the remedy continues to meet the remedial objectives. The final report is then made available for the public to review. For more information on five-year remedy reviews go to the following EPA site: sww.epa.gov/superfund/community/today/pdfs/sf_5year.pdf.

9. Have we found any animal carcasses in the reactor building, and have they been examined for levels of contamination/radiation?

Response: We have found bird carcasses in the reactor building but they have all been found in radiologically clean areas and have not been monitored for contamination.

10. Has the present condition of the reactor tank structural integrity been examined for corrosion degradation?

Response: While the reactor was operating, the reactor tank was periodically examined for evidence of corrosion. The predominant corrosion mechanisms in stainless steel are localized pitting and stress corrosion cracking rather than by generalized surface corrosion which occurs with plain carbon steel. The vulnerable weld areas and formed metal sections were visually examined for pitting and stress corrosion cracking with a periscope. Up until operations ceased, pitting and stress corrosion cracking had not been observed in the reactor tank.

11. Can more detailed information/justification identifying the monumental task to remove the reactor vessel and supporting components, and transporting them to an approved repository, be provided?

Response: A qualitative evaluation of the tasks involved in removing the reactor vessel has been made for the purposes of alternative evaluation to support the PAOU RFI/FI/CMS/FS with BRA. The relevant text is provided below:
With the exception of removal of the reactor vessel, activities involved with the preferred end state alternative will be readily implemented using conventional D&D techniques for decommissioning radiologically contaminated structures. The generally low-levels of gamma radiation in the 105-P building would not result in elevated dose to the workers.

In comparison, removal and off site disposal of commercial power and military nuclear reactor vessels is typically undertaken during the decommissioning activities. To date in the United States, around 13 commercial power reactors have been permanently shut down and are in various stages of decommissioning and a further 10 have completed the decommissioning process (***United States Nuclear Regulatory Commission Fact Sheet, Decommissioning Nuclear Power Plants, January 2008, http://wwwnrc.gov/reading-rm/doc-collections/fact-sheets*****). In addition about 120 US Navy reactors have been decommissioned, and additional commercial reactors have been decommissioned worldwide.**

However, the SRS reactor vessels were designed and constructed very differently from commercial power reactors. Commercial vessels were originally designed for a 30 year operating life, and many have been

extended to 40 and 50 years. In a commercial reactor design, the major items of equipment (reactor, steam generator, pumps etc) are located within a large spacious containment building, with designed in provision for removal and replacement of all of the major components. The SRS reactor vessels were not designed and built with accessibility or removal in mind. The concrete biological shield of the SRS reactor vessels acts as the outer radiation containment and records indicate that the biological shield was actually constructed with the vessel and associated piping already in place. If the reactor vessel were to be removed, the processes involved would be subject to a very rigorous engineering evaluation. Nevertheless, some of the steps involved are described below to illustrate the difficulties involved.

Prior to tank removal, numerous large piping and instrument penetrations that pass through the concrete biological shield to the reactor tank would need to be severed in place at the tank wall by using a remotely operated saw, cutter or torch. The top shield tank and plenum would then need to be lifted from the vessel. The highly radioactive internal components that remain within the reactor tank, would then need to be extracted and packaged in shielded containers. The reactor tank and annular shield tanks would need to be filled with grout before removal to provide protection from radiation. The reactor tank and shield tanks, which are welded to the building floor structure, possibly together with portions of the concrete biological shield, would then have to be cut free, and would also have to be segmented either during or subsequent to removal. This would have to be conducted remotely by using diamond wire, abrasive media cutting, plasma torch or other cutting techniques. The pieces would then have to be packaged for transportation to the final repository. The very high gamma radiation field from the activated metal would mandate that most of these operations would have to be carried out either remotely, behind substantial shielding or under water for protection to the workers and the environment. As a direct result of these activities, an elevated dose to the decommissioning work force involved in these procedures would be inevitable. An additional consequence of these removal and segmentation operations would be the generation of quantities of contaminated waste water, which would also have to be disposed in a regulated facility. Also the potential generation of radioactive air emissions during the cutting operations would require substantial capture equipment and monitoring together with disposal of the products.

Should the reactor vessel be removed, the only off site repositories able to accept this type of material are located in the Western United States at the Nevada Test Site or at a commercial disposal facility in Utah. The reactor tank and shield tanks would need to be segmented to meet transportation size and weight restrictions. Transportation to these sites would be either by road or rail on specially constructed trailers in specially designed and constructed shielded casks. Possibly as many as a dozen individual container

shipments could be required and each shipment would require approval from the regulatory agencies in each State along the route.

Transportation of this material across the country would impose a low but measurable risk to the general public along the route from exposure to the low levels of gamma radiation emanating from the passing vehicles. The transportation workers involved would also receive an elevated dose level from exposure to the same source. Other transportation risks would include the possibility of an accident either along the route, during loading and unloading and ultimately with vehicle decontamination. The costs and risks involved with off site transportation and disposal and would not seem to justify the expense of relocating the "problem" elsewhere.

12. Has any assessment/study been initiated/completed on the possible contamination of birds and bats prior to and after in-situ decommissioning of the reactor building?

Response: No assessment/study has been initiated/completed on the possible contamination of birds and bats prior to and after in-situ decommissioning of the reactor building. Controls are in place to minimize bird/bat access to the building prior to decommissioning (doors closed, screens in place). After in-situ decommissioning, the building will be sealed to prevent the access of birds and bats.

13. Is there a plan to study the effects on animals that may inhabit any contamination/radiation areas that exist after the in-situ decommissioning of the reactor building?

Response: Currently there is not a plan to study the effects on animals that may inhabit a decommissioned reactor though it is not expected that animals would receive a significant dose due to the isolated deactivated state of the facility.

APPENDIX A.3 –
Response to Public Comments from Public Workshop on May 19, 2008

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Third Public Meeting – May 19, 2008 – DoubleTree Conference Center, Savannah, GA

1. Can the South Carolina Department of Health and Environmental Control (SCDHEC) slides be made available?

   Response: Yes. A copy of the slides can be obtained by contacting Heather Cathcart via email at cathcahe@dhec.sc.gov or phone at (803)896-4165.

2. You described uranium-235, what is depleted uranium?

   Response: Depleted uranium (DU) results from the enrichment of natural uranium for use in nuclear reactors. Natural uranium is a slightly radioactive metal that is present in most rocks and soils as well as in many rivers and sea water. Natural uranium consists primarily of a mixture of two isotopes (forms) of uranium, uranium-235 (U235) and uranium-238 (U238), in the proportion of about 0.7 and 99.3 percent, respectively. Nuclear reactors require U235 to produce energy, therefore, the natural uranium has to be enriched to obtain the isotope U235 by removing a large part of the U238. As a result of this enrichment, U238 becomes DU, which is 0.7 times as radioactive as natural uranium. DU has a half-life of 4.5 billion years.

3. Where is the water table in relation to the bottom of Reactor Building (105-P)?

   Response: Depth to the water table at the Reactor Building (105-P) is approximately 50 feet below ground surface. The water table has been measured as high as 45 feet below ground surface during times of greater precipitation and recharge of the shallow groundwater. Currently, the bottom of the Reactor Building (105-P) resides at the same elevation as the water table.

4. Where is the "high hat"?

   Response: The "high hat" is the reactor actuator tower which is centrally located on the Reactor Building (105-P) and contains the drive systems for the reactor control and safety rod systems.

5. What does "cooled off" mean in terms of reactor components in the disassembly basin?

   Response: Reactor assemblies were placed into the disassembly basin to give the short-lived, high activity isotopes time to decay. Heat was also generated during decay. During this time, the assemblies would become both radiologically and thermally cooler.

6. What is the weight of the reactor vessel?

Response: The weight of the vessel and its various shield/components is 388 tons.

7. What is the volume of water in the Disassembly Basin?

   Response: Current volume of water within the Disassembly Basin is 4.18 million gallons. The basin has a capacity of 4.4 million gallons.

8. What can 211,000 curies do to a person?

   Response: A curie is a measurement of radioactivity and does not provide an indication of effective dose to a person. To determine the affect to person, a measurement of effective dose, measured in rad or rem, is used to determine how much radiation a person can or will receive when near a radioactive source.

   There is no effective dose data associated with the radioactive stainless steel within P-Reactor vessel. However, as a point of comparison, work performed at R-Reactor back in the 1960's had indicated the effective dose to be greater than 1000 rad. Without protective measures in place, exposure to the radioactive stainless steel at that dose, even in the short-term (less than one hour), would be lethal.

   Currently, the radionuclides contained within the P-Reactor tank (a component of the reactor vessel) are part of the matrix material (stainless steel) that comprises the reactor vessel. Existing protective measures that were engineered into reactor construction include surrounding the reactor vessel with biological and thermal shields that provide shielding from the reactor vessel internals. This shielding provides protection in the short-term in the sense that exposure to a worker near the reactor vessel is minimal. However, one should limit time near the reactor vessel as part of As Low As Reasonable Achievable (ALARA). DOE and SRS have strict guidelines to acceptable rates of exposure for workers and the public. For the long-term, protective measures will include, but not limited to, land use and deed restrictions, institutional controls, and sealing of all points of entrance into the Reactor Building (105-P) to prevent exposure.

   Some ways to manage exposure is by implementing and adhering to radiological controls such as shielding to protect the workers, limiting time near radioactive areas, maintaining distance from the radioactive areas, and utilizing remote operating equipment.

9. What is the Site (SRS) definition of high radiation?

   Response: As defined in Title 10 of the Code of Federal Regulations (CFR) Part 835, a high radiation area is defined as any area, accessible to

individuals, in which radiation levels could result in an individual receiving a deep dose equivalent in excess of 0.1 rem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

10. Can water transfer the contamination that is left in the building?

    Response: Water intrusion into the structure is of concern if contaminants are left in place and no mitigation controls are implemented. However, as part of the in situ decommissioning (ISD) approach, contaminant immobilization through the use of various types of grout and additives along with surveillance and maintenance activities are under consideration for long-term stewardship of the structure. One of the remedial objectives is to minimize the potential for rainwater to enter into the structure to prevent degradation of the structure and subsequently release contaminants into the environment.

11. What isotopes will last greater than 100 years?

    Response: The principle radionuclides that are present in the Disassembly Basin and reactor vessel that have a half-life greater than 100 years are carbon-14 (5.73E+03 yr), nickel-59 (8.1E+05 yr), and nickel-63 (1.02E+02 yr). The presence of these radionuclides is associated with the activated stainless steel in the reactor vessel and scrap metal in the Disassembly Basin. In addition to these three radionuclides, niobium-93m (1.00E+02 yr), molybdenum-93 (4.8E+03 yr), and technetium-99 (2.12E+05 yr) are also principle radionuclides in the reactor vessel. There are other radionuclides present in both the disassembly basin and reactor vessel that have half-lives greater than 100 yrs, however, these radionuclides are at very low concentrations (<0.1 pCi/g).

    As for the Reactor Building (105-P), which includes the concrete and process components that are not associated with the reactor vessel and Disassembly Basin, iodine-129 (1.57E+07 yr) is the principal radionuclide with a very long half-life. However, the estimated activity associated with iodine-129 is 0.37 Ci.

12. Do we have models of buildings or stainless steel or concrete that says what happens to it after 500 years?

    Response: The Nuclear Regulatory Commission (NRC), United States Environmental Protection Agency (USEPA), national laboratories, universities, and private companies have over the years experimented and studied the effects of degradation of these materials. Much of this information from these studies is used to support predictions which aid in providing an evaluation of a system component(s) or building structure.

13. What is the current temperature of the stainless steel in the reactor?

    Response: Current temperature of the reactor vessel is ambient room temperature.

14. Will the selection of the in situ alternative affect the Tier II model?

    Response: No. The selection of an in situ alternative will not affect the Tier II model. The Tier II is used to provide an evaluation of all the alternatives under consideration. Changes to the alternatives can be remodeled to determine the short- and long-term effect change(s) will have on the environment. The model is one of the tools used by the Core Team in making a decision on the pathforward for ISD closure of the Reactor Building (105-P).

15. Was a sensitivity analysis done?

    Response: A sensitivity analysis was performed on the contaminant transport model to determine what affects certain inputs (i.e., infiltration, contaminant retardation, concrete and stainless steel degradation, structural integrity, etc...) would have on the outcome of the modeled results.

16. There will be 24,000 curies left after 100 years?

    Response: It is estimated based on the inventory that in approximately 100 years, between 90-95% of the total curie inventory will have decayed resulting in approximately 64,300 curies will remain of the total curie inventory for the entire building.

17. There will be 2,000 curies left after 1,000 years?

    Response: It is estimated based on the current inventory that in approximately 1,000 years, about 99% of the total curie inventory will have decayed resulting in approximately 1,490 curies remaining.

18. NRC uses 25 mrem per year as a performance objective. How is that applied at SRS?

    Response: The NRC standard is used in support of USDOE Performance Assessments. Performance Assessments are used to provide the USDOE with a reasonable expectation that disposal or closure of facilities will meet defined performance objectives for the protection of the public and the environment in the future.

    Under CERCLA and according to the USEPA Office of Solid Waste and Emergency Response (OSWER) directive, a dose of 15 mrem/yr is used as an

applicable or relevant and appropriate requirement (ARAR). This dose is equivalent to a risk of 3.0E-04 risk.

19. Why aren't we using the NRC standard?

    Response: The NRC standard is used in support of USDOE Performance Assessments. Performance Assessments are used to provide the USDOE with a reasonable expectation that disposal or closure of facilities will meet defined performance objectives for the protection of the public and the environment in the future.

    Under CERCLA and according to the USEPA Office of Solid Waste and Emergency Response (OSWER) directive, a dose of 15 mrem/yr is used as an applicable or relevant and appropriate requirement (ARAR). This dose is equivalent to a risk of 3.0E-04 risk.

    According to *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* (OSWER No. 9200.4-18, August 22, 1997), the USEPA has determined that the dose limits established in the Nuclear Regulatory Commission's Radiological Criteria for License Termination will not provide a protective basis for establishing Preliminary Remedial Goals under CERCLA. While the Nuclear Regulatory Commission rule standard must be met (or waived) at sites where it is applicable or relevant and appropriate, cleanups at these sites will typically have to be more stringent than required by the Nuclear Regulatory Commission dose limits in order to meet the CERCLA and National Contingency Plan requirement to be protective.

20. Was the Goldsim model run with the proposed chosen alternative?

    Response: Yes. The model performed a simulation for the No Action base case and all four insitu decommissioning alternatives.

21. In the Goldsim model, what is the method of migration?

    Response: In the long-term, rain infiltration is the primary mechanism for movement of the contaminants. Other factors such as stainless steel corrosion, longevity of the grout and concrete structure, infiltration amounts, pore-water velocity, and radioactive half-life contribute to the combined effect on the availability and movement of the contaminants.

22. Does the plan include institutional controls? Will they include monitoring?

    Response: Yes. Institutional controls are inherent to any site that does not allow unrestricted land use such as P Area. Groundwater monitoring along with surveillance and maintenance of the Reactor Building (105-P) would be

components of the institutional controls, if waste is left in place. Land use controls will be part of the final remedy and will be documented in the final Record of Decision for the P-Area Operable Unit.

23. Were the Tier I and Tier II models run with the same or different data?

Response: No. The most recent data was not available at the time the Tier I model was run. This did not impact the Tier I model because the primary purpose at this stage was to determine how much material could remain in the building without exceeding the regulatory groundwater standards (i.e., maximum concentration limits). The model was a conservative calculation and did not account for multiple sources and building layout and construction. In the next phase, the Tier II model did utilize the most recent data collected to determine if it exceeded the Tier I limits and to evaluate the impact to the groundwater.

24. Is the water table high (in general) in SC?

Response: The depth to the water table varies across the state. The depth to which the water table can be found is controlled by many factors such as topography, geology, and location to another surface water body (i.e., streams, ponds, lakes). At the SRS, the water table has been observed to be lower due to the drought conditions over the past few years.

25. Where is the balance of plant contaminants?

Response: The balance of the contaminants in the Reactor Building (105-P) (those located outside of the reactor vessel and the disassembly basin) are in building elevations -20/-40 and in the purification area in the form of concrete and equipment contamination, along with tritium contamination which exists in the general concrete of the building.

26. Did the Tier II model assume that the high hat would collapse and drive the reactor vessel closer to the water table?

Response: The model did not assume collapse of the high hat. Under the ISD alternative, the sublevels of the Reactor Building (105-P) and reactor vessel are to be grouted and essentially the reactor vessel becomes entombed. Any impact of structure collapse after 500 years would have minimal impact on the movement of the reactor vessel.

27. SRS chose a robust model (Goldsim), but is it applicable to a reactor facility?

Response: Goldsim is designed to evaluate hardened facilities, like a reactor building, that are of multiple configurations (i.e., levels, layout, design), various construction materials, and various type and quantity of

contaminants. The Department of Energy and other government agencies have used the Goldsim software to evaluate the impact to the environment from structures and disposal sites.

28. How many curies are in the Disassembly Basin sludge?

    Response: It is estimated that approximately 57 curies are present in the sludge within the Disassembly Basin.

29. Is neutron embrittlement an issue with the reactor vessel like it was with the Tank Farm waste tanks?

    Response: No, it is not since the Tank Farm waste tanks are made of carbon steel versus the reactor vessel being made of stainless steel.

30. Could SRS have predicted current building conditions based on data from 20 years ago? Was data available then?

    Response: Yes. Data collected over the years are available and are being used to evaluate the longevity of the hardened facilities. Various analyses have been performed on concrete samples collected and evaluation of the data has indicated that the concrete has not degraded significantly over the last 45 years.

31. What happens to the water in the disassembly basin?

    Response: A Site Removal Evaluation Report/Engineering Evaluation/Cost Analysis was completed for the Disassembly Basin. The report evaluated various alternatives for disposition of the Disassembly Basin water. Likely alternatives selected as part of the evaluation were to use the water for making grout, evaporation, or trucking to the SRS Effluent Treatment Plant. An Action Memorandum for the Non-Time Critical Removal Action for disposition of the water has been approved and the preferred alternative of forced evaporation was selected. The implementation of this alternative will provide for a protective and cost-effective method for disposition of the Disassembly Basin water. This action is considered an interim measure that supports final decommissioning of the Reactor Building (105-P).

32. What is the amount of grout in the building? How does that compare to the amount of grout being used in all the tanks in F Tank Farm?

    Response: It is estimated that approximately 90,000 yds^3 will be needed to grout the below grade levels of the Reactor Building (105-P), which is approximately 55% of the grout needed at the F Tank Farm.

33. Will the Reactor Building (105-P) be sealed? How?

Response: Yes. To prevent access to the Reactor Building (105-P) after decommissioning activities are completed steel, plates will be welded over all exterior access areas which include, but not limited to, personnel entry points, vehicle entrances, and ventilation system. Concrete walls will also be poured to seal the building where the Disassembly Basin will be removed.

34. Why put grout in the below grade areas at all if the models show it is not needed to prevent migration?

    Response: Emplacement of grout in the below grade areas will prevent human and ecological receptor contact with the waste and contaminated areas, reduce degradation, stabilize, and isolate waste, and reduce potential future release of contaminants, and provides for structural integrity.

35. What is the risk associated with the Disassembly Basin water?

    Response: Currently, the Disassembly Basin contains approximately 4.18 million gallons of radioactively contaminated water. Tritium makes up nearly 99.9% of the radionuclide inventory in the water. Other radionuclides are also present in the water, such as cesium-137 and strontium-90, but in a very small percentage of the total inventory. The current total risk to a maintenance/industrial worker associated with exposure to the water is estimated to be 6.1E-04.

    Recognizing there is a concern with the contaminated water, a Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis was prepared. The selected alternative for disposal of the contaminated water is forced evaporation. The estimated total risk to an offsite individual as a result of forced evaporation is 7.5E-09 (5.4E-09 from food ingestion and 2.1E-09 from inhalation).

36. Will it take an act of Congress to choose the in situ alternative? Is it within our rules to make the choice?

    Response: It will not take an act of Congress. An Early Action Record of Decision (EAROD) has been prepared to identify ISD as the selected alterative and is currently under review by the regulatory agencies.

37. How many curies are left in the waste tanks vice what is being left in the reactor?

    Response: The total curies in the P-Reactor vessel (211,000 Ci) are comparable to what is estimated to be remaining in the waste tanks after closure.

38. Will the cap over the Disassembly Basin be earthen?

Response: To minimize rainfall infiltration and subsequent migration of contaminants remaining in the Disassembly Basin, an engineered cover system will be constructed of both man-made and natural materials over the Disassembly Basin.

39. If you use Disassembly Basin water to make the grout, will the isotopes in the grout go away in 100 years?

Response: Yes and no. The primary radionuclides present that account for the majority of the curies in the Disassembly Basin water are tritium (99.9%), cesium-137 (0.02%), andtrontium-90 (0.006%). Within 100 years, most of the tritium (88%) will have decayed away as the half-life for tritium is 12.3 yrs. As for cesium-137 and strontium-90, approximately a third of activities will remain after 100 yrs as the half-life for cesium-137 and strontium-90 is 30 and 28.78 yrs, respectively.

Please note that since this meeting, forced evaporation of the Disassembly Basin water is the chosen alternative for water removal versus using the water to make grout.

40. Has analysis been done to say that the building will support the weight of the additional grout?

Response: A structural integrity evaluation is currently being performed to evaluate any impacts that might occur to the existing due to the in situ decommissioning alternative selected.

41. If the whole Reactor Building (105-P) is deactivated and decommissioned, would the curies be relocated somewhere else?

Response: As part of the alternatives evaluation, this alternative was one of four remedial alternatives evaluated. Removal of contaminated equipment or building structure would be sent elsewhere for disposition. As part of the alternatives evaluation, this criterion was evaluated.

42. Are the price estimates in current dollars?

Response: Yes.

43. Why not use bioremediation on the Disassembly Basin water vice evaporation or making grout or processing thru the SRS Effluent Treatment Plant?

Response: Bioremediation is not a viable option as there currently are no known microbes capable of "treating" tritium; which accounts for nearly 99.9% of the curies in the water. The principle reasons for managing the

basin water are to complement the overall Area Completion and eliminate the potential threat to human health and the environment.

44. Where is the final 12% of the contaminants in the building?

    Response: It is estimated that there is approximately 240,000 curies in the building with 88% of the curies located within the reactor vessel. The remaining 12% is divided equally between the remainder of the Reactor Building (105-P), which includes the building concrete and contaminated components, and the sludge, water, and activated metal within the Disassembly Basin.

45. Why not evaporate the Disassembly basin water?

    Response: This option was evaluated and selected as part of the Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis and is being pursued as an alternative for managing the water. Please note the decision to use forced evaporation was made after conducting the public workshop.

46. The Reactor Building (105-P) has been just sitting there for 20 years. Have there been any events due to the "no action"? Why not just continue that approach? What does the money buy us?

    Response: Over the past 20 years, routine surveillance and maintenance activities have been performed at the Reactor Building (105-P), as with other unused facilities at the SRS. During this time, no impact to the public or the environment has occurred from the structure.

    Currently, the Reactor Building (105-P) poses a risk to human health and the environment because of the possibility that people could come into contact with contamination or that the contamination in the building could leak into the environment. Being good environmental stewards, it is SRS's obligation to protect human health and the environment. One way to address this is to prevent access to the facility and in particular, the reactor vessel and the Disassembly Basin so as not to expose someone to contamination within the building. SRS will also implement remedial actions which break the pathways by which contamination could possibly leak into the environment.

47. There are still a bunch of curies left after 100 years?

    Response: After 100 years, approximately 64,300 curies will remain. Most of the curies will be located within the reactor vessel.

48. The no action option seems like it was very effective over the last 20 years?

Response: Routine surveillance and maintenance actions have been occurring in the facility for the last 20 years which have mitigated any impact to people or the environment. That being said, for the short-term (<100 years), a No Action scenario could be implemented. After which, the principal parties (i.e., DOE, SCDHEC, and EPA) will need to re-evaluate the condition of the facility and decide what action(s) is needed to be taken to mitigate future impact to the environment. By implementing some actions earlier, the need to reconsider taking an action(s) later is not warranted as the potential impact to the environment has been addressed.

49. What are you trying to communicate with the colors in the 'yes' and 'no' boxes?

    Response: The intent was to denote (by color) what actions were effective short- and long-term as well as cost effectiveness. In general, Green was effective, Yellow was marginal, and Red was not effective.

50. Is SRS looking at other reactor areas for closure?

    Response: Yes. R-Area Reactor is the next reactor facility to be evaluated.

51. When will P Area closure be complete?

    Response: It is assumed that the remedial action construction activities will be completed by late 2014.

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APPENDIX A.4 –
Response to Public Comments for the Early Action Proposed Plan for the PAOU

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1. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: I found the document poorly written and incomprehensible. On page 4, the document states another public meeting may be held if warranted and requested in writing. I would like to request such a public meeting.

   Response: The Early Action Proposed Plan (EAPP) for the P-Area Operable Unit (PAOU) was written in a format approved by the United Stated Department of Energy (USDOE), the United States Environmental Protection Agency (USEPA), and the South Carolina Department of Health and Environmental Control (SCDHEC). The content of the document does not contradict, but rather supports, the proposed remedial actions as discussed at the public meetings. Therefore, SRS has determined that the EAPP has met its purpose and intent of providing the public with the appropriate information. However, SRS will continue to strive for clarity on items noted by the public in the subsequent Early Action Record of Decision (EAROD). Additionally, SRS feels that the two public meetings held in Aiken, SC and the one in Savannah, GA adequately conveyed information related to the pathforward and preferred closure of the hardened reactor building to the public. Given this, and the fact that the EAPP has been approved by the regulatory agencies, an additional public meeting is not warranted.

2. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: The document was poorly written for a document that was to be distributed for public review and comment. It appears to be written for a select group of SRS employees and regulators. It contains much jargon and uses many abbreviations not defined in the glossary. For example RAO, used on page 27; SVE, used on page 28; VOC also used on page 28, and HQ; used on page 16. All abbreviations should be included in the glossary. The list of Acronyms (page iv) should be deleted since it will no longer serve any purpose.

   Response: The EAPP for the PAOU was written in a format approved by the USDOE, the USEPA, and the SCDHEC. The content of the document does not contradict, but rather supports, the proposed remedial actions discussed in the public meetings. All abbreviations, including the above mentioned abbreviations (RAO, SVE, and VOC), are currently listed in the List of Acronyms and Abbreviations. Only a subset of definitions are included in the Glossary section because they require additional explanation than what is provided in the List of Acronyms and Abbreviations. SRS has determined that the EAPP has met its purpose and intent of providing the public with the appropriate information. However, SRS will continue to strive for clarity on items noted by the public in the subsequent EAROD.

3. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: Add a summary section to the document to simplify the document. This summary will

help the public determine what is proposed. The present section V on page 10 does not fulfill this purpose.

Response: Section V, Summary of Site Risks, presents and discusses activities related to the characterization and risk assessment of the early action units and is not intended to provide a summary of the EAPP.

The EAPP for the PAOU was written in a format approved by the USDOE, the USEPA, and the SCDHEC. SRS has determined that the EAPP has met its purpose and intent of providing the public with the appropriate information.

4. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: I found Appendix A, detailed Cost Estimate, to be useless. It is simply a tabular set of numbers with no logic for validation or understanding.

   Response: Appendix A, Detailed Cost Estimates, was provided as supplemental information to the public to convey the estimated costs of the proposed remedial alternatives. The format and information of the cost estimates provided are commensurate with the intent of the Proposed Plan. The detailed cost estimates are based on current knowledge and information that is available at this time.

5. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: Appendix B, Potential Threat Source Material Risk Detail Evaluation, has no explanatory test and is valueless to the public. It contains a list of curies with no source identification. As a member of the public, I was disappointed.

   Response: Appendix B, Potential Threat Source Material (PTSM), was provided as supplemental information in support of the Remedial Action Objectives. The PTSM evaluation was previously submitted to and approved by the USEPA and SCDHEC. The PTSM analysis can be obtained through the public reading rooms in the document titled *RCRA Facility Investigation/ Remedial Investigation with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for P Area Operable Unit (U)*, WSRC-RP-2007-4032, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC, 2008.

6. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: I was unable to find in the text the curies of induced activity contained in the reactor vessel and how it is expected to decrease with time. All I could find on that activity was industrial worker risk on page 16 (it had apparently been determined using a DTSM process, whatever that is.) This section of the text on reactor

vessel induced activity followed a reasonable description of curies of activity found in the basin water and basin sludge and curies of fission product contamination on the railroad track. The text indicated that nuclear testing fall-out may be responsible for part of this activity. The plan was to remove this contamination and dispose of it in the concrete building if the proposed Action is selected. Not clear why this activity should be cleared up now since its risk must be low since this contamination has been exposed to the elements since the reactor was shut down in 1991 and if from fall out much longer. It is unclear to me why the risk reduction is needed at this time. I am convinced that disposal of some activity in the concrete portion of the building before it is sealed is a valid suggestion. At one of the public meetings, it was stated that only P-Area waste could be disposed on in this area closure. The logic of only P-Area waste is not clear. I could not locate this decision in the document. At SRS we are currently disposing of waste in this manner. It might be more cost effective to use reactor buildings for this purpose. The logic of exclusions should be openly discussed in the report.

Response: As stated on page 13, the reactor vessel contains approximately 211,000 curies while on page 16 a risk evaluation is presented that compares the most prominent radionuclides within the reactor vessel to a threshold of 1E-03 risk to an industrial worker. This threshold equates to a regulatory-defined term called principal threat source material (PTSM) and PTSM typically warrants a response within the Proposed Plan. Table B-1 in the Early Action Proposed Plan depicts the radionuclides modeled to be present in the reactor vessel.

To clarify, radionuclide contamination (cesium-137 and cobalt-60) at the railroad track is attributed to past operations associated with contaminated water dripping on to the railroad from the cask cars. To determine the appropriate cleanup goal, typically the 95th percentile is proposed as the appropriate background cleanup goal. However, if this approach is applied to cesium-137, the cleanup goal would be less then the SRS background value; which is attributed to nuclear testing fallout. Some of the cesium-137 activities at the railroad track could be attributed to the fallout, but the cesium-137 activity detected are orders of magnitude greater than the overall contribution from fallout and is therefore negligible.

The Reactor Building (105-P) is being considered an appropriate avenue for disposal of contaminated soil excavated from any of the early action units. However, the final disposition of the excavated material will be decided in the post-Record of Decision documentation.

7. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: My major comment is to **rewrite this document so the public can understand** why the actions proposed were selected and why the federal budget should be used in this manner. I got a much better understanding of the proposed actions from the public meetings.

   Response: The EAPP for the PAOU was written in a format approved by the USDOE, USEPA, and the SCDHEC. The content of the document does not contradict, but rather supports the proposed remedial actions discussed in the public meetings. Therefore, it has been determined that the EAPP has met its purpose and intent of providing the public with the appropriate information. However, SRS will continue to strive for clarity on items noted by the public in the subsequent EAROD.

8. Attachment to Email from Lee Poe, dated June 25, 2008 to Paul Sauerborn: After the document rewrite has been completed and the public given a chance to review it again, **another public meeting should be held**. I got a much better understanding of the proposed actions from the previous public meetings. I concluded the public will support this action if presented properly. At this time, this document does not support this action.

   Response: The two public meetings held in Aiken, SC and the one in Savannah, GA adequately conveyed information related to the pathforward and preferred closure of the hardened reactor building to the public. Given this and the fact that the EAPP has been approved by the regulatory agencies, an additional public meeting is not warranted.

9. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: The intrusion of water from a leaking roof drain and back up through underground piping (p.12) will be sealed. Please provide specifics on materials and methodology that will be used to address this water ingress.

   Response: The specifics on engineering/construction details for the selected remedial alternatives will be provided in the early action post-Record of Decision (ROD) documentation (Corrective Measures Implementation/ Remedial Action Implementation Plan). These details are typically not included in a Proposed Plan.

10. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: The lack of ventilation inside the building has led to decomposition by biological agents (fungi) and chemical processes which was evidenced as peeling paint, mold, and oxidation of metal (p.12). How is this evidence of decomposition congruent with the later statement (p.16) "There are no ecological risks associated with the P-reactor Building (105-P) because there is no suitable

habitat in this industrial facility. Remediation is necessary to reduce risk to the industrial worker from direct exposure to radionuclides"?

Response: The two statements are not meant to be congruent to one another. As mentioned in the Section III, Scope and Role of the PAOU, the Reactor Building (105-P) is undergoing deactivation activities in preparation for decommissioning. These deactivation activities include mold and asbestos abatement, as well as paint chip removal from the floors. Once completed, these deactivation activities will eliminate the risk to the industrial worker from exposure to the decomposition by the biological agents and chemical processes.

Ecological risk is associated with the chance of harmful effects to ecological systems resulting from exposure to an environmental stressor. Even though the building contains contaminants, the building does not provide a suitable habitat for the ecology to thrive and therefore, no ecological risks are associated with the building.

11. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: How do you define "ecological risks" (p.16)?

    Response: SRS conducts its ecological risk assessment following the USEPA guidance. The USEPA considers ecological risk to be the chance of harmful effects to ecological systems resulting from exposure to an environmental stressor. A stressor is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact.

12. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: I have visited P-Reactor (Summer 2005 CAB tour) and observed a cavernous concrete tomblike structure with normal bird activity outside. I have commented at both workshops that this is likely habitat for bats. Again, how is this building deemed unsuitable habitat for either diurnal or nocturnal flying vertebrates?

    Generally speaking, a quantitative ecological risk assessment was not performed on the Reactor Building (105-P) due mainly to the lack of habitat (i.e., industrial setting). In this instance, the exposure pathways for the receptors evaluated in a normal risk assessment are not complete, and there is negligible potential for contaminant exposure to ecological receptors. Typical receptors for a SRS risk assessment include soil invertebrates (earthworm), insectivorous mammals (shrew), herbivorous mammals (mouse), omnivorous mammals (raccoon), omnivorous birds (robin), and carnivorous birds (red-tailed hawk).

While diurnal/nocturnal flying (primarily insectivorous) mammals have the potential to frequent the Reactor Building (105-P), the likelihood of these receptors spending their entire lives within the building and foraging solely from insects that may also reside in the reactor building is unlikely since their home range varies from 30 ha to 100s of ha.

Additionally, the quantitative ecological risk associated with exposure to radionuclides is not evaluated since it is recognized that the radiological screening benchmarks used in the human health risk assessment are conservative threshold values. Therefore, any problems warranting action from a human health perspective would be protective of ecological receptors.

Furthermore, controls are in place to minimize bird/bat access to the building prior to decommissioning (doors closed, screens in place). After in-situ decommissioning, the building will be sealed to prevent future access of birds, bats, and other animals.

13. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: I recognize that in-situ decommissioning will include removal of some portion of the above grade building, such as the actuator tower and stack (app.A-5). This will leave a large space for potential mold habitat. Furthermore, the relationship between degradation and the structural integrity of the remainder of P-Reactor building depends upon the lack of life sustaining conditions. How will the sealed space be monitored for potential decomposition and intrusion by fungi, insects, and flying vertebrates (birds and bats)?

    Response: The specifics on monitoring and engineering/construction details for the selected remedial alternatives will be provided in the post-ROD documentation (Corrective Measures Implementation/ Remedial Action Implementation Plan). These details are typically not included in a Proposed Plan or Record of Decision document.

14. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: ISD of the reactor vessel and 105-P will result in approximately 225,193 Ci (94% of total) in a fixed form highly unlikely to migrate. Please provide explicit descriptions and locations of the air and water monitoring that will be part of the sentinel protection for the public.

    Response: The specifics on monitoring details for the selected remedial alternatives will be provided in the early action post-ROD documentation (Corrective Measures Implementation/ Remedial Action Implementation Plan). These details are typically not included in a Proposed Plan or Record of Decision document.

15. Attachment to Email from Donna Antonucci, received July 15, 2008 to Paul Sauerborn: At the July 8 FD & SR committee meeting, I attended a very informative presentation by Ray Hannah concerning the disposition of approximately 4.5 million gallons of tritiated water (HTO) from the disassembly basin. This material accounts for roughly 14,637 Cu (6% of total, p.13) of the radiological inventory at 105-P. The EE/CA approach selected alternative 5d and went out for public comment in March 2008. No public comments were offered. After the public comment period, alternative 3 was selected. This involves evaporation and release of HTO by permitted limits to the atmosphere.

I am troubled by the process where an alternative is selected, 5d (using the HTO as part of the in-situ grout used to entomb below grade) and placed in the public arena for comment, then after the public comment period ends for that EE/CA, a change is announced that ends up with a release to the atmosphere. The reasons for the change are sound. To protect the site worker, reduce the technical uncertainty, and improve the quality of the grout, are substantial gains. However, the public resource is being asked to absorb a quantity of radiological inventory.

Often in first of its kind work, a precedent is set for what is allowed in the future. Therefore, I strongly believe that extra caution and effort is required before proceeding. While I accept that HTO is released according to permit at many nuclear facilities, I would like to see the amounts permitted for SRS, as well as the verification and monitoring planned for this HTO release of PAOU disassembly basin water.

Response: The selected alternative was based on many factors even though it differed from the preferred alternative as stated in the Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA). All the alternatives presented in the RSER/EE/CA were evaluated to determine what affects the release of additional tritium would have on the public and environment and found to be three orders of magnitude less than the CERCLA limit of 1E-06.

16. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: The Early Action Proposed Plan, as delineated in the May, 2008, WSRC Report WSRC-RP-2007-4064 is a commendable means of informing the public of the final end state decision for the P-Reactor building and the remedial alternatives for the five (5) subunits within the P Area Operable Unit (PAOU). In particular, the schedule-related benefits of the EAPP approach should be significant.

Response: The comment is appreciated.

17. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: While the Federal Facility Agreement (FFA) between South Carolina and DOE, as well as prior DOE analysis (such as program-level "End State" vision documents) may

have identified in situ decommissioning as an acceptable alternative for the P-Reactor Building, CERCLA calls for a separate investigation and selection of remedial alternatives. The EAPP addresses that independent and separate alternatives review. Stated differently, CERCLA requires a hard look -- a fresh review -- of alternatives for the specific Operable Units, notwithstanding prior FFA and DOE reviews that, at the program level, may have identified in situ decommissioning.

Response: Agree. A CERCLA review of the alternatives was conducted and is documented in the *RCRA Facility Investigation/ Remedial Investigation with Baseline Risk Assessment and Corrective Measures Study/Feasibility Study for P Area Operable Unit (U)*, WSRC-RP-2007-4032, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC, 2008.

18. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: Selection of In-Situ Decommissioning (ISD) ***for the reactor and reactor building structure and ancillary equipment (Table 7) within the P-Reactor Building (105-P)*** is reasonable and appropriate, in light of the radiological inventory within the reactor vessel and biological shield, the institutional controls anticipated for the SRS, and the limited potential for nickel isotopes to migrate to receptor groundwater over a 10,000 year time frame. (page 17 of EAPP). These factors do not, however, support the conclusion relative to actual or potential releases and the need for early action for the entire P-Reactor Building. The Disassembly Basin and its aqueous inventory (not "water" as depicted on one of the figures) is the potential source of concern that justifies early action for *a portion* of the P-Reactor Building.

Response: The premise of the Early Action Proposed Plan for the Reactor Building (105-P) was to enter into an early remedial decision for hardened facilities that no longer have an identified future mission at SRS and is agreeable between DOE, USEPA, and SCDHEC.

In the short-term, the water contained in the Disassembly Basin represents a large risk to the environment in the event of a catastrophic release. To address this short-term issue, the Disassembly Basin and its aqueous inventory are being addressed under a Removal Site Evaluation Report/Engineering Evaluation/ Cost Analysis document. The selected remedy for removal of the tritiated water is through forced evaporation. The remaining water, sludge, and activated metal scrap within the Disassembly Basin will be addressed as part of in-situ decommissioning activities for the Reactor Building (105-P).

19. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: DOE should consider segmenting -- in other words, analyzing separately -- the early action decisions associated with P-reactor proper and associated structures/equipment

from an early action decision associated with the Disassembly Basin. The Disassembly Basin presents a discernable and discrete processing unit within the P Area and its attributes support an early action.

Response: The Disassembly Basin and its aqueous inventory are being addressed under a Removal Site Evaluation Report/Engineering Evaluation/ Cost Analysis document. The remaining water, sludge, and activated metal scrap will be addressed as part of *in situ* decommissioning of the Reactor Building (105-P)

20. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: ISD of the P-Reactor Building (including the Disassembly Basin) includes various grouting scenarios for equipment; spaces below grade would be "solidified and stabilized with grout." (page 25). Although less than clear, and not highlighted in the EAPP, the Disassembly Basin inventory appears to be the source of makeup water for the grouting.

    Response: The Disassembly Basin and its aqueous inventory are being addressed under a Removal Site Evaluation Report/Engineering Evaluation/ Cost Analysis (RSER/EE/CA) document. USDOE has selected the evaporation alternative to disposition the Disassembly Basin water. The Disassembly Basin water will not be utilized for the below-grade grout. However, discrepancies between the EAPP and the RSER/EE/CA will be addressed in the Early Action Record of Decision.

21. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: Grouting of the Disassembly Basin should be a separate and distinct decision from grouting of the reactor and reactor building structure and ancillary equipment. DOE should not grout the reactor building and stored (Table 7) equipment with Disassembly Basin inventory. To do so will "spread" the radiological inventory of the P-Reactor Building and preclude application of new or evolving approaches for straightforward decommissioning that is likely to develop in the future.

    Response: The Disassembly Basin and its aqueous inventory are being addressed under a RSER/EE/CA document in which evaporation will be employed to remove nearly 90% of the water. The decision to use the Disassembly Basin water at the time of the writing of the EAPP has changed based on many factors. The discrepancies between the EAPP and the RSER/EE/CA will be addressed in the Early Action Record of Decision.

22. Email from Arthur Domby, dated July 15, 2008 to Paul Sauerborn: ISD for the P-Reactor should apply a "SAFESTOR" type approach to the reactor and reactor building structure and ancillary equipment (Table 7) and defer grouting. Because the SAFESTOR approach for those areas will assure that the Building will not be accessible due to institutional controls, no incremental benefit with respect to human exposure is achieved by grouting. Deferred grouting may be expressly

identified as a future action, dependent on certain time or other criteria, within the early action ROD.

Response: The comment is appreciated. The viability of this approach will be further evaluated as part of the decommissioning activities.

23. Hardcopy Letter from Donald Bridges, received July 22, 2008 to Paul Sauerborn: The overall approach is very responsible being carefully studied and well though-out.

Response: The comment is appreciated.

24. Hardcopy Letter from Donald Bridges, received July 22, 2008 to Paul Sauerborn: Recommended features for In Situ Decommissioning
    - Retention of the basic structure with the actuator tower being removed at the +66 foot level. This allows for a smaller building profile with less falling hazard and less hazard to any flying objects.
    - Retention of the basic stack with the height reduced to approximately 50 feet to establish a smaller building profile with falling hazard and less falling hazard to any flying objects.
    - Complete grouting and cover of the disassembly basin as presently proposed.
    - Grouting of the 105 building in the following manner:
        - Complete grouting of the reactor vessel and the space below the tank all the way from top of the vessel to the -40 foot level. The top of the tank should then be capped. This encapsulates the vast majority of the radioactive material.
        - Complete grouting of the -40 portion of the 105 building up to the -20 foot level. This encapsulates essentially all the remaining contamination. Further grouting from the -20 foot level to the ground level provides little additional advantage but will be very expensive.
        - Complete grouting in the purification wing from below-ground to ground level only. Further grouting above ground level is not cost effective.
    - Disposition of the 105-P building in the manner proposed would in my judgment make the hazards adequately stabilized and isolated from release to the environment.

Response: The recommended features for ISD will be considered as part of the overall engineering approach to closure of the facility.

APPENDIX B
COST ESTIMATES FOR THE SELECTED REMEDIES

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Table B-1. Cost Estimate for Alternatives AR-1 and AR-2 of P-Reactor Building (105-P)

Item	Quantity	Units	No Action	ISD	ISD Max Case
Direct Capital Costs					
Removal of Major Contaminated Equipment			$0	$130,000	$210,000
Fix Contaminated Equipment that is Abandoned In Place			$0	$650,000	$220,000
Removal of Shield Door Gantries and Modify Roof (includes disposal costs)			$0	$4,820,000	$4,820,000
Remove Stack to +55 ft (includes disposal costs)			$0	$2,030,000	$2,030,000
Decontamination			$0	$150,000	$150,000
Characterization and Surveys			$0	$2,650,000	$2,650,000
Fill Spaces with Grout			$0	$12,500,000	$12,500,000
Demolition and Removal of Above Ground Structures with Size Reduction			$0	$540,000	$7,530,000
Removal of Reactor Vessel, Plenum, and Internals (includes disposal costs)			$0	$0	$5,520,000
Grade and Cover			$0	$1,700,000	$4,990,000
Major Equipment Waste Disposal			$0	$333,000	$850,000
Above Ground Structure Waste Disposal			$0	$0	$91,000,000
Total Direct Capital Cost			**$0**	**$25,503,000**	**$132,470,000**
Indirect Capital Costs					
Engineering and Management			$0	$5,540,600	$9,640,000
Total Indirect Capital Cost			**$0**	**$5,540,600**	**$9,640,000**
Total Estimated Capital Cost			**$0**	**$31,043,600**	**$142,110,000**

Table B-1. Cost Estimate for Alternatives AR-1 and AR-2 of P-Reactor Building (105-P) *(Continued)*

Item	Quantity	Units	No Action	ISD	ISD Max Case
Direct O&M Costs					
	200	year O&M period		*Years 2008 - 2208*	
Present value of 200 years of Surveillance and Monitoring			$35,000,000	$700,000	$0
Total Direct O&M Cost			**$35,000,000**	**$700,000**	**$0**
Indirect O&M Costs					
Contingency	25%	of direct costs	$0	$7,760,900	$35,527,500
Overhead	33%	of direct costs + contingency	$11,550,000	$13,036,485	$58,620,375
Total Indirect O&M Cost			**$11,550,000**	**$20,797,385**	**$94,147,875**
Total Estimated O&M Cost			**$46,550,000**	**$21,497,385**	**$94,147,875**
TOTAL ESTIMATED COST			**$46,550,000**	**$52,540,985**	**$236,257,875**

Cost Estimates were taken from *105-P D&D Alternatives Cost Analysis* (SDD-2008-00003, Rev. 0)

Cost Element Description

The cost elements in Table B-1 are order of magnitude estimates in 2008 dollars that are based on limited engineering data using specific analogy techniques (scale up or scale down factors from prior known systems and parametric techniques. The cost estimates are for comparison purposes between alternatives only and are not intended to portray actual costs for any alternatives chosen. Once an alternative is chosen, formal estimates will be prepared for costing/funding purposes.

The major components of each cost element are summarized below. A more detailed description of the scope included in each element together with the unit rates used is given in WSRC 2008e.

Element #1 - Removal of Major Contaminated Equipment
Cost Element #1 estimates the cost to dismantle the major equipment that will be removed from the building, which is itemized in Table A in WSRC 2008e. The quantity, volume and weight for each item were calculated along with a removal complexity factor. Unit rates were then consistently applied to calculate the total cost. The cost of waste disposal is captured in Element #12a.

Element #2 - Abandoned-In-Place Contaminated Equipment
This Cost Element estimates the cost to abandon in place the contaminated equipment that will remain inside the building and is itemized in Table B in WSRC 2008e). This equipment primarily consists of the reactor tank and associated components.

Element #3 - Removal of Shield Door Gantries and Install New Roof
This cost Element estimates the cost of removing the Shield Door Gantries and allows for construction of a new roof. This portion of the 105-P building is showing signs of structural degradation.

Element #4 - Removal of Stack
This Cost Element estimates the cost of removing the stack above the +55 ft roof elevation. The stack is considered unsound to last as a structure over the time frames being considered for in situ decommissioning. The disposal cost is included in Element #12.

Element #5 - Decontamination
This Cost Element estimates the cost of decontaminating or fixing-in-place the radionuclide contamination on exposed surfaces that are within reach of human receptors within the building structure based on current knowledge of radiological conditions.

Element #6 - Characterization and Surveys
See WSRC 2008e for a detailed description of this complex Cost Element.

Element #7 - Fill Lower Spaces with Grout

This Cost Element estimates the cost of grouting the 105-P building to grade level (approximately 114,000 cubic yards).

Element #8 - Demolition and Removal of Above-Ground Structures with Size Reduction
This cost was based on construction drawings that indicated that around 137,000 tons of material would need to be demolished, size reduced and transported to a repository. The disposal cost is captured in Element 12b.

Element #9 - Removal of Reactor Vessel
This Cost Element is based on the weight of the vessel at 247.3 tons. See WSRC 2008e for a detailed description of this complex cost element.

Element #10 - Grade and Cover
This Cost Element is based on covering 12 acres of land at $400,000 with a cover design consisting of backfill, geo-synthetic material, clay, drainage, topsoil and vegetation layers.

Element #11 - Engineering and Management
This Cost Element is based on a team of exempt professionals assigned for the full duration of the project.

Element #12 - Waste Disposal
Cost Element #12 is divided into two sub-element #12a and 12b. The disposal cost for the major equipment removed in Element #1 and #2 are included in sub-element #12a. The disposal cost for the above-ground structure removed in Element #4and #8 is included in sub-element #12b. Costs were based on disposal options at the Nevada Test Site and Clive, Utah.

Table B-2. Cost Estimate for Complete Removal (Alternative AR-3) of P-Reactor Building (105-P)

Bldg No	Cost Basis	End State	ROM (03 $K direct) (Model Calc)	ROM (08 $K direct)	ROM + Adders (28% for Demo) (08 $K direct)
105-P	ROM	D	$85,060	$101,219	$129,560
108-1P	ROM	D	$266	$217	$405
108-2P	ROM	D	$345	$410	$525
				Total ROM	**$130,490**

Adders to the ROM

Remove/dispose of the reactor vessel	$10,000
Remove/dispose of tritiated heat exchangers (offsite disposal)	$400
Remove/dispose tritiated process water piping and tanks (offsite disposal)	$200
Offsite disposal of tritiated concrete (10,000 truck loads)	$91,500
Disposal of mixed waste (contaminated lead, brass, & 630K sq ft of PCBs)	$1,200
Excavate to access below grade structure (7500 truck loads)	$7,209
Remove sludge/activated metal from Disassembly Basin	$500
Remove/dispose of Disassembly Basin water	$2,700
Disposal of Disassembly Basin activated metal and sludge	$128
Total Estimated Cost (direct)	$244,327
Contingency @ 20%	$48,865
Overheads @ 30%	$73,398
Total Estimated Cost (FY-2008 dollars)	**$366,491.01**

Assumptions:

- Complete demolition of 105-P, 108-1P and 108-2P, including below grade structures down to the footers
- Soil excavated from URMA must be disposed of as LLW (some must go to NTS for TCE)
- Concrete in pump room, heat exchanger bay, process room, purification cells and Disassembly Basin walls can not go to slit trenches due to tritium
- Heat Exchangers, moderator piping, moderator storage tanks, purification equipment can not go to slit trenches due to tritium
- Reactor vessel will be segmented, packaged and disposed of off site
- Disassembly Basin sludge can not go to the slit trenches due to tritium
- Disassembly Basin activated metal will be packaged in shipping casks and can go to slit trenches
- PCB paint will have to be scabbled from concrete walls before demolition and disposed of as mixed waste
- Will include removal/disposal of 109-P and 106-P (required t excavated below grade structure)
- No MC&A issues with Disassembly Basin sludge/activated metal
- All waste for offsite disposal (except for mixed) will go to NTS
- Mixed waste will go to either EnviroCare or Oak Ridge
- Non Mixed Waste costs are for packaging and shipment only.....NTS disposal is no charge
- Mixed waste costs include treatment costs and disposal
- Heat Exchangers shipped as is with no additional packaging
- Concrete disposal to Clive, Utah by rail using existing 50 site gondola rail cars and rail spur to 100-P must be refurbished

Table B-3. Cost Estimate for Alternative AP-1 of P02 Outfall

Item		Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs					
No Action					
	Subtotal - Direct Capital Cost				$0 *
	Mobilization/Demobilization	10% of subtotal direct capital			$0 *
	Site Preparation/Site Restoration	10% of subtotal direct capital			$0 *
	Total Direct Capital Cost	(sum of * items)			**$0**
Indirect Capital Costs					
Engineering & Design		15% of direct capital			$0
Project/Construction Management		25% of direct capital			$0
Health & Safety		5% of direct capital			$0
Overhead		30% of direct capital			$0
Contingency		20% of direct capital			$0
	Total Indirect Capital Cost				**$0**
	Total Estimated Capital Cost				**$0**
Direct O&M Costs		3.9% discount rate for costs > 30 years duration			
Annual Costs (Existing System during Post-ROD Design & Const)		30 year O&M period		*Years 2008 - 2038*	
	Subtotal - Annual Costs				$0
	Present Worth Annual Costs				$0
Five Year Costs		0			
Remedy Review		0	ea	$15,000	$0
	Subtotal - Five Year O&M Costs				$0
	Present Worth Five Year Costs				$0
	Total Present Worth Direct O&M Cost				**$0**
Indirect O&M Costs					
Project/Admin Management		40% of direct O&M			$0
Health & Safety		10% of direct O&M			$0
Overhead		30% of direct O&M			$0
Contingency		15% of direct O&M			$0
	Total Present Worth Indirect O&M Cost				**$0**
	Total Estimated Present Worth O&M Cost				**$0**
	TOTAL ESTIMATED COST				**$0**

There are no O&M or 5-year review costs for the No Action alternative, as per EPA-540-R-98-031 guidance.

ARF # 15839

Table B-4. Cost Estimate for Alternative AP-2 of P02 Outfall

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
P-02 Outfall Contamination Removal and Disposal (Warranting Action)				
Excavate P-02 Outfall Contamination Area	411	cy	$85	$34,935
Intermodal Purchase (13.1 cy / unit)	32	ea	$11,000	$352,000
Stage Waste for Disposal	1	lt	$10,000	$10,000
Confirmatory Sampling and Analysis	63	ea	$400	$25,200
Equipment Decontamination (Allowance)	1	lt	$5,000	$5,000
Load Waste For Transport	314	cu m	$87	$27,318
Transport Waste to Disposal Site	314	cu m	$30	$9,420
Unload Waste Transported	314	cu m	$87	$27,318
Waste Disposal	314	cu m	$765	$240,210
Grading of site	1	ea	$10,000	$10,000
Subtotal - Direct Capital Cost				$741,401 *
Mobilization/Demobilization	10% of subtotal direct capital			$74,140 *
Site Preparation/Site Restoration	10% of subtotal direct capital			$74,140 *
Total Direct Capital Cost	(sum of * items)			**$889,681**
Indirect Capital Costs				
Engineering & Design	14% of direct capital			$124,555
Project/Construction Management	25% of direct capital			$222,420
Health & Safety	5% of direct capital			$44,484
Overhead	30% of direct capital			$266,904
Contingency	20% of direct capital			$177,936
Total Indirect Capital Cost				**$836,300**
Total Estimated Capital Cost				**$1,725,982**
Direct O&M Costs	3.9% discount rate for costs > 30 years duration[1]			
Annual Costs (Existing System during Post-ROD Design & Const)	2 years O&M			*Years 2008 - 2009*
Access Controls	1	ea	$500	$500
Subtotal - Annual Costs				$500
Present Worth Annual Costs (2.1% Discount Rate)				$969
Annual Costs	5 years O&M			*Years 2010 - 2014*
Access Controls	1	ea	$500	$500
Annual Inspections	1	ea	$5,000	$5,000
Subtotal - Annual Costs				$5,500
Present Worth Annual Costs (3.0% Discount Rate)				$23,742
Five Year Costs	2			
Remedy Review	1	ea	$15,000	$15,000
Subtotal - Five Year O&M Costs				$15,000
Present Worth Five Year Costs				$22,620
Total Present Worth Direct O&M Cost				**$47,332**
Indirect O&M Costs				
Project/Admin Management	150% of direct O&M			$70,997
Health & Safety	70% of direct O&M			$33,132
Overhead	30% of direct O&M			$14,199
Contingency	15% of direct O&M			$7,100
Total Present Worth Indirect O&M Cost				**$125,429**
Total Estimated Present Worth O&M Cost				**$172,760**
TOTAL ESTIMATED COST				**$1,898,742**

1. Interest rate for costs with duration < 30 years (i.e., before 2034) is based on WSRC's 16 April 2002 Technical Memorandum.

Table B-5 Cost Estimate for Alternative AV-1 of the Potential Source Areas

Item		Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs					
No Action					
	Subtotal - Direct Capital Cost				$0 *
	Mobilization/Demobilization	10%	of subtotal direct capital		$0 *
	Site Preparation/Site Restoration	10%	of subtotal direct capital		$0 *
	Total Direct Capital Cost		(sum of * items)		**$0**
Indirect Capital Costs					
Engineering & Design		15%	of direct capital		$0
Project/Construction Management		25%	of direct capital		$0
Health & Safety		5%	of direct capital		$0
Overhead		30%	of direct capital		$0
Contingency		20%	of direct capital		$0
	Total Indirect Capital Cost				**$0**
	Total Estimated Capital Cost				**$0**
Direct O&M Costs		3.9%	discount rate for costs > 30 years duration		
Annual Costs (Existing System during Post-ROD Design & Const)		30	year O&M period	*Years 2008 - 2038*	
	Subtotal - Annual Costs				$0
	Present Worth Annual Costs				$0
Five Year Costs		0			
Remedy Review		0	ea	$15,000	$0
	Subtotal - Five Year O&M Costs				$0
	Present Worth Five Year Costs				$0
	Total Present Worth Direct O&M Cost				**$0**
Indirect O&M Costs					
Project/Admin Management		40%	of direct O&M		$0
Health & Safety		10%	of direct O&M		$0
Overhead		30%	of direct O&M		$0
Contingency		15%	of direct O&M		$0
	Total Present Worth Indirect O&M Cost				**$0**
	Total Estimated Present Worth O&M Cost				**$0**
	TOTAL ESTIMATED COST				**$0**

*There are no O&M or 5-year review costs for the No Action alternative, as per EPA-540-R-98-031 guidance.

Table B-6. Cost Estimate for Alternative AV-2 of PSA-3B

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Soil Vapor Extraction				
4" Extraction Wells @ 50 feet (Microblower) - Active Low Energy	12	ea	$25,000	$300,000
Subtotal - Direct Capital Cost				$300,000 *
Mobilization/Demobilization	25% of subtotal direct capital			$75,000 *
Site Preparation/Site Restoration	25% of subtotal direct capital w/o waste			$75,000 *
Total Direct Capital Cost	(sum of * items)			**$450,000**
Indirect Capital Costs				
Engineering & Design	20% of direct capital			$90,000
Project/Construction Management	25% of direct capital			$112,500
Health & Safety	10% of direct capital			$45,000
Overhead	30% of direct capital			$135,000
Contingency	20% of direct capital			$90,000
Total Indirect Capital Cost				**$472,500**
Total Estimated Capital Cost				**$922,500**
Direct O&M Costs	3.9% discount rate for costs > 30 years duration[1]			
Annual Costs (Existing System during Post-ROD Design & Const)	2 years O&M			*Years 2008 - 2009*
Access Controls	1	ea	$500	$500
Subtotal - Annual Costs				$500
Present Worth Annual Costs (2.1% Discount Rate)				$969
Annual Costs	5 years O&M			*Years 2010 - 2014*
Access Controls	1	ea	$500	$500
Performance Monitoring	1	ea	$10,000	$10,000
Soil Vapor Extraction Operation / Maintenance	1	ea	$64,000	$64,000
Performance Analysis Report	1	ea	$40,000	$40,000
Subtotal - Annual Costs				$114,500
Present Worth Annual Costs (3.0% Discount Rate)				$494,275
Annual Costs (Passive Soil Vapor Extraction Operation - Baroballs)	5 years O&M			*Years 2015 - 2019*
Access Controls	1	ea	$500	$500
Baroball Operation / Maintenance	1	ea	$5,000	$5,000
Performance Analysis Report	1	ea	$10,000	$10,000
Subtotal - Annual Costs				$15,500
Present Worth Annual Costs (3.2% Discount Rate)				$56,616
Five Year Costs	3			
Remedy Review	1	ea	$15,000	$15,000
Subtotal - Five Year O&M Costs				$15,000
Present Worth Five Year Costs				$31,070
Total Present Worth Direct O&M Cost				**$526,314**
Indirect O&M Costs				
Project/Admin Management	115% of direct O&M			$605,261
Health & Safety	24% of direct O&M			$126,315
Overhead	30% of direct O&M			$157,894
Contingency	15% of direct O&M			$78,947
Total Present Worth Indirect O&M Cost				**$968,418**
Total Estimated Present Worth O&M Cost				**$1,494,733**
TOTAL ESTIMATED COST				**$2,417,233**

1. Interest rate for costs with duration < 30 years (i.e., before 2034) is based on WSRC's 16 April 2002 Technical Memorandum.

Table B-7. Cost Estimate for Alternative AV-3 of PSA-3A

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Soil Fracturing w/Amendments (Persulfate)				
Soil Fracture Well Points (50 ft depth)	3	ea	$10,000	$30,000
Soil Fracture Cost (2 per well, $1500 per fracture)	3	ea	$3,000	$9,000
Thermocouple Well Points	12	ea	$5,000	$60,000
Steam Injection Well Points	12	ea	$10,000	$120,000
Persulfate Injections (CPT)	6	ea	$1,350	$8,100
Portable Steam Generator (1 Unit)	1	ea	$10,000	$10,000
Monitoring / Sampling and Analysis	15	ea	$400	$6,000
Monitoring / Reporting	1	ea	$30,000	$30,000
Install Vadose Zone Treatment System				
4" Extraction Wells @ 50 feet (Microblower) - Active Low Energy	15	ea	$25,000	$375,000
Subtotal - Direct Capital Cost				$648,100 *
Mobilization/Demobilization	20% of subtotal direct capital			$129,620 *
Site Preparation/Site Restoration	15% of subtotal direct capital			$97,215 *
Total Direct Capital Cost	(sum of * items)			**$874,935**
Indirect Capital Costs				
Engineering & Design	20% of direct capital			$174,987
Project/Construction Management	25% of direct capital			$218,734
Health & Safety	10% of direct capital			$87,494
Overhead	30% of direct capital			$262,481
Contingency	20% of direct capital			$174,987
Total Indirect Capital Cost				**$918,682**
Total Estimated Capital Cost				**$1,793,617**
Direct O&M Costs	3.9% discount rate for costs > 30 years duration[1]			
Annual Costs (Existing System during Post-ROD Design & Const)	2 years O&M		*Years 2008 - 2009*	
Access Controls	1	ea	$500	$500
Subtotal - Annual Costs				$500
Present Worth Annual Costs (2.1% Discount Rate)				$969
Annual Costs (Persulfate Monitoring)	1 years O&M		*Year 2010*	
Access Controls	1	ea	$500	$500
Performance Monitoring	1	ea	$10,000	$10,000
Injection Monitoring (1 CPT at each location)	15	ea	$2,000	$30,000
Performance Analysis Report	1	ea	$40,000	$40,000
Subtotal - Annual Costs				$80,500
Present Worth Annual Costs (2.1% Discount Rate)				$75,634
Annual Costs (Soil Vapor Extraction / Microblower Operation)	3 years O&M		*Years 2010 - 2012*	
Access Controls	1	ea	$500	$500
Performance Monitoring	1	ea	$10,000	$10,000
Soil Vapor Extraction / Microblower Operation / Maintenance	1	ea	$64,000	$64,000
Performance Analysis Report	1	ea	$40,000	$40,000
Subtotal - Annual Costs				$114,500
Present Worth Annual Costs (2.8% Discount Rate)				$307,655
Annual Costs (Passive Soil Vapor Extraction Operation - Baroballs)	5 years O&M		*Years 2013 - 2017*	
Access Controls	1	ea	$500	$500
Performance Monitoring	1	ea	$10,000	$10,000
Baroball Operation / Maintenance	1	ea	$44,000	$44,000
Performance Analysis Report	1	ea	$25,000	$25,000
Subtotal - Annual Costs				$79,500
Present Worth Annual Costs (3.1% Discount Rate)				$311,654
Five Year Costs	2			
Remedy Review	1	ea	$15,000	$15,000
Subtotal - Five Year O&M Costs				$15,000
Present Worth Five Year Costs				$22,620
Total Present Worth Direct O&M Cost				**$718,533**
Indirect O&M Costs				
Project/Admin Management	120% of direct O&M			$862,239
Health & Safety	27% of direct O&M			$194,004
Overhead	30% of direct O&M			$215,560
Contingency	15% of direct O&M			$107,780
Total Present Worth Indirect O&M Cost				**$1,379,583**
Total Estimated Present Worth O&M Cost				**$2,098,116**
TOTAL ESTIMATED COST				**$3,891,732**

1. Interest rate for costs with duration < 30 years (i.e., before 2034) is based on WSRC's 16 April 2002 Technical Memorandum.

Table B-8. Cost Estimate for Alternative AC-1 of the HCA at the Cask Car Railroad Tracks

Item		Quantity	Units	Unit Cost	Total Cost	
Direct Capital Costs						
No Action						
	Subtotal - Direct Capital Cost				$0	*
	Mobilization/Demobilization	10%	of subtotal direct capital		$0	*
	Site Preparation/Site Restoration	10%	of subtotal direct capital		$0	*
	Total Direct Capital Cost		(sum of * items)		**$0**	
Indirect Capital Costs						
Engineering & Design		15%	of direct capital		$0	
Project/Construction Management		25%	of direct capital		$0	
Health & Safety		5%	of direct capital		$0	
Overhead		30%	of direct capital		$0	
Contingency		20%	of direct capital		$0	
	Total Indirect Capital Cost				**$0**	
	Total Estimated Capital Cost				**$0**	
Direct O&M Costs		3.9%	discount rate for costs > 30 years duration			
Annual Costs (Existing System during Post-ROD Design & Const)		30	year O&M period	*Years 2008 - 2038*		
	Subtotal - Annual Costs				$0	
	Present Worth Annual Costs				$0	
Five Year Costs		0				
Remedy Review		0	ea	$15,000	$0	
	Subtotal - Five Year O&M Costs				$0	
	Present Worth Five Year Costs				$0	
	Total Present Worth Direct O&M Cost				**$0**	
Indirect O&M Costs						
Project/Admin Management		40%	of direct O&M		$0	
Health & Safety		10%	of direct O&M		$0	
Overhead		30%	of direct O&M		$0	
Contingency		15%	of direct O&M		$0	
	Total Present Worth Indirect O&M Cost				**$0**	
	Total Estimated Present Worth O&M Cost				**$0**	
	TOTAL ESTIMATED COST				**$0**	

There are no O&M or 5-year review costs for the No Action alternative, as per EPA-540-R-98-031 guidance.

Table B-9. Cost Estimate for Alternative AC-2 of the HCA at the Cask Car Railroad Tracks

Item	Quantity	Units	Unit Cost	Total Cost
Direct Capital Costs				
Cask Car RR Contamination Removal and Disposal (Warranting Action)				
Remove RR Tracks & Package Waste for Disposal	1	ls	$50,000	$50,000
Remove RR Track Ties & Package Waste for Disposal	1	ls	$30,000	$30,000
Excavate Cask Car RR Contamination Area	21	cy	$200	$4,200
Intermodal Purchase (13.1 cy / unit)	2	ea	$11,000	$22,000
Stage Waste for Off-site Disposal	1	ls	$10,000	$10,000
Confirmatory Sampling and Analysis	10	ea	$400	$4,000
Equipment Decontamination (Allowance)	1	ls	$5,000	$5,000
Load Waste For Transport	17	cu m	$163	$2,771
Transport Waste to 105-P Disposal Site	17	cu m	$30	$510
Unload Waste Transported	17	cu m	$163	$2,771
Waste Disposal (105-P)	17	cu m	$765	$13,005
Subtotal - Direct Capital Cost				$144,257 *
Mobilization/Demobilization	30%	of subtotal direct capital		$43,277 *
Site Preparation/Site Restoration	30%	of subtotal direct capital		$43,277 *
Total Direct Capital Cost		(sum of * items)		$230,811
Indirect Capital Costs				
Engineering & Design	18%	of direct capital		$41,546
Project/Construction Management	25%	of direct capital		$57,703
Health & Safety	7%	of direct capital		$16,157
Overhead	30%	of direct capital		$69,243
Contingency	20%	of direct capital		$46,162
Total Indirect Capital Cost				$230,811
Total Estimated Capital Cost				$461,622
Direct O&M Costs	3.9%	discount rate for costs > 30 years duration[1]		
Annual Costs (Existing System during Post-ROD Design & Const)	2	years O&M		*Years 2008 - 2009*
Access Controls	1	ea	$500	$500
Subtotal - Annual Costs				$500
Present Worth Annual Costs (2.1% Discount Rate)				$969
Annual Costs	5	years O&M		*Years 2010 - 2014*
Access Controls	1	ea	$500	$500
Annual Inspections	1	ea	$5,000	$5,000
Subtotal - Annual Costs				$5,500
Present Worth Annual Costs (3.0% Discount Rate)				$23,742
Five Year Costs	2			
Remedy Review	1	ea	$15,000	$15,000
Subtotal - Five Year O&M Costs				$15,000
Present Worth Five Year Costs				$22,620
Total Present Worth Direct O&M Cost				$47,332
Indirect O&M Costs				
Project/Admin Management	150%	of direct O&M		$70,997
Health & Safety	66%	of direct O&M		$31,239
Overhead	30%	of direct O&M		$14,199
Contingency	15%	of direct O&M		$7,100
Total Present Worth Indirect O&M Cost				$123,535
Total Estimated Present Worth O&M Cost				$170,867
TOTAL ESTIMATED COST				$632,489

1. Interest rate for costs with duration < 30 years (i.e., before 2034) is based on WSRC's 16 April 2002 Technical Memorandum.

APPENDIX C
EARLY ACTION POST-ROD SCHEDULE

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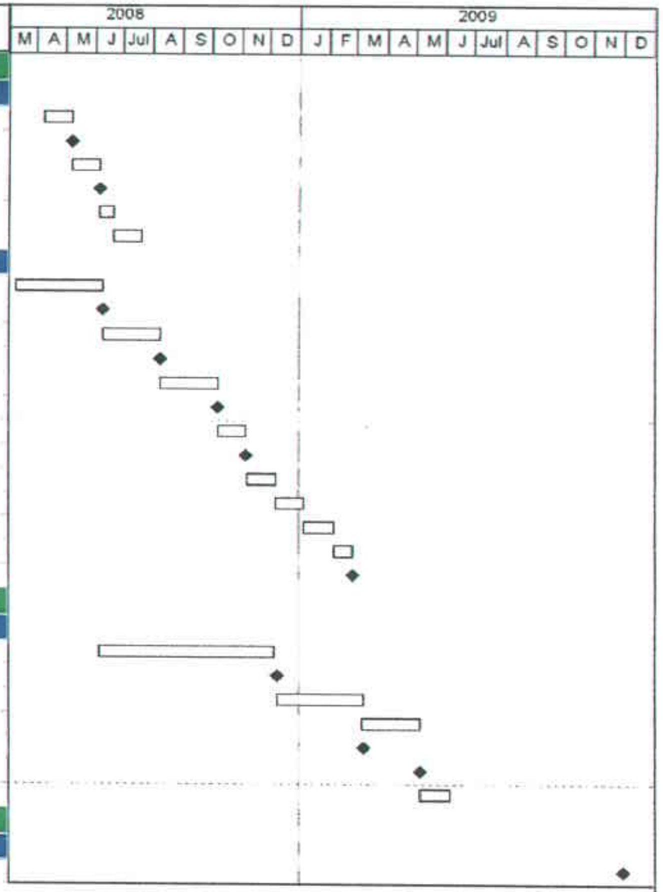
ARF # 15839

Figure C-1. Early Action Post-ROD Schedule

Activity Name	OD	Start	Finish
REGULATORY REQUIREMENTS	191d	11-Mar-08	25-Feb-09
Early Action Proposed Plan	57d	8-Apr-08	20-Jul-08
SRS Incorporate Comments of Rev.1 EAPP	30d	8-Apr-08	7-May-08
Submit Redline Rev.1.1 EAPP	0d		7-May-08
EPA/SCDHEC Review & Approve Rev.1.1 EAPP	30d	8-May-08	6-Jun-08
Final Approval of EAPP	0d		6-Jun-08
Public Notification Period EAPP	14d	7-Jun-08	20-Jun-08
Public Comment Period EAPP	30d	21-Jun-08	20-Jul-08
Early Action Record of Decision	191d	11-Mar-08	25-Feb-09
Develop Rev.0 EAROD	63d	11-Mar-08	9-Jun-08
Submit Rev.0 EAROD	0d		9-Jun-08
EPA/SCDHEC Rev of Rev.0 EAROD	60d	10-Jun-08	8-Aug-08
EPA/SCDHEC returns comments on Rev. 0 EAROD	0d		8-Aug-08
Incorporate Comments of Rev.0 EAROD	60d	9-Aug-08	7-Oct-08
Submit Rev.1 EAROD	0d		7-Oct-08
Review & Approval of Rev.1 EAROD	30d	8-Oct-08	6-Nov-08
Receipt of EAROD APPROVAL	0d		6-Nov-08
DOE Obtain Signature on EAROD	30d	7-Nov-08	6-Dec-08
EPA Obtain Signature on EAROD	30d	7-Dec-08	5-Jan-09
SCDHEC Obtain Signature on EAROD	30d	6-Jan-09	4-Feb-09
EAROD Prepare for Public Notice	14d	5-Feb-09	25-Feb-09
Issue EAROD	0d		25-Feb-09
DETAILED ENGINEERING & PRECONSTRUCTION ACTIVITIE	197d	7-Jun-08	5-Jun-09
Early Action CMI/RAIP/LUCIP	197d	7-Jun-08	5-Jun-09
Develop Early Action CMI/RAIP/LUCIP Rev. 0	182d	7-Jun-08	5-Dec-08
Submit Rev. 0 Early Action CMI/RAIP/LUCIP	0d		8-Dec-08
EPA/SCDHEC review Rev. 0 Early Action CMI/RAIP/LUCIP	90d	8-Dec-08	8-Mar-09
Incorporate EPA/SCDHEC Early Action CMI/RAIP/LUCIP Comments	60d	7-Mar-09	6-May-09
EPA/SCDHEC return Rev. 0 Early Action CMI/RAIP/LUCIP Comments	0d		8-Mar-09
Submit Redline Rev.1 Early Action CMI/RAIP/LUCIP	0d		6-May-09
EPA/SCDHEC Final Rev/Approval Early Action CMI/RAIP/LUCIP	30d	6-May-09	5-Jun-09
CONSTRUCTION	0d	2-Dec-09	2-Dec-09
P Area Remedial Action	0d	2-Dec-09	2-Dec-09
Early Action Remedial Action Start	0d	2-Dec-09	



Primary Baseline
◆ Milestone

SOIL AND GROUNDWATER CLOSURE PROJECTS

Page 1 of 1

P-AREA OPERABLE UNIT

RCRA/CERCLA Implementation Schedule

Date	Revision	Che...	Approved

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