008625

United States Department of Energy

Savannah River Site

Proposed Plan for the R-Area Bingham Pump Outage Pits (643-8G, -9G, -10G) and R-Area Unknown Pits #1, #2, #3 (RUNK-1, -2, -3) (U)

WSRC-RP-2001-4128

Revision 0

December 2001

Prepared by:
Westinghouse Savannah River Company LLC
Savannah River Site
Aiken, SC 29808

SRS

Prepared for the U.S. Department of Energy under Contract No. DE-AC09-96-SR18500

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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CM RCOCs	contaminant migration refined constituents of concern
CPT	cone penetrometer technology
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
GPR	ground penetrating radar
GRA	general response action
LLC	Limited Liability Company
LUCs	land use controls
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Contingency Plan
O&M	operation and maintenance
OU	operable unit
PAHs	polycyclic aromatic hydrocarbons
pCi/g	picoCuries per gram
PP	Proposed Plan
ppmV	parts per million by volume
PTSM	principal threat source material
RAO	remedial action objective
RBC	risk-based concentration
RCOCs	refined constituents of concern
RGs	remedial goals
RGOs	remedial goal options
RI	Remedial Investigation
ROD	Record of Decision
R BPOPs	R-Area Bingham Pump Outage Pits
RUNKs	R-Area Unknowns
SCDHEC	South Carolina Department of Health and Environmental Control
SRS	Savannah River Site
TBC	to-be-considered
ug/kg	micrograms per kilogram
USC	United States Code
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
WSRC	Westinghouse Savannah River Company

(This page intentionally left blank)

I. INTRODUCTION AND BACKGROUND

Introduction

This Proposed Plan (PP) is being issued by the United States Department of Energy (USDOE), which functions as the lead agency for Savannah River Site (SRS) remedial activities, with concurrence by the United States Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC). The purpose of this PP is to describe the preferred remedial alternative for the R-Area Bingham Pump Outage Pits (R BPOPs) and the R-Area Unknowns (RUNKs) operable unit (OU) and to provide for public involvement in the decision-making process. The R BPOPs and RUNKs OU is located at the SRS in Barnwell County, South Carolina (Figure 1).

On December 21, 1989, SRS was included on the National Priorities List (NPL). In accordance with Section 120 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 United States Code (USC) Section 9620, USDOE has negotiated a Federal Facility Agreement (FFA) (FFA 1993). The FFA lists the R BPOPs and RUNKs OU as a CERCLA unit requiring further evaluation using the CERCLA Remedial Investigation (RI) process. The CERCLA RI process is used to determine the actual or potential impact to human health and the environment of releases of hazardous substances to the environment.

CERCLA requires that the public be given an opportunity to review and comment on proposed remedial alternatives. Public participation requirements are listed in Sections 113 and 117 of CERCLA, 42 USC Sections 9613 and 9617. These requirements include establishment of an Administrative Record File that documents the investigation and selection of remedial alternatives and allows for review and comment by the public regarding those alternatives (see Section II). The Administrative Record File must be established at or near the facility at issue. The SRS Public Involvement Plan (USDOE 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. Section 117(a) of CERCLA, as amended, requires the advertisement of any proposed remedial action and to provide the public an opportunity to participate in the selection of the remedial action.

Community involvement in consideration of this evaluation for the R BPOPs and RUNKs OU alternatives is strongly encouraged. All submitted comments will be reviewed and considered. Following the public comment period, a Responsiveness Summary will be prepared to address issues raised during the public comment period. The Responsiveness Summary will be made available with the Record of Decision (ROD).

The final remedial decision will be made only after the public comment period has ended and all the comments have been received and considered. Selection of the remedial alternative that will satisfy the FFA requirements will be made by USDOE, in consultation with USEPA and SCDHEC. It is

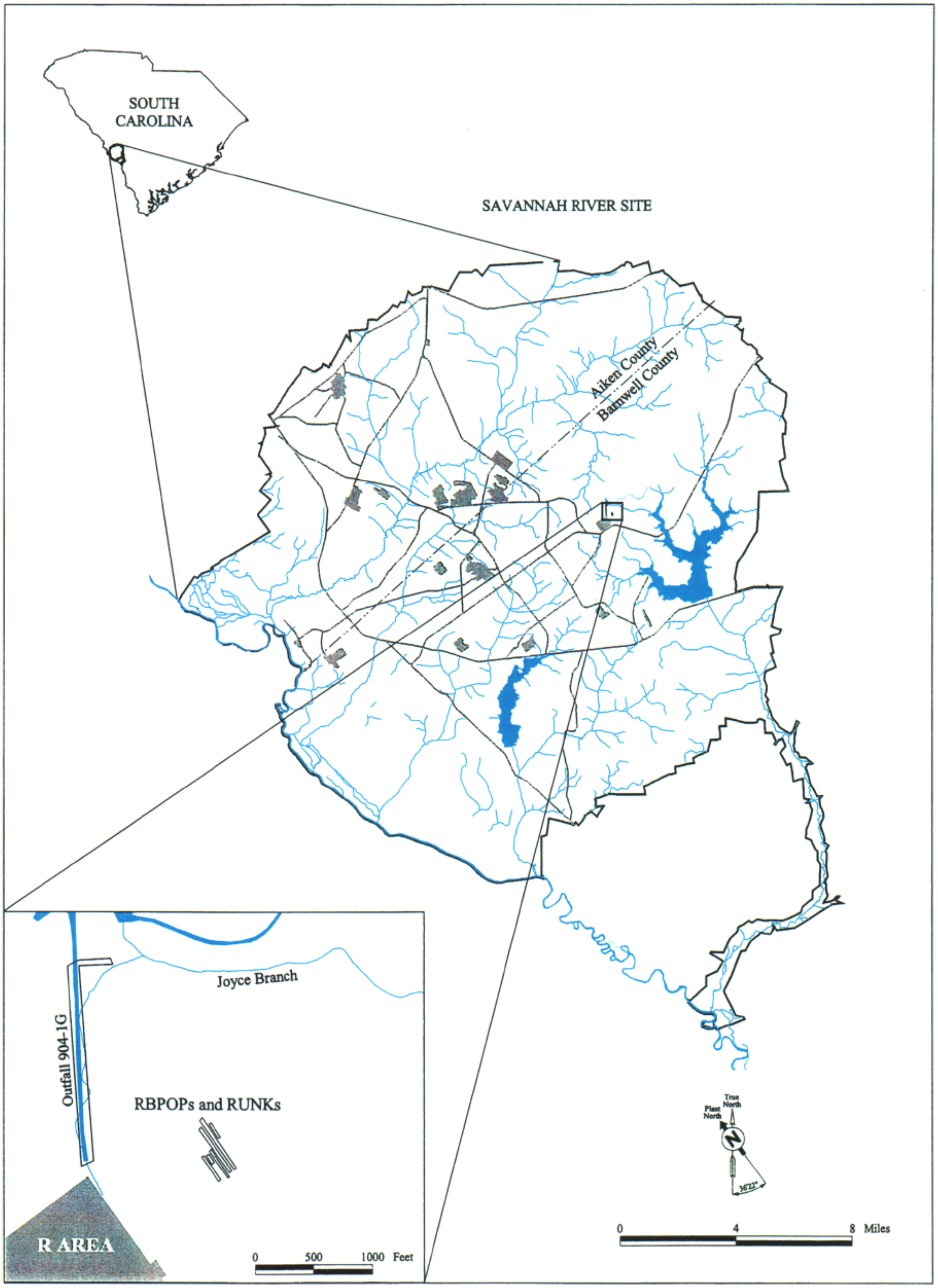


Figure 1. Location of R BPOPs and RUNKs OU at SRS

important to note that the final action(s) may be different from the preferred alternative discussed in this plan depending on new information or public comments. The alternative chosen will be protective of human health and the environment as well as comply with all federal and state laws.

Background

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

SRS is owned by the USDOE. Management and operating services are provided by Westinghouse Savannah River Company LLC (Limited Liability Company) (WSRC). SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are byproducts of nuclear material production processes. Hazardous substances, as defined by CERCLA, are currently present in the environment at SRS.

II. COMMUNITY PARTICIPATION

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

U.S. Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina-Aiken
171 University Parkway
Aiken, South Carolina 29802
(803) 641-3465

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

Hard copies of the PP are available at the following locations:

Reese Library
Augusta State University
2500 Walton Way
Augusta, Georgia 30910
(706) 737-1744

Asa H. Gordon Library
Savannah State University
Tompkins Road
Savannah, Georgia 31404
(912) 356-2183

The public will be notified of the public comment period through mailing 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* newspapers. The public comment period will also be announced on local radio stations.

USDOE will provide an opportunity for a public meeting during the public comment period if significant interest is expressed. The public will be notified of the date, time, and location. At the meeting, the proposed action will be discussed, and questions about the action will be answered.

To request a public meeting during the public comment period, to obtain more information concerning this document, or to submit written comments, contact one of the following:

Jim Moore
Westinghouse Savannah River Company
Public Involvement
Savannah River Site
Building 742-A
Aiken, South Carolina 29808
(800) 249-8155
jim02.moore@srs.gov

The South Carolina Department of Health and Environmental Control
Attn.: J. T. Litton, P.E., Director
Division of Waste Management
Bureau of Land and Waste Management
2600 Bull Street
Columbia, South Carolina 29201
(803) 896-4000

Following the public comment period, a ROD will be signed. The ROD will detail the remedial alternative chosen for this OU and include responses to oral and written comments received during the public comment period in the Responsiveness Summary.

III. OPERABLE UNIT BACKGROUND

The R BPOPs and RUNKs OU consists of six pits including three known pits called R BPOPs (643-8G, 643-9G, and 643-10G) and three pits with unknown or incomplete histories called RUNKs (RUNK-1, RUNK-2, and RUNK-3). Pits 643-8G and 643-9G are approximately 250 ft long, 16 ft and 20 ft wide respectively, and up to 13 ft deep. Pit 643-10G is approximately 522 ft long, 19 ft wide, and 14 ft deep. The sum of the areas for each pit is 0.9 acres; the total area of the OU, including the areas between the pits, is 1.75 acres. The OU is located on the northeast side of R Area at the SRS (Figure 1).

Operable Unit History

Historical aerial photographs indicate RUNK-2 predates the R BPOPs and was in existence as early as 1953. Construction debris has been verified in RUNK-2 based upon a magnetic survey, ground penetrating radar (GPR) surveys, and soil sampling in the pit. A historical photograph indicates that liquid wastes were also introduced into the pit but no containerized liquids were discovered during characterization. Historical photographs indicate that RUNK-2 was closed in 1956.

The R BPOPs were constructed during 1957 and 1958 when major modifications were made to primary and secondary SRS reactor cooling water systems. The outages of the cooling water systems that occurred as a result of these modifications became known as Bingham Pump Outages. Wastes generated during these outages were segregated based on levels of radioactivity. Higher activity waste was sent to the SRS Burial Ground Complex in E-Area while lower activity waste was buried in the R BPOPs. Waste disposed in the R BPOPs consisted of miscellaneous construction materials such as pipes, cables, ladders, concrete, and miscellaneous hardware. The R BPOPs were closed in the late 1950s by backfilling with approximately 4 ft of cover soil.

RUNK-1 and RUNK-3 were discovered in 1993 during a GPR survey of the area. The survey indicated that these areas had been previously disturbed but their history is unknown. Magnetic surveys of these RUNKs indicated they do not contain metallic debris, and additionally, no metallic or non-metallic debris was encountered during soil sampling. Due to the lack of any identified debris, it is possible that no debris was ever placed in these two RUNKs.

R BPOPs and RUNKs Investigations

Investigation of R BPOPs and RUNKs began in 1987 with a radiological survey of vegetation. Although no quantitative data was provided in the resulting Environmental Information Document (Pekkala et al. 1987) it is noted that radiation levels were elevated above background but "very low". In November 1991, surface soil samples were screened for beta/gamma and alpha radiations but no activity was detected above background.

In 1992 a soil-gas survey was conducted on the R BPOPs. Sample results indicated low levels of light hydrocarbons which were attributed to decaying organic matter. Additionally, tetrachloroethene was detected in pits 643-8G and 643-10G. Maximum concentrations were 0.046 parts per million by volume (ppmV) and 0.005 ppmV respectively. O-Xylene was also detected at pit 643-10G at 0.81 ppmV.

In 1993, a GPR survey was conducted to delineate the vertical boundaries of the pits. This survey was followed in 1995 by a magnetic survey which located metallic debris in the R BPOPs and RUNK-2.

Phase I pre-Work Plan characterization activities began in summer of 1996. Intra-pit soil samples (samples collected from borings advanced through the pits), background soil samples, and cone penetrometer technology (CPT) data were collected from June 26 through August 19, 1996.

Phase II sampling, designed to augment data from Phase I, included additional intra-pit soil samples, perimeter samples (samples collected from borings advanced around the edges of the pits), background samples, and installation and sampling of monitoring wells.

To refine information about groundwater flow and to determine the nature and extent of any contamination in the water table aquifer, three phases of groundwater sampling occurred in 1998 and 1999.

Operable Unit Characteristics

Geographical Characteristics and Land Use

The R BPOPs and RUNKs OU is located in the west-central portion of SRS (Figure 1). The OU is located to the northeast of R Area (Figure 1), approximately 900 ft from the reactor area perimeter fence. The area is delineated by signs and orange balls which mark the edges of the OU and identify the OU as a CERCLA unit. Figure 2 is a recent photograph of the OU.

The R BPOPs and RUNKs OU is close to, but outside of, the perimeter fence and industrial buffer zone of R-Area, one of several inactive nuclear reactor areas at SRS. The proximity of the R BPOPs and RUNKs to the heavy industrial (nuclear) area and the presence of buried debris at the unit make the OU unsuitable for residential use. The USDOE, USEPA, and SCDHEC agree that industrial land use

Figure 2. Ground-Level Photograph of R BPOPs and RUNKs OU

All six pits of the OU are located in the center of the open grassy area behind the signs. The pits were backfilled to grade in the late 1950s and are not evident at the surface.

restrictions are appropriate for the R BPOPs and RUNKs OU area. Industrial land use restrictions will include land use controls to ensure protection against unrestricted (residential) uses. Unrestricted (residential) use of this area is not anticipated.

Geological Characteristics

Soil in the immediate vicinity and overlying each pit is classified as Udorthents with friable substratum per the Unified Soil Classification System. Udorthents are well-drained soils formed in heterogeneous materials derived as spoil or refuse from excavations and construction operations.

The near surface geology comprises interbedded layers of sand, silt, and clay of the mid- to late-Tertiary Upland Unit, Tobacco Road Sand, and Dry Branch Formation. These lithologic units compose a multilayered hydraulic complex in which retarding beds are interspersed with more permeable beds.

The vadose zone is approximately 47 ft thick at the R BPOPs and RUNKs OU. The water table aquifer is the upper aquifer zone of the Upper Three Runs Aquifer and is composed of silt and clay. Regional groundwater flow in R Area is to the east.

Ecological Characteristics

The land surface at R BPOPs and RUNKs OU is gently sloping and covered by grassy vegetation. Dense vegetation and trees are located around the unit.

In 1994, a threatened, endangered, and sensitive species survey was performed. The survey included but was not limited to R BPOPs and RUNKs. A bird known as the loggerhead shrike was seen during the survey but this species generally prefers other habitats than this and it was determined that activity in this area would not have a negative impact on this species. The habitats at the OU generally do not meet the needs of most threatened, endangered, or sensitive species. No unique or sensitive ecosystems have been identified. Information about the ecology in the vicinity is documented in a Threatened, Endangered, and Sensitive Species Listing (Jarvis and Bumpus 1994).

Threatened or Affected Resources

Threatened or affected resources at the OU are limited to soils. The potential adverse impacts to the natural resources of the unit are minimal due to the small affected area, the limited potential for migration and/or receptor contact, and the generally low contaminant concentrations. If future land use were unrestricted, potential exposure to debris in the pits would need to be addressed by the selected remedy.

Principal and Low Level Threat Source Materials

No principal threat source material (PTSM) (see Glossary) is present at the R BPOPS and RUNKs OU. No highly-mobile or highly-toxic source materials have been identified. The contamination at the OU consists of low-mobility and low-toxicity material isolated by backfill with its exposure limited by land use restrictions.

IV. SCOPE AND ROLE OF OPERABLE UNIT RESPONSE ACTION

The overall strategy for addressing the OU was to (1) characterize the waste unit, delineating the nature and extent of contamination and identifying the media of concern (perform the RI); (2) perform a Baseline Risk Assessment (BRA) to evaluate media of concern and exposure pathways and to characterize potential risks and identify constituents warranting remedial action (referred to as refined constituents of concern [RCOCs]); and (3) identify and perform a final action to remediate, as needed, the identified media of concern.

The RI/BRA identified contamination warranting remedy selection in the R BPOPs and RUNKs OU (see Section V). This PP identifies the final action for these subunits.

A tetrachloroethene (PCE) plume in groundwater appears to have originated as a result of leaching from RUNK-2, and it has intermingled with trichloroethene (TCE) and tritium plumes from unrelated upgradient sources in R Area. The source of the tetrachloroethene in RUNK-2 is now depleted and is no longer contributing to the plume. USDOE, USEPA, and SCDHEC have agreed that groundwater at the OU will be evaluated separately in association with the R Area Groundwater OU. Groundwater is not addressed in the scope of this PP.

The response action proposed in this PP for the R BPOPs and RUNKs OU will not impact the response actions of other OUs at SRS.

The R BPOPs and RUNKs OU is within the Lower Three Runs watershed. Several source control and groundwater OUs within this watershed will be evaluated to determine impacts, if any, to associated streams and wetlands. SRS will manage all OUs to mitigate impact to the watershed. Upon disposition of all OUs, a final comprehensive ROD for the Lower Three Runs watershed will be pursued with additional public involvement.

No PTSM is present at the R BPOPs and RUNKs OU.

V. SUMMARY OF OU RISKS

An RI/BRA was performed to assess the risks posed by the OU to human health and the environment (WSRC 2000). The assessment included quantitative calculation of human health risks, ecological risks, and the threat posed by future leaching to groundwater. A summary of risks and hazards is presented in Table 1.

The human health risk assessment evaluated various exposure scenarios, including the current condition (the current industrial worker scenario) and hypothetical future scenarios (on-unit industrial worker and future on-unit resident scenarios).

Table 1. Summary of Risks and Hazards Surface Soil at R BPOPs and RUNKs

Known On-Unit Worker
No RCOCs

Future On-Unit Industrial Worker				
RCOC	**Ingestion**	**Inhalation**	**Dermal/External**	**Total of All Exposure Routes**
Benzo(a)pyrene	2.54×10^{-6}	----	5.24×10^{-6}	7.78×10^{-6}
Dibenzo(a,h)anthracene	----	----	1.54×10^{-6}	1.54×10^{-6}
Cesium-137	----	----	1.94×10^{-6}	1.94×10^{-6}
Cobalt-60	----	----	2.17×10^{-6}	2.17×10^{-6}
			Total Cumulative Risk	1.34×10^{-5}

Hypothetical On-Unit Resident Adult				
RCOC	**Ingestion**	**Inhalation**	**Dermal/External**	**Total of All Exposure Routes**
Benzo(a)anthracene	3.51×10^{-6}	----	2.41×10^{-6}	5.92×10^{-6}
Benzo(a)pyrene	2.27×10^{-5}	----	1.56×10^{-5}	3.84×10^{-5}
Benzo(b)fluoranthene	3.22×10^{-6}	----	2.21×10^{-6}	5.44×10^{-6}
Dibenzo(a,h)anthracene	6.70×10^{-6}	----	4.60×10^{-6}	1.13×10^{-5}
Indeno(1,2,3-c,d)pyrene	1.30×10^{-6}	----	----	1.30×10^{-6}
Cesium-137	----	----	6.35×10^{-6}	6.35×10^{-6}
Cobalt-60	----	----	7.10×10^{-6}	7.10×10^{-6}
			Total Cumulative Risk	7.58×10^{-5}

---- = not a RCOC for this pathway.
There are no ecological RCOCs or CM RCOCs for the R BPOPs and RUNKs OU.

There are no human health RCOCs under current conditions (the current industrial worker scenario). A current industrial worker is an SRS employee who works at or in the vicinity of the OU under current land use conditions. This receptor may be a researcher, environmental sampler, an employee who mows the unit, or other person who comes to the area on an infrequent or occasional basis. The fact that there are no RCOCs for this scenario indicates that the unit does not pose an unacceptable risk (greater than one additional incident of cancer per one million people, or 1×10^{-6}) to a worker who comes to the area on an infrequent basis.

It is anticipated that future conditions at the OU will be similar to current conditions. Although development is unlikely and the future use of the land is not likely to change from current use, a hypothetical on-unit industrial exposure scenario was evaluated in the RI/BRA. The hypothetical on-unit industrial exposure scenario addressed long-term risks to workers who are exposed to unit-related constituents while working within an industrial setting. The hypothetical on-unit industrial worker is an adult who works in an outdoor industrial setting that is in direct proximity to the contaminated media for the majority of his time while at his workplace. Under this scenario, human health risk calculations indicate benzo(a)pyrene, dibenzo(a,h)anthracene, cobalt-60, and cesium-137 in surface soil would pose an unacceptable risk to a future industrial worker (carcinogenic risks of up to 5.24×10^{-6} for a future industrial worker exceed the benchmark level of 1×10^{-6}).

Although residential development of the OU is unlikely, a hypothetical residential exposure scenario was evaluated for comparative purposes. The hypothetical on-unit resident exposure scenario evaluates long-term risks to individuals having unrestricted use of the unit. It assumes that residents live on-unit and are chronically exposed (both indoors and outdoors) to unit-related constituents. If future land use is unrestricted, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, cobalt-60, and cesium-137 would pose an unacceptable risk to a future on-unit resident adult (carcinogenic risks of up to 2.27×10^{-5} for a future on-unit resident exceed the benchmark level of 1×10^{-6}).

The ecological risk assessment in the RI/BRA evaluated whether contaminants at the OU would have an adverse impact on potential ecological receptors. No ecological RCOCs were identified, indicating that the unit does not pose a risk to biota.

Contaminant fate and transport analyses in the RI/BRA indicated that there are no contaminant migration (CM) RCOCs. This means no constituents are predicted to exceed the Safe Drinking Water Act maximum contaminant levels (MCLs) or risk-based concentrations (RBCs) in groundwater within 1,000 years. Leaching of contaminants in soil does not present a contaminant migration (leachability) threat to groundwater quality.

At R BPOPs and RUNKs OU, miscellaneous contaminated construction debris remains buried at depth in the unit.

The assessments in the RI/BRA conclude that no PTSM is present at the OU. However, soil at R BPOPs and RUNKs OU poses risks to human health. Hence, actual or threatened releases of hazardous substances, pollutants or contaminants from the OU, if not addressed by the Preferred Alternative or another active measure, would present a current or potential threat to public health, welfare, or the environment.

VI. REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are used as the framework for developing remedial alternatives and are formulated to achieve the overall goal of protecting human health and the environment. RAOs are based on the nature and extent of contamination, threatened resources, potential for human and environmental exposure, and the anticipated future land use (industrial for the R BPOPs and RUNKs OU).

The RAO for the R BPOPs and RUNKs OU is as follows:

- Prevent exposure of future industrial workers to benzo(a)pyrene, dibenzo(a,h)anthracene, cesium-137, and cobalt-60 at concentrations that exceed remedial goals (RGs).

In the RI/BRA, remedial goal options (RGOs) were calculated for each RCOC. RGOs are concentration goals for individual chemicals for specific medium and land use combinations. They are designed to provide conservative, long-term targets for the selection and analysis of remedial alternatives.

Human health RGOs were calculated for various land use/receptor scenarios including future industrial workers and hypothetical on-unit residents. Table 2 presents RGOs.

There were no ecological RGOs or CM RGOs calculated because no ecological RCOCs or CM RCOCs were identified for soil at R BPOPs and RUNKs OU.

Final RGs are selected from the RGOs to be protective of both human health and the environment, as well as to comply with federal and state applicable or relevant and appropriate requirements (ARARs). Table 3 is a list of ARARs.

Because of the generally conservative assumptions used in the RGO calculations, it is possible for a risk-based RG to be less than what occurs naturally in unimpacted ambient background conditions. This RG would not be technically possible to achieve. To avoid this, the RGs are compared to background benchmarks. Table 2 presents two benchmarks: the maximum result in the unit-specific background soil and the unit-specific 2X average background concentration. Comparison of the risk-based RGOs to these background benchmarks indicates that the calculated cesium-137 RGO for the future industrial worker is less than the background levels and therefore is not achievable. The clean-up goal for cesium-137 is consequently set to background (unit-specific maximum background, see Table 2).

Table 2. Remedial Goals

RCOC	Type of RCOC	Units	Frequency of Detection		Maximum Detection		RGOs		Background Benchmarks		RGs	
			Surface Soil (0-1 ft)	All Depths	Surface Soil (0-1 ft)	All Depths	Industrial 1×10^{-6}	Residential 1×10^{-6}	Unit-Specific Max. Bkgd. (all depths)	Unit-Specific 2X Avg. Bkgd. (all depths)	Value	Basis
Benzo(a)anthracene	HH_{res}	ug/kg	2/13	8/115	13,800	29,100	NA	519	ND	NA	NA	Not a RCOC for anticipated future land use
Benzo(a)pyrene	$HH_{ind,res}$	ug/kg	2/13	12/115	8,750	17,000	256	51.9	3.27	11.1	256	Carcinogenic RGO for target risk of 1×10^{-6} for the future industrial worker
Benzo(b)fluoranthene	HH_{res}	ug/kg	2/13	12/115	12,100	25,600	NA	519	6.2	10.8	NA	Not a RCOC for anticipated future land use
Dibenzo(a,h)anthracene	$HH_{ind,res}$	ug/kg	2/13	6/115	2,620	4,520	256	51.9	ND	NA	256	Carcinogenic RGO for target risk of 1×10^{-6} for the future industrial worker
Indeno(1,2,3-c,d)pyrene	HH_{res}	ug/kg	2/13	11/115	5,060	14,000	NA	519	3.06	8.38	NA	Not a RCOC for anticipated future land use
Cesium-137	$HH_{ind,res}$	pCi/g	15/22	68/186	0.47	537	0.105	0.0319	0.112	0.0492	0.112	Greater of industrial 1×10^{-6} RGO or unit-specific max. background
Cobalt-60	$HH_{ind,res}$	pCi/g	2/22	12/186	0.26	3.61	0.0224	0.00685	ND	NA	0.0224	Carcinogenic RGO for target risk of 1×10^{-6} for the future industrial worker

$HH_{ind,res}$ = Human Health COC for the industrial worker, resident
NA = not applicable – not a RCOC for industrial exposure scenario
ND = not detected
Due to radioactive decay, cesium-137 levels in surface soil will drop below RG in 63 years.
Due to radioactive decay, cobalt-60 levels in surface soil will drop below RG in 19 years.

Table 3. ARARs and TBC Criteria for the R BPOPs and RUNKs

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Remedial Alternatives Considered
Chemical-Specific				
SC R.61-107.11, Part IV, Subtitle G. Solid Waste Management: Construction, Demolition and Land-Clearing Debris Landfills, Long-Term Landfills, Closure	Applicable	Identifies regulations for closure of a debris landfill. Section 1 identifies that the closure cover must meet specifications including a two-foot-thick cover, a 1-4% slope to provide drainage, and at least a 75% vegetative ground cover. Section 6a requires a survey plat be performed and filed. Section 6b requires a deed notation.	Applicable because non-hazardous construction debris placed in landfill disposal.	No Action Institutional Controls Soil Cover
40 CFR 264, Part G, Section 116. SC R.61-79.264.116 Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal, Closure and Post-Closure, Survey Plat	Relevant & Appropriate	Mandates a survey plat indicating the location and dimensions of the waste unit. The plat must be certified by a land surveyor and filed with the local zoning authority restricting disturbance of the disposal unit.	Not Applicable because debris is not hazardous waste. Relevant & Appropriate because contamination will be left in place.	No Action Institutional Controls Soil Cover
42 USC 201, Sections 2011-2259 Atomic Energy Act	Applicable	The AEA makes the federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproducts. DOE is required to maintain control over these materials.	Applicable because pit debris is byproduct material.	No Action Institutional Controls Soil Cover
10 CFR 835 Occupational Radiation Protection	Relevant and Appropriate	Establishes radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities. Establishes monitoring requirements, posting and labeling requirements. 10 CFR 835.1001 mandates as-low-as-reasonably-achievable (ALARA) principles.	Radioactive contamination is present in surface soil and at depth.	No Action Institutional Controls Soil Cover
Action-Specific				
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards	Applicable	The concentration of particulate matter (PM_{10}) in ambient air shall not exceed 50 ug/m^3 (annual arithmetic mean) or 150 ug/m^3 (24-hour average concentration).	Dust suppression would likely be required to minimize dust emissions during construction/ remedial action.	Soil Cover
SC R.61-62.6 Fugitive Dust	Applicable	Fugitive particulate material shall be controlled.	Construction/remedial action may be required for dust suppression.	Soil Cover
SC R.72-300 Standards for Stormwater Management and Sediment Reduction	Applicable	Stormwater management and sediment control plan for land disturbances.	Construction/remedial action may require an erosion control plan.	Soil Cover
Location-Specific				
None.	--	--	--	--

TBC = to-be-considered

The RGs for the other RCOCs are set to the most restrictive human health RGO for the expected future land use (industrial).

Figure 3 shows where industrial RCOCs in surface soil in the pits exceed RGs. Areas of the R BPOPs (643-8G, 643-9G, and 643-10G) and RUNK-2 exceed RGs. RGs are not exceeded in RUNK-1 or RUNK-3. Soils around the perimeter of the pits are generally uncontaminated, though there is a single exceedance of the cesium-137 RG in one perimeter boring immediately adjacent to the northwest end of pit 643-10G. Cesium-137 in this sample exceeds its RG primarily because the calculated risk-based RGO for cesium-137 is low (below background levels) and the RG defaulted to background. Consequently, any result above the selected background value is identified as an exceedance of the RG, even if it reflects normal variability expected under natural ambient background conditions. The activity of cesium-137 in the perimeter sample is only twice that found in unit-specific background soil, and therefore the amount of unit-related contamination, if any, is minimal and not readily discernible from ambient background levels. The preferred alternative proposed in this PP is an OU-wide remedy that will address contamination within the pits and also any incidental contamination that may be present in the areas between the pits or immediately adjacent to the pits.

VII. SUMMARY OF ALTERNATIVES

Generally, before a PP is written, a Feasibility Study (FS) is prepared to identify and screen a wide range of potential remedial technologies and identify a short list of candidate alternatives to be assessed in the PP. For this OU, however, USDOE, USEPA, and SCDHEC agreed that the problem warranting action and the scope of the problem were well-defined. They also agreed that the list of likely response actions was short enough to proceed directly from the RI/BRA to the PP without the need for a full FS.

Although a FS was not prepared, throughout the RI process USDOE, USEPA, and SCDHEC have evaluated a range of possible response actions for the R BPOPs and RUNKs OU. The information regarding the development and evaluation of remedial alternatives and their cost estimates, which is generally presented in a FS report, is presented in Appendices A and B of this PP.

Because USDOE, USEPA, and SCDHEC agreed the problem warranting action and scope of the problem were well-defined, and because they agreed there is a limited range of appropriate response actions, the number of alternatives is small. Three alternatives are identified for R BPOPs and RUNKs OU. The alternatives are: (1) No Action, (2) Institutional Controls, and (3) Soil Cover with Institutional Controls. The alternatives evaluated are briefly summarized in the following paragraphs. For additional information on the development and evaluation of alternatives, refer to Appendix A of this PP.

Alternative 1: No Action. No Action would consist of no remedial activities at the OU. Institutional controls would not be implemented. The No Action alternative

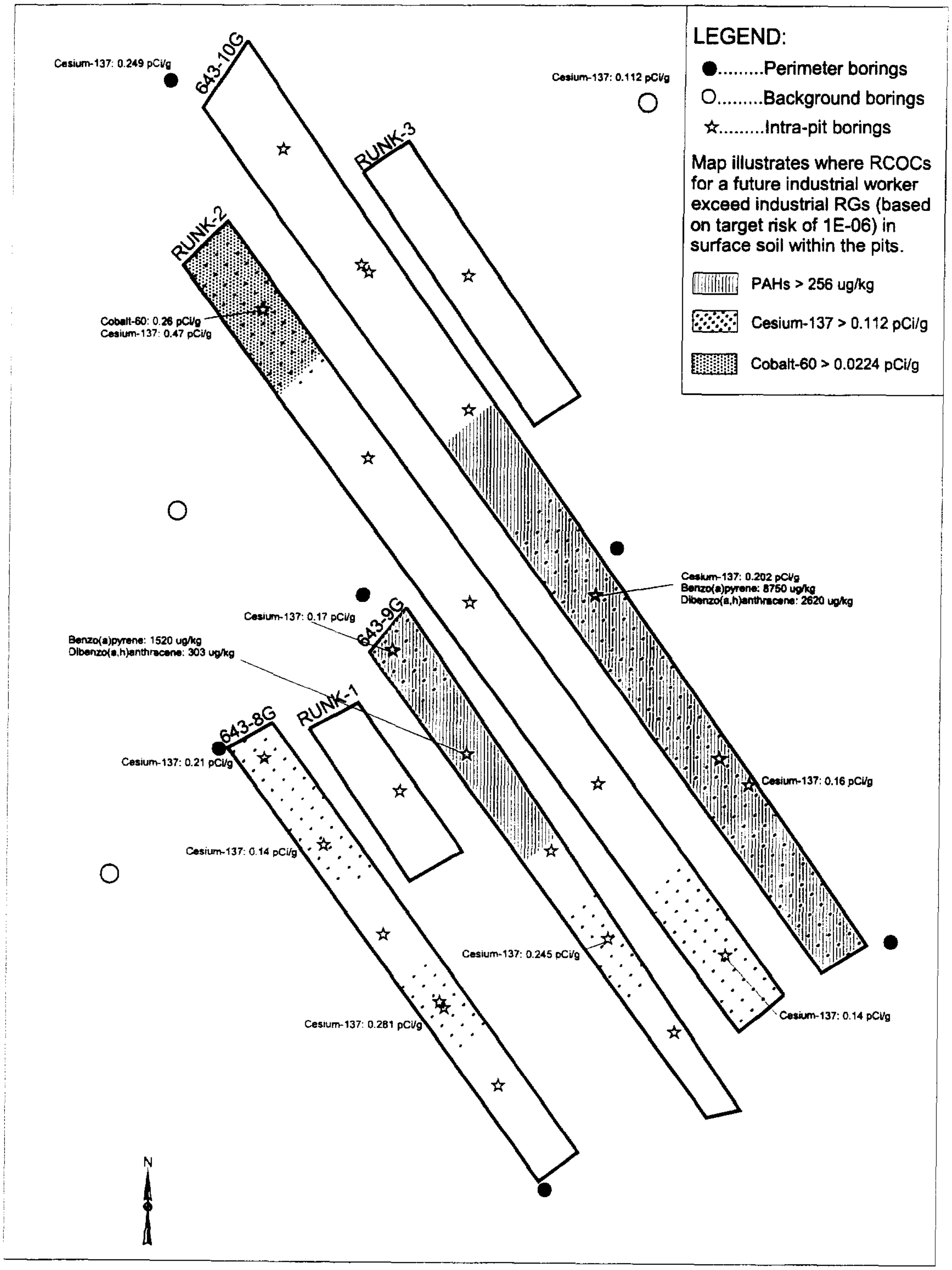


Figure 3. Industrial RCOCs in Surface Soil at R BPOPs and RUNKs OU

Cesium-137, cobalt-60, and PAHs were identified as RCOCs in surface soil for the future industrial worker. Although cesium-137 levels in surface soil are comparable to ambient background levels, the presence of higher levels buried at depth within the pits indicate this constituent is unit-related. Cobalt-60 and PAHs are elevated above RGs at only one and two locations, respectively.

is required by 40 Code of Federal Regulations (CFR) 300.430(e)(6) of the National Oil and Hazardous Substances Contingency Plan (NCP) to serve as a baseline for comparison with other remedial alternatives. The No Action alternative would not be protective of human health and the environment. There would be no reduction of risk, and exposure pathways posing unacceptable risks would remain. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Capital Cost:	$0
O&M Cost:	$32,367
Total Present Value Cost:	$32,367

For a detailed cost estimate, refer to Appendix B, Table B-1.

Alternative 2: Institutional Controls. Under this alternative, institutional controls would be implemented. Institutional controls would consist of site maintenance (inspections, repair of any erosion damage, and mowing) and access controls (posting and maintenance of warning signs, and SRS Site Use and Site Clearance Programs). Institutional controls would prevent residential use of the area and prevent unauthorized excavation. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years, as needed, to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Capital Cost:	$37,800
O&M Cost:	$75,799
Total Present Value Cost:	$113,599

For a detailed cost estimate, refer to Appendix B, Tables B-1 and B-2.

Alternative 3: Engineered Cover System with Institutional Controls. Under this alternative, a soil cover would be emplaced over the pits to provide a barrier isolating the RCOCs in surface soil from potential human contact.

Institutional controls, consisting of site maintenance (inspections, repair of any erosion damage, and mowing) and access controls (posting and maintenance of warning signs, SRS Site Use and Site Clearance Programs) would also be implemented. Institutional controls would prevent residential use of the area and prevent unauthorized excavation. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years, as needed, to determine whether the remedy is meeting RAOs. The costs for this alternative are as follows:

Capital Cost:	$966,285
O&M Cost:	$276,149
Total Present Value Cost:	$1,242,434

For a detailed cost estimate, refer to Appendix B, Tables B-1, B-2, and B-3.

VIII. EVALUATION OF ALTERNATIVES

The NCP identifies nine criteria for evaluating alternatives in a comparative analysis to support the remedy selection process. The nine evaluation criteria are identified in 40 CFR 300.430(e)(9)(iii)(A-I). The criteria were derived from the statutory requirements of CERCLA Section 121. The nine criteria are as follows:

Threshold criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs

Balancing criteria:

3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost

Modifying criteria:

8. State acceptance
9. Community acceptance

For a detailed description of the nine criteria and evaluation of the alternatives against them, refer to Appendix A. Table 4 presents a summary of this evaluation. The evaluation is also briefly summarized below.

Overall Protection of Human Health and the Environment: Institutional Controls (Alternative 2) and Soil Cover with Institutional Controls (Alternative 3) are protective because they would prevent unacceptable exposure scenarios. They would prevent unrestricted (residential) land use and would provide controls to prevent unacceptable exposure of future industrial workers to RCOCs. No Action (Alternative 1) is not protective because human health RCOCs would remain at the unit in surface soil and would pose an unacceptable risk to future industrial workers and hypothetical residents. Although there are no ecological RCOCs under current conditions and no leachability threat, if excavation were to occur, contaminants brought to the surface could pose an unacceptable risk to ecological receptors.

Compliance with ARARs: Alternatives 2 and 3 would meet all ARARs, but No Action would not. All alternatives would comply with SC R.61-107.11 Part IV Subtitle G Section 1 because the closure requirements for a debris landfill were met when the debris was covered with backfill in the late 1950s.

There is already at least 2 ft of soil over the debris, the pits are on the top of a hill so there is adequate drainage, and there is an adequate grassy vegetative cover. All three alternatives also comply with Sections 6a and 6b of that regulation, as well as SC R.61-79.264.116, because in the unlikely event that the land is ever transferred to non-federal ownership, the U.S. Government would be required by CERCLA Section 120(h) to perform a survey and place a notification on the deed. No Action would not comply with the Atomic Energy Act because DOE would not maintain control over the wastes. No Action would not comply with 10 CFR 835 because the posting requirements would not be met. Standard construction procedures to control dust and stormwater runoff would allow action-specific ARARs associated with the soil cover to be met.

Long-Term Effectiveness and Permanence: Institutional Controls and Soil Cover with Institutional Controls offer greater long-term effectiveness compared to No Action. Whereas the residual risk associated with No Action would be the same as current conditions, Institutional Controls and Soil Cover with Institutional Controls would provide controls to prevent unacceptable exposure scenarios. An assessment of permanence for No Action is not applicable because RAOs are not met and there are

Table 4. Alternative Evaluation Summary

Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Implementability	Cost (Total Present Value)
Alternative 1: No Action	Not Protective	Does not comply	Not Effective	None, other than natural decay	Not Effective	Readily Implementable	$32,367
Alternative 2: Institutional Controls	Protective	Complies	Effective	None, other than natural decay	Effective	Readily Implementable	$113,599
Alternative 3: Soil Cover with Institutional Controls	Protective	Complies	Effective	None, other than natural decay	Effective	Readily Implementable	$1,242,434

The cost for Alternative 1 is detailed in Appendix B, Table B-1.
The cost for Alternative 2 is the sum of costs presented in Appendix B, Tables B-1 and B-2.
The cost for Alternative 3 is the sum of costs presented in Appendix B, Tables B-1, B-2, and B-3.

no remedy components. Institutional Controls are generally considered permanent. Although there is some uncertainty with the ability to maintain institutional controls in the very long term, this uncertainty is mitigated by the fact that the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay.

A soil cover would not provide significantly greater long-term effectiveness and permanence compared to institutional controls alone because institutional controls provide adequate protection and a soil cover would only be effective as long as institutional controls (including cover maintenance) are being implemented. In the unlikely event that institutional controls are relinquished, maintenance of the soil cover would also cease and erosion of the soil cover could re-expose contaminated soil.

Reduction of Toxicity, Mobility, or Volume: None of the alternatives offers reduction in toxicity, mobility, or volume through treatment, however over time, PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay. Due to radioactive decay, cesium-137 levels in surface soil will drop below its RG in 63 years. Due to radioactive decay, cobalt-60 levels in surface soil will drop below its RG in 19 years.

Short-Term Effectiveness: Institutional Controls and Soil Cover with Institutional Controls offer greater short-term effectiveness compared to No Action. This is because Institutional Controls and Soil Cover with Institutional Controls both immediately prevent humans from direct contact with contaminated soil through access restrictions. A soil cover with institutional controls would not provide additional short-term effectiveness compared to institutional controls alone because institutional controls would sufficiently prevent unacceptable exposure. Isolation of RCOCs under a soil cover to prevent unacceptable exposure would be redundant. No Action does not achieve RAOs and is therefore not effective.

Implementability: All alternatives are implementable. No Action does not involve any action; therefore, it is readily implementable. Institutional Controls and Soil Cover with Institutional Controls pose no implementability restrictions.

Cost: No Action is the least expensive. Soil Cover with Institutional Controls is the most expensive.

State Acceptance: USEPA and SCDHEC have approved this PP. The regulatory agencies agree with the preferred alternative discussed under Section IX.

Community Acceptance: This PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

IX. PREFERRED ALTERNATIVE

Based upon the characterization data and risk assessments in the RI/BRA (WSRC 2000), the RAOs, and the evaluation of alternatives, the preferred alternative for the R BPOPs and RUNKs OU is Alternative 2: Institutional Controls.

Institutional Controls will consist of site maintenance and access controls. Site maintenance will consist of inspections of the OU and maintenance of drainage features to minimize the formation of large gullies. Minor earthwork will be performed as needed to repair any erosion damage that may occur. Site maintenance will also include mowing. Access controls will include security measures such as posting and maintenance of warning signs. Signs will be posted around the OU with a legend warning of the hazard. They will be posted at appropriate locations in sufficient numbers to be seen from any approach. Administrative controls (land use restrictions) will be implemented to restrict human exposure to contaminants remaining at the unit. Figure 4 is a conceptual model of the proposed remedy.

The present value costs for this remedy are as follows:

Capital Cost:	$37,800
O&M Cost:	$75,799
Total Present Value Cost:	$113,599

These costs include the cost of implementation of Institutional Controls ($81,232) and the Five-Year ROD Review Requirement ($32,367). For detailed cost estimates, refer to Appendix B, Tables B-1 and B-2.

The primary uncertainty with the preferred alternative is the ability to maintain Institutional Controls for the very long term. This uncertainty is small because the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years, respectively) and attenuate through radioactive decay. Due to radioactive decay, cesium-137 levels in surface soil will drop below its RG in 63 years. Due to radioactive decay, cobalt-60 levels in surface soil will drop below its RG in 19 years.

No wastes are expected to be generated during the implementation of the preferred remedy. Contamination at the OU is limited to soil and debris. Based upon process history and soil sampling results, the vegetation is not considered contaminated. Therefore, the trees are not considered waste material. Primary and secondary wastes will be managed in accordance with a site-specific waste management plan.

Per the USEPA – Region IV Land Use Controls (LUCs) Policy, a LUC Assurance Plan (LUCAP) for SRS has been developed and approved by the regulators. In addition, a LUC Implementation Plan (LUCIP) for the R BPOPs and RUNKs OU will be developed and submitted to the regulators for their approval with the post-ROD documentation (the Final Remediation Report). The LUCIP will detail how

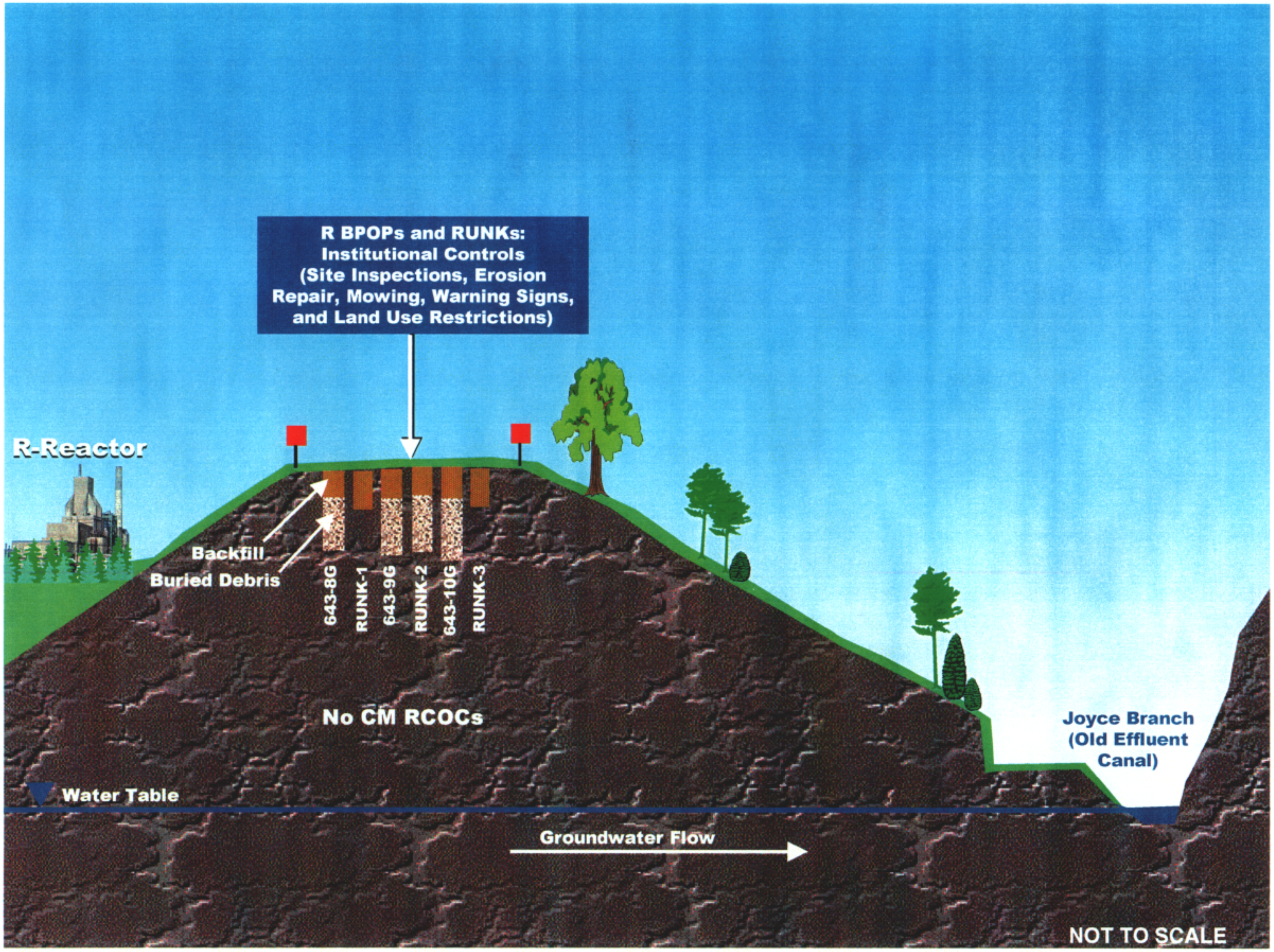


Figure 4. Conceptual Model of Proposed Remedy

SRS will implement, maintain, and monitor the land use control elements of the OU preferred alternative to ensure that the remedy remains protective of human health and the environment. The institutional controls prescribed by the preferred alternative will be implemented in accordance with Section 3.2 of the LUCAP. This includes compliance with SRS Site Use and Site Clearance Programs, which restrict invasive and permanent installation activities at the waste unit.

In the long term, if the property is ever transferred to nonfederal ownership, the U.S. Government will take those actions necessary pursuant to Section 120(h) of CERCLA. Those actions will include a deed notification disclosing former waste management and disposal activities as well as remedial actions taken on the OU. The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of waste.

The deed shall also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that exposure assumptions differ and/or the residual contamination no longer poses an unacceptable risk under residential use. Any reevaluation of the need for the deed restrictions will be done through an amended ROD with USEPA and SCDHEC review and approval.

In addition, if the site is ever transferred to nonfederal ownership, a survey plat of the OU will be prepared, certified by a professional land surveyor, and recorded with the appropriate county recording agency.

Based on information currently available, USDOE, USEPA, and SCDHEC believe the preferred alternative provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The three parties expect the preferred alternative to satisfy the statutory requirements in CERCLA Section 121(b) to (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element (treatment technologies were considered for this OU, but, given the relatively low long-term threat (40 CFR 300.430[a][iii][B]), were not as practical and cost-effective as the preferred remedy).

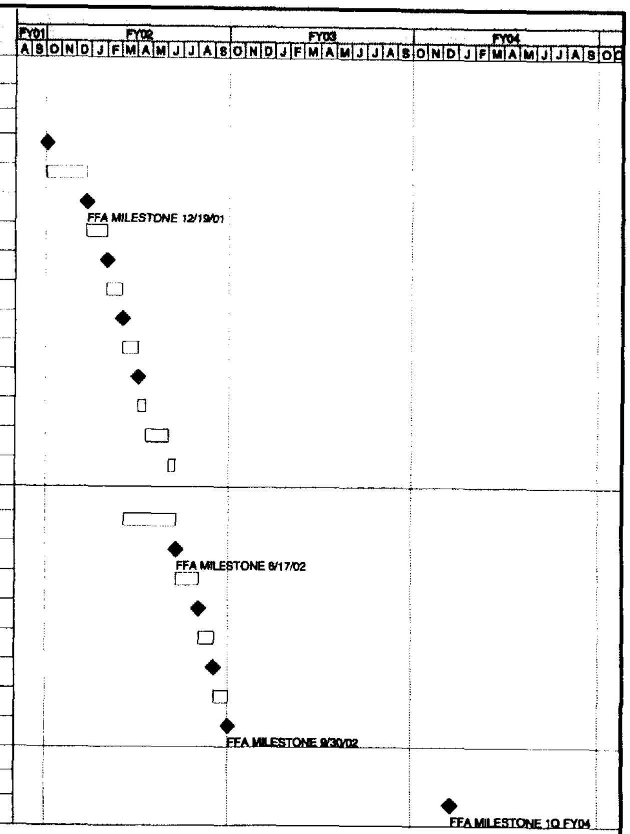
This PP provides for involvement with the community through a document review process and a public comment period. As previously discussed, public input will be documented in the Responsiveness Summary. The preferred alternative can change in response to public comment or new information. To submit written or oral comments, please refer to Section II.

X. POST-ROD SCHEDULE

Table 5 is an implementation schedule for the OU. The ROD will be drafted after receipt of, and response to, public and regulatory comments on this PP. The Revision 0 ROD is scheduled for submittal to USEPA and SCDHEC for review on June 17, 2002.

Table 5. Implementation Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish
CA 1216 BINGHAM PUMP OUTAGE PITS				
LCS 14 - STATEMENT OF BASIS/PROPOSED PLAN & ROD				
PP-PROPOSED PLAN				
BEP0390039	PROPOSED PLAN SCOPING MEETING	0		03OCT01*
BEP0390040	DEVELOP PROPOSED PLAN	53	04OCT01	19DEC01
BEP0390045	SUBMIT REV.0 PROPOSED PLAN	0		19DEC01
BEP0390050	EPA/SCDHEC REVIEW OF REV.0 PROPOSED PLAN	45	20DEC01	02FEB02
BEP0390051	EPA/SCDHEC RETURNS REV.0 COMMENTS ON PP	0		02FEB02
BEP0390055	SRS INCORPORATE EPA/SCDHEC COMMENTS PP	30	03FEB02	04MAR02
BEP0390060	SRS SUBMITTAL OF REV. 1 PROPOSED PLAN	0		04MAR02
BEP0390065	EPA/SCDHEC FINAL REVIEW AND APPROVAL PP	30	05MAR02	03APR02
BEP0390070	RECEIPT OF EPA/SCDHEC APPROVAL	0		03APR02
BEP0390075	NOTIFICATION OF PUBLIC COMMENT	14	04APR02	17APR02
BEP0390080	PUBLIC COMMENT PERIOD	45	18APR02	01JUN02
BEP0390081	RESPONSIVENESS SUMMARY	14	02JUN02	15JUN02
RECORD OF DECISION				
BEP0390103	DEVELOP ROD	70	08MAR02	17JUN02
BEP0390105	SUBMIT REV. 0 ROD	0		17JUN02
BEP0390110	EPA/SCDHEC REVIEW OF REV.0 ROD	45	18JUN02	01AUG02
BEP0390112	EPA/SCDHEC RETURNS REV.0 COMMENTS FOR ROD	0		01AUG02
BEP0390115	SRS INCORPORATES EPA/SCDHEC COMMENTS ROD	30	02AUG02	31AUG02
BEP0390120	SRS SUBMITTAL OF REV. 1 ROD	0		31AUG02
BEP0390125	EPA/SCDHEC FINAL REVIEW AND APPROVAL OF ROD	30	01SEP02	30SEP02
BEP0390130	SUBMIT FINAL SIGNED ROD	0		30SEP02
LCS 16 - REMEDIAL ACTION IMPLEMENTATION				
BEP0306160	REMEDIAL ACTION (RA) START DATE R-AREA	0	18DEC03	



Start Date	01OCT92	Early Bar	IMPL - BEPC
Finish Date	08NOV27	Progress Bar	Sheet 1 of 1
Data Date	01SEP99	Critical Activity	
Run Date	05NOV01 09:30		

Environmental Restoration
CA1216 R BROP
RCRA/CERCLA Implementation Schedule

Date	Revision	Checked	Approved
13MAR01	APPROVED IMPLEMENTATION SCHEDULE		

Installation of warning signs for access control will be the only field activity required to implement the preferred remedial alternative (i.e., institutional controls). The LUCIP, which will be appended to the Final Remediation Report, and the LUCAP will provide all requirements for institutional control (i.e., post-ROD activities for short and long-term land use control, and inspection and maintenance of the OU including descriptions of warning signs for access controls). The warning signs will be installed in accordance with the LUCAP. Because there is no design or construction activity associated with the preferred remedial alternative, no Remedial Action Implementation Plan will be necessary.

XI. REFERENCES

FFA, 1993. *Federal Facility Agreement for the Savannah River Site*, Administrative Docket No. 89-05-FF, WSRC-OS-94-42, Effective Date: August 16, 1993.

Jarvis, W. and D. Bumpus, 1994. *Threatened, Endangered, & Sensitive Species Listing: 1994 R-Area Bingham Pump Outage Pit*, United States Department of Agriculture, Savannah River Forest Station, Savannah River Site, Aiken, South Carolina (August).

Pekkala, R.O., C.E. Jewell, W.G. Holmes, and I.W. Marine, 1987. *Environmental Information Document Bingham Pump Outage Pits*, DPST-85-695, E.I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina.

USDOE, 1994. *Public Involvement, A Plan for Savannah River Site*, United States Department of Energy, Savannah River Operations Office, Aiken, South Carolina.

USDOE, 1996a. *Savannah River Site: Future Use Project Report*, Stakeholder Recommendations for SRS Land and Facilities. January 1996. Cover letter: Fiori, Mario P., "SRS Future Use Project Report (Reference: Transmittal of Final Draft "Forging the Missing Link: A Resource Document for Identifying Future Use Options," Grumbly/Pearlman letter, 1-12-94)", United States Department of Energy Letter EB-96-015, Savannah River Site, Aiken, South Carolina 29808 (January 29).

WSRC, 2000. *Remedial Investigation Report with Baseline Risk Assessment for the R-Area Bingham Pump Outage Pist and the R-Area Unknowns (U)*, WSRC-RP-98-4106, Rev. 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, South Carolina (December).

XII. GLOSSARY

Administrative Record File: A file that is maintained, and contains all information used to make a decision on the selection of a response action under the CERCLA. This file is to be available for public review, and a copy is to be established at or near the site, usually at one of the information repositories. Also, a duplicate file is held in a central location, such as a regional or state office.

All Depths Soil: The soil interval from the ground surface tot he maximum depth of sampling (45 ft below land surface at R BPOPs and RUNKs OU).

Applicable or Relevant and Appropriate Requirements (ARARs): Applicable or Relevant and Appropriate Requirements. Refers to the federal and state requirements that a selected remedy will attain. These requirements may vary from site to site.

Baseline Risk Assessment (BRA): Analysis of the potential adverse health effects (current or future) caused by hazardous substance release from a site in the absence of any actions to control or mitigate these releases.

Characterization: The gathering, identification, and compilation of data about the waste units to determine the rate and extent of contaminant migration resulting from the waste site, and the concentration of any contaminants that may be present.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 1980: A Federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act. The Acts created a special tax that goes into the Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites.

Exposure: Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, digestive tract, etc.) and available for absorption.

Federal Facility Agreement (FFA): The legally binding agreement between regulatory agencies (USEPA and SCDHEC) and regulated entities (USDOE) that sets the standards and schedules for the comprehensive remediation of the SRS.

Integrator Operable Unit (IOU): IOUs are defined as surface water bodies (e.g., SRS streams, Savannah River) and associated wetlands, including the water, sediment, and related biota. These surface water bodies are referred to as IOUs because they represent the integration of potential contamination discharged to surface water or migrating through groundwater from source OUs, Site Evaluation Areas, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure.

Media: A pathway through which contaminants are transferred. Five media by which contaminants may be transferred are groundwater, soil, surface water, sediments, and air.

National Priorities List (NPL): USEPA's formal list of the nation's most serious uncontrolled or abandoned waste sites, identified for possible long-term remedial response, as established by CERCLA.

Operable Unit (OU): A discrete action taken as one part of an overall site cleanup. The term is also used in USEPA guidance documents to refer to distinct geographic areas or media-specific units within a site. A number of OUs can be used in the course of a cleanup.

Operation and Maintenance (O&M): Activities conducted at a site after a response action occurs to ensure that the cleanup and/or systems are functioning properly.

Overall Protection of Human Health and the Environment: The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

Principal Threat Source Material (PTSM): PTSM are those materials that have a high toxicity or mobility and cannot be reliably contained or present significant risk to human health or the environment.

They include liquids (e.g., drummed wastes, waste in lagoons or tanks, or free product floating on or under groundwater) and other highly mobile materials (e.g., materials that are released from surface soil due to volatilization, leaching, or surface runoff), or materials having high concentrations of toxic compounds. A threshold concentration level for defining principal threat has not been established. However, general guidance is to consider treatment alternatives for source materials where the combined toxicity and mobility pose a potential risk of 10^{-3} or greater.

Proposed Plan (PP): A legal document that provides a brief analysis of remedial alternatives under consideration for the site and proposes the preferred alternative. It actively solicits public review and comment on all alternatives under consideration.

Record of Decision (ROD): A legal document that explains to the public which remedial cleanup alternative will be used at a site. The ROD is based on information and technical analysis generated during the RI//BRA/FS and consideration of public comments and community concerns.

Refined Constituent of Concern (RCOC): A constituent that poses an exposure risk that requires a risk management decision. Human health RCOCs have a cancer risk of at least 1×10^{-6} or a noncancer hazard of greater than or equal to 0.1. Ecological RCOCs have a hazard quotient greater than 1. CM RCOCs are predicted to leach to groundwater above MCLs within 1,000 years.

Responsiveness Summary: A summary of oral and/or written comments received during the proposed plan comment period and includes responses to those comments. The Responsiveness Summary is a key part of the ROD, highlighting community concerns.

Solid Waste: Any solid, semi-solid, liquid, or contained gaseous material discarded from industrial, commercial, mining, or agricultural operations, or from community activities. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, and other discarded materials.

Superfund: The common name used for CERCLA; also referred to as the Trust Fund. The Superfund program was established to help fund cleanup of hazardous waste sites. It also allows for legal action to force the responsible parties for the sites to clean them up.

Surface Soil: Soil that is 0 to 1 ft below land surface.

Target Risk Range: USEPA guidance for carcinogenic risk due to exposure to a known or suspected carcinogen between one excess cancer in an exposed population of ten thousand (1×10^{-4}) and one excess cancer in an exposed population of one million (1×10^{-6}). Risks within this range require risk management evaluation of remedial action alternatives to determine if risks can be reduced below one excess cancer in a million (1×10^{-6}). Risks greater than 1×10^{-4} indicate that remedial action is generally warranted.

(This page intentionally left blank)

APPENDIX A

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

(This page intentionally left blank)

A.1 RI/BRA Findings

An RI was performed to determine the nature and extent of contamination and the media of concern associated with the R BPOPs and RUNKs OU. The RI evaluated six pits (three BPOPs and three RUNKs), two seeps, and groundwater. The results of the field investigations and sampling analyses concluded that constituents warranting remediation, or RCOCs, are present in the pits. The RI/BRA determined that there is no problem warranting action for the seeps, and the stakeholders agreed to address groundwater contamination under the R-Area Groundwater OU. Consequently, the scope of this PP focuses on the six pits.

At R BPOPs and RUNKs, health risk calculations indicate benzo(a)pyrene, dibenzo(a,h)anthracene, cobalt-60 and cesium-137 would pose an unacceptable risk to a future industrial worker. For these RCOCs, carcinogenic risks of up to 5.24×10^{-6} for a future industrial worker (total cumulative risk = 1.34×10^{-5}) exceed the benchmark level of 1×10^{-6}. If future land use is unrestricted, these constituents plus benzo(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene would pose an unacceptable risk to a future on-unit resident. For these RCOCs, carcinogenic risks of up to 2.27×10^{-5} for a future on-unit resident (total cumulative risk = 7.58×10^{-5}) exceed the benchmark levels of 1×10^{-6}. Ecological risk calculations indicate that no constituents at the R BPOPs and RUNKs OU pose an unacceptable risk to ecological receptors. Contaminant fate and transport analyses indicate that leaching of contaminants in soils would not would impact groundwater at levels exceeding MCLs or RBCs within 1,000 years. Therefore, there is no contaminant migration threat warranting action.

Unit-related contamination is identified in the three BPOPs (643-8G, 643-9G, 643-10G) and in RUNK-2 (Figure 3). RCOCs for a future industrial worker include five polycyclic aromatic hydrocarbons (PAHs) (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene), cesium-137, and cobalt-60. In general, these RCOCs have a low frequency of detection, low concentrations, and/or low risk levels, however, review of all the data indicates they are probably all unit-related:

- In surface soil, the PAHs are localized to one area in 643-9G and one area in 643-10G. Although the frequency of detection is low (2 of 13 surface soil samples) and the risk levels are only slightly elevated above 1×10^{-6}, PAH concentrations in surface soil are two to three orders of magnitude higher than in unit-specific background soils (Table 2). Furthermore, higher concentrations were found at depth in the pits among the debris (Table 2), suggesting these RCOCs are unit-related.

- Cesium-137 is present in several surface soil samples in pits 643-8G, 643-9G, 643-10G, and RUNK-2 at levels somewhat above background (Table 2 and Figure 3). The presence of higher concentrations buried at depth in the unit (Table 2) suggests the cesium-137 at depth in the unit is unit-related. Because the levels in surface soil are only slightly above background and the risk level is low ($<2 \times 10^{-6}$), there is a higher degree of uncertainty that the cesium-137 in surface soil is unit-related. Due to radioactive decay, cesium-137 levels will drop below its RG in 63 years.

- Cobalt-60 has a low frequency of detection in surface soil (2 of 22 surface soil samples) and has low risk levels (2×10^{-6}), but higher concentrations at depth in the unit and its absence in background indicate it is unit-related. Due to radioactive decay, cobalt-60 levels will drop below its RG in 19 years.

A.2 Remedial Action Objectives (RAOs)

RAOs are used as the framework for developing remedial alternatives and are formulated to achieve the overall goal of protecting human health and the environment. RAOs are based on the nature and extent of contamination, threatened resources, and potential for human and environmental exposure and the anticipated future land use (industrial for R BPOPs and RUNKs OU).

The RAO for the R BPOPs and RUNKs OU is as follows:

- Prevent exposure of the future industrial worker to benzo(a)pyrene, dibenzo(a,h)anthracene, cesium-137, and cobalt-60 at concentrations that exceed RGs.

A.3 General Response Actions (GRAs)/Technologies

GRAs are those media-specific actions that will satisfy the RAOs. GRAs are identified based on review of the RAOs and remedies that have been used in the past for waste sites similar to this OU.

A.3.1 R BPOPs and RUNKs Pits

GRAs identified for R BPOPs and RUNKs pits include No Action, Institutional Controls, Containment, In-situ Treatment, and Removal/Disposal.

<u>No Action</u>. This GRA is required by 40 CFR 300.430(e)(6) to serve as a baseline for comparison with other remedial actions. No Action excludes any effort to monitor, remove, treat, or otherwise mitigate the potential spread of contamination. Contaminant reduction is achieved through natural attenuation. This response action takes no measures to reduce the potential for exposure to contaminants. The only cost associated with this response is the Five-Year Review Requirement, a ROD review every five years, to determine if RAOs are being met. The No Action response action can be readily implemented and represents the least expensive alternative possible.

<u>Institutional Controls</u>. Institutional Controls are administrative measures taken to minimize the potential for human exposure. Such controls currently limit public access to the unit (e.g., controlled site access) and warn site workers (e.g., CERCLA unit postings).

<u>Containment</u>. Containment involves construction of an engineered barrier to isolate wastes. When properly constructed and maintained, containment technologies can provide a reliable and effective method for controlling

direct exposure to waste and minimizing contaminant transport through leaching, erosion, and/or bio-uptake. Examples of technologies in this GRA include low permeability covers and containment cells.

In-situ Treatment. In-situ treatment technologies treat contaminated media in place. In-situ treatment technologies generally involve physical, chemical, and/or biological treatment processes that immobilize contaminants or reduce contaminant concentrations in soil. Relative to comparable ex-situ treatment technologies, in-situ remedial technologies have the advantages of minimal handling of contaminated media, lower capital cost, and lower remedial worker exposure. Examples of technologies in this GRA include in-situ stabilization (grouting or chemical fixation) and in-situ biological treatment.

Removal/Disposal: This GRA involves the removal of contaminated material (soil/debris) by excavation for either treatment or disposal, or both. Material is excavated using conventional earth-moving equipment (e.g., a backhoe). The extent of excavation of contaminated soil is based on the RG. Dust suppression is required to minimize fugitive dust and ensure compliance with air discharge regulations. Following removal, the waste is treated (e.g., by soil washing, chemical oxidation/reduction, or chemical extraction) and/or disposed, and the excavation is backfilled and restored.

A.4 Identification and Screening of Treatment Processes

The identified GRAs were screened using criteria derived from CERCLA Section 121. These criteria include effectiveness, implementability, and cost.

Effectiveness: For a technology to be effective it must achieve specified RAOs, be compatible with the contaminant characteristic and waste unit conditions, and be protective of public health and the environment. To accomplish this, the technology must effectively reduce or eliminate any short-term and long-term risk to human health or the environment directly associated with the waste unit, and must not adversely impact the environment, public health, or public welfare. Technologies for which unit contaminants or conditions clearly limit effectiveness or which do not provide adequate protection of the environment, public health, and public welfare are rejected and are not considered for detailed analysis. Additionally, technologies that have not demonstrated effectiveness at similar units are eliminated from further consideration.

Implementability: Implementability addresses both the technical and institutional feasibility of applying a technology. Under this criterion, technologies are evaluated based on technical feasibility, availability of resources and equipment, and administrative feasibility of implementation. The nature of the technology should be such that it can be implemented in a cost-effective and timely manner in the physical setting at the OU. In addition, implementation of the technology should not elicit substantial public concern. Site accessibility, available area, and potential future use of the property also affect the implementation of certain technologies. Mobilization and permitting requirements, where applicable, must be workable and must have been demonstrated previously at equivalent projects. Preliminary consideration is also given to regulatory constraints such as handling, disposal, and treatment requirements that affect the implementation of certain remedial technologies. These considerations are evaluated further during detailed analysis for retained technologies when action-specific ARARs are developed. Technologies that are not technically or administratively feasible are removed from further consideration.

Cost: A qualitative cost evaluation is provided so that cost comparisons can be made among technologies. Technology costs are described as being high, medium, or low, relative to technologies of similar type (e.g., process options within a GRA). Qualitative evaluations, which consider capital costs and operation and maintenance costs, are based upon prior estimates, previous experience, and engineering judgement. Technologies that provide comparable levels of applicability, effectiveness, and implementability at significantly greater cost are eliminated. Similarly, technologies that are comparable in cost but are clearly less effective than other retained technologies are also rejected.

Table A-1 summarizes the results of the identification and screening of the GRAs/treatment technologies.

A.5 Development of Alternatives

After screening, the retained GRAs are combined to develop the remediation alternatives. Because USDOE, USEPA, and SCDHEC agreed the problem warranting action and scope of the problem was well-defined, and because they agreed there are a limited range of appropriate response actions, the number of alternatives is small. Three alternatives are identified for the R BPOPs and RUNKs OU. The alternatives are briefly described below.

Alternative 1: No Action. The No Action alternative is required by NCP as a baseline for comparison with other remediation alternatives. No Action would consist of no remedial activities at the R BPOPs and RUNKs OU. Institutional controls would not be implemented. The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

Alternative 2: Institutional Controls. Institutional Controls would be implemented that would consist of site maintenance (inspections, repair of any erosion damage, and mowing) and access controls (posting and maintenance of warning signs, and SRS Site Use and Site Clearance Programs). The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

Alternative 3: Soil Cover with Institutional Controls. Under this alternative, a soil cover would be emplaced over the pits to provide a barrier isolating contaminants in surface soil from potential human contact. The soil cover would be composed of native soils from an SRS borrow pit. Topsoil would be placed and seeded to support a vegetative cover. The soil cover would be at least 1 ft thick. Because the RI/BRA determined that there is no leachability threat warranting action, the soil cover would not be designed specifically to reduce infiltration.

Institutional Controls would be implemented that would consist of site maintenance (inspections, repair of any erosion damage, and mowing) and access controls (posting and maintenance of warning signs, SRS Site Use and

Site Clearance Programs). The Five-Year Review Requirement, a CERCLA ROD review, would be conducted every five years to determine whether the remedy is meeting RAOs.

A.6 Detailed Analysis of Alternatives

A.6.1 Description of the Nine Evaluation Criteria

CERCLA provides the basis for criteria to evaluate remedial alternatives. The criteria are identified in 40 CFR 300.430(e)(9)(iii)(A-I). The nine criteria are divided into three categories: threshold, primary balancing, and primary modifying criteria.

Threshold Criteria

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

1. Overall Protection of Human Health and the Environment: Each alternative is evaluated based on how it uses engineering or institutional controls to reduce the risk of exposure to contaminants from potential exposure pathways. Each alternative is evaluated as to whether or not it provides overall protection of human health and the environment, in the short-term and long-term.

2. Compliance with ARARs: Remedial actions under CERCLA are required to attain all ARARs. Applicable requirements are defined as "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site". Relevant and appropriate requirements are defined as "those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not applicable, address problems or situations sufficiently similar to those encountered at a CERCLA site". A third category of requirements is known as to-be-considered (TBCs). TBCs are defined as "non-promulgated advisories or guidance issued by Federal or State government that are not legally binding". They may also include draft or proposed Federal or State regulations.

   There are three categories of ARARs: chemical-, action-, and location-specific. Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. Location-specific ARARs are restrictions placed on the concentration of hazardous substances for the conduct of activities solely because they occur in special locations. Table A-2 provides the chemical-, action-, and location-specific requirements and identify whether the requirement is applicable, relevant and appropriate, or TBC. The last column of the ARAR table indicates the alternative(s) to which the ARAR or TBC pertains.

Primary Balancing Criteria

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

3. Long-Term Effectiveness and Permanence: Each alternative is evaluated based on the magnitude of residual risk and the adequacy and reliability of controls used to manage remaining waste after remedial objectives have been achieved. Alternatives that offer long-term effectiveness and permanence in halting or otherwise mitigating exposure or off-unit contaminant transport, and thereby minimize the need for future engineering controls, are comparatively considered as more suitable.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment: The statutory preference is to select a remedial action that employs treatment to reduce the toxicity, mobility, or volume of hazardous substances. The degree to which alternatives employ recycling or treatment is assessed, including how treatment is used to address the principal threats posed by the unit.

5. Short-Term Effectiveness: This factor takes into account protection of remedial workers, members of the community, and the environment during implementation of the remedial action, and evaluates the time required to achieve clean-up goals. This factor also considers any adverse short-term impacts that may be posed to human health and the environment during implementation of the remedy.

6. Implementability: Each alternative is evaluated with respect to the technical and administrative feasibility of implementing the alternative, as well as the availability of necessary equipment and services. This criterion includes such items as the ability to obtain services, capabilities, equipment, and specialists necessary to construct components of the alternatives; the ability to operate the technologies and monitor their performance and effectiveness; and the ability to obtain necessary approvals from other agencies.

7. Cost: The present value costs of direct and indirect capital costs, as well as the operating and maintenance costs, are calculated for each alternative. The cost of any long-term liability associated with implementing the remedial alternative is also considered (where applicable). Accuracy of present worth cost estimates is +50/-30%.

Modifying Criteria

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

8. State Acceptance: The preferred alternative should be acceptable to State and support agencies. The agencies have conducted their review and approved this PP.

9. Community Acceptance: Community concerns are considered when selecting alternatives. This criterion cannot be fully considered until formal public comments on the PP have been received during the public comment period and addressed in a Responsiveness Summary (which is included in the ROD).

A.6.2 Individual Analysis of Alternatives

Table A-3 presents an assessment of the alternatives for the R BPOPs and RUNKs OU against the nine evaluation criteria. This assessment is discussed below.

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

Overall Protection of Human Health and the Environment: No Action is not protective of human health and the environment. Exposure to human health RCOCs remaining at the unit would not be restricted, which would pose unacceptable risks to future industrial workers and hypothetical future residents. Though there are no ecological RCOCs under current conditions and there is no leachability threat, if excavation were to occur, contaminants brought to the surface could pose an unacceptable risk to ecological receptors.

Compliance with ARARs: No Action would comply with SC R.61-107.11 Part IV Subtitle G Section 1 because the closure requirements for a debris landfill were met when the debris was covered with backfill in the late 1950s. There is already at least 2 ft of soil over the debris, the pits are on the top of a hill so there is adequate drainage, and there is an adequate grassy vegetative cover. No Action also complies with Sections 6a and 6b of that regulation, as well as SC R.61-79.264.116, because in the unlikely event that the land is ever transferred to non-federal ownership, the U.S. Government would be required by CERCLA Section 120(h) to perform a survey and place a notification on the deed. No Action would not comply with the Atomic Energy Act because DOE is required to maintain control over the wastes. No Action would not comply with 10 CFR 835 because the posting requirements would not be met.

Long-Term Effectiveness and Permanence: No Action does not offer long-term effectiveness because the magnitude of residual risks would be unacceptable. There would be no change in the residual risks compared to current conditions. Assessment of permanence is not applicable because No Action would not meet the RAO and there are no remedy components to fail.

Reduction in Toxicity, Mobility, or Volume through Treatment: No Action offers no reduction in the toxicity, mobility, or volume of contamination through treatment. However, the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, and cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay.

Short-Term Effectiveness: No Action does not provide short-term effectiveness because RAOs are not achieved.

Implementability: No Action is readily implementable because there are no remedy components to implement. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The cost for No Action is $32,367. This is the present worth cost to perform the Five-Year Review Requirement (review of the ROD) for 30 years.

<u>Alternative 2 – Institutional Controls</u>

Overall Protection of Human Health and the Environment: Institutional Controls would protect against unrestricted land use (e.g., unauthorized excavation) and would provide access controls to prevent unacceptable exposure of the future industrial worker to RCOCs.

Compliance with ARARs: Institutional Controls would meet all ARARs. It would would comply with SC R.61-107.11 Part IV Subtitle G Section 1 because the closure requirements for a debris landfill were met when the debris was covered with backfill in the late 1950s. There is already at least 2 ft of soil over the debris, the pits are on the top of a hill so there is adequate drainage, and there is an adequate grassy vegetative cover. Institutional Controls also complies with Sections 6a and 6b of that regulation, as well as SC R.61-79.264.116, because in the unlikely event that the land is ever transferred to non-federal ownership, the U.S. Government would be required by CERCLA Section 120(h) to perform a survey and place a notification on the deed. Institutional Controls would comply with the Atomic Energy Act because DOE would maintain control over the wastes. Institutional Controls would comply with 10 CFR 835 because the posting requirements would be met.

Long-Term Effectiveness and Permanence: The magnitude of residual risk is acceptable because access controls would prevent exposure of future industrial workers and hypothetical residents to RCOCs. Institutional controls are generally considered permanent. Although there is some uncertainty with the ability to maintain controls in the very long term, this uncertainty is mitigated by the fact that the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay.

Reduction in Toxicity, Mobility, or Volume through Treatment: Institutional Controls offers no reduction through treatment. However, the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay.

Short-Term Effectiveness: Institutional Controls would immediately prevent (upon implementation) humans from direct contact with contaminated surface soil.

Implementability: Institutional Controls is readily implementable. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The present worth cost for Institutional Controls is $113,599. This is the cost to implement the controls ($81,232) and to perform the Five-Year Review Requirement (review of the ROD) for 30 years ($32,367).

<u>Alternative 3 – Soil Cover with Institutional Controls</u>

Overall Protection of Human Health and the Environment: Soil Cover with Institutional Controls would be protective of human health and the environment. Institutional controls would protect against unrestricted land use (e.g., unauthorized excavation) and would provide access controls to prevent unacceptable exposure of the future industrial worker to RCOCs. The soil cover would further isolate RCOCs in surface soil from exposure to humans by burying surface contamination.

Compliance with ARARs: Soil Cover with Institutional Controls would meet all ARARs. It would would comply with SC R.61-107.11 Part IV Subtitle G Section 1 because the closure requirements for a debris landfill were met when the debris was covered with backfill in the late 1950s. There is already at least 2 ft of soil over the debris, the pits are on the top of a hill so there is adequate drainage, and there is an adequate grassy vegetative cover. Soil Cover with Institutional Controls also complies with Sections 6a and 6b of that regulation, as well as SC R.61-79.264.116, because in the unlikely event that the land is ever transferred to non-federal ownership, the U.S. Government would be required by CERCLA Section 120(h) to perform a survey and place a notification on the deed. Soil Cover with Institutional Controls would comply with the Atomic Energy Act because DOE would maintain control over the wastes. Soil Cover with Institutional Controls would comply with 10 CFR 835 because the posting requirements would be met. Measures to control dust and stormwater runoff would be implemented to comply with action-specific ARARs.

Long-Term Effectiveness and Permanence: The magnitude of residual risk is acceptable because access controls would prevent exposure of future industrial workers and hypothetical residents to RCOCs. Institutional controls are generally considered permanent. Although there is some uncertainty with the ability to maintain controls in the very long term, this uncertainty is mitigated by the fact that the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay. The soil cover would effectively reduce exposure to underlying contaminants as long as the soil cover is maintained (i.e., erosion is controlled and erosion damage is repaired).

Reduction in Toxicity, Mobility, or Volume through Treatment: Soil Cover with Institutional Controls offers no reduction through treatment. However, the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay. In the short-term, reduction is achieved by preventing exposure through access controls and by isolating contaminants under the soil cover. Because the RI/BRA determined that there is no leachability threat warranting action, the soil cover would not be designed specifically to reduce infiltration. However, some reduction in infiltration and contaminant mobility would be realized with the soil cover.

Short-Term Effectiveness: Soil Cover with Institutional Controls would immediately prevent (upon implementation) humans from direct contact with contaminated surface soil.

Implementability: Soil Cover with Institutional Controls is readily implementable. A soil cover would require periodic inspection and routine maintenance such as erosion repair, but there are no implementability restrictions. The Five-Year Review Requirement (review of the ROD) is a standard administrative procedure.

Cost: The present worth cost for Soil Cover with Institutional Controls is $1,242,434. This is the cost to build and maintain the soil cover ($1,128,835), implement institutional controls ($81,232), and perform the Five-Year Review Requirement (review of the ROD) for 30 years ($32,367).

A.6.3 Comparative Analysis of Alternatives

In this section, the alternatives are evaluated against each other in context of the nine evaluation criteria.

A.6.3.1 <u>R BPOPs and RUNKs Pits</u>

<u>Overall Protection of Human Health and the Environment</u>: Institutional Controls (Alternative 2) and Soil Cover with Institutional Controls (Alternative 3) are protective because these alternatives would prevent unacceptable exposure scenarios. They would prevent unrestricted (residential) land use and would provide controls to prevent unacceptable exposure of future industrial workers to RCOCs. No Action (Alternative 1) is not protective because human health RCOCs would remain at the unit in surface soil and would pose an unacceptable risk to future industrial workers and hypothetical residents. Although there are no ecological RCOCs under current conditions and no leachability threat, if excavation were to occur, contaminants brought to the surface could pose an unacceptable risk to ecological receptors.

Compliance with ARARs: Institutional Controls and Soil Cover with Institutional Controls would meet all ARARs, but No Action would not. No Action would not comply with the Atomic Energy Act because DOE would not maintain control over the wastes. No Action would not comply with 10 CFR 835 because the posting requirements would not be met. Standard construction procedures to control dust and stormwater runoff would allow action-specific ARARs associated with the soil cover to be met.

Long-Term Effectiveness and Permanence: Institutional Controls and Soil Cover with Institutional Controls both offer greater long-term effectiveness compared to No Action. Whereas the residual risk associated with No Action would be the same as current conditions, institutional controls would provide controls to prevent unacceptable exposure scenarios. An assessment of permanence for No Action is not applicable because RAOs are not met and there are no remedy components. Institutional controls are generally considered permanent. Although there is some uncertainty with the ability to maintain institutional controls in the very long term, this uncertainty is mitigated by the fact that the types of contaminants at this OU are not persistent in the environment in the long term. PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years respectively) and attenuate through radioactive decay. A soil cover would not provide significantly greater long-term effectiveness and permanence compared to institutional controls alone because institutional controls provide adequate protection and a soil cover would only be effective as long as institutional controls (including cover maintenance) are being implemented. In the unlikely event that institutional controls are relinquished, maintenance of the soil cover would also cease and erosion of the soil cover could re-expose contaminated soil.

Reduction of Toxicity, Mobility, or Volume: None of the alternatives offers reduction in toxicity, mobility, or volume through treatment, however over time, PAHs attenuate through natural processes such as biodegradation and volatilization, while cesium-137 and cobalt-60 have relatively short half-lives (30 and 5.2 years, respectively) and attenuate through radioactive decay. Because the RI/BRA determined that there is no leachability threat warranting action, the soil cover would not be designed specifically to reduce infiltration. However, some reduction in infiltration and contaminant mobility would be realized with the soil cover.

Short-Term Effectiveness: Institutional Controls and Soil Cover with Institutional Controls both offer greater short-term effectiveness compared to No Action. This is because Institutional Controls and Soil Cover with Institutional Controls both immediately prevent humans from direct contact with contaminated soil through access restrictions. A soil cover with institutional controls would not provide additional short-term effectiveness compared to institutional controls alone because institutional controls would sufficiently prevent unacceptable exposure. Isolation of RCOCs under a soil cover to prevent unacceptable exposure would be redundant. No Action does not achieve RAOs and is therefore not effective.

Implementability: All three alternatives are implementable. No Action does not involve any action; therefore, it is readily implementable. Institutional Controls poses no implementability restrictions. Soil Cover with Institutional

Controls is implementable but installation of the soil cover would increase the time needed to implement a remedy and routine maintenance to repair erosion and subsidence would be needed.

Cost: No Action is the least alternative. Soil Cover with Institutional Controls is the most expensive alternative.

State Acceptance: USEPA and SCDHEC have approved this PP. The regulatory agencies agree with the proposed remedy.

Community Acceptance: This PP provides for community involvement through a document review process and a public comment period. Public input will be documented in the Responsiveness Summary section of the ROD.

Table A-1. Screening of GRAs/Technologies Using NCP Criteria

GRA/Technology	Effectiveness	Implementability	Cost	Status	Rationale
R BPOPs and RUNKs					
No Action	Does not meet RAO	High	Low	Retained	Required as a baseline by the NCP.
Institutional Controls	Mitigates exposure to humans through access controls	High	Low	Retained	Meets RAO, implementable, and low cost.
Containment	Mitigate exposure to humans by covering contamination	High	Moderate	Retained	Meets RAO, implementable, and moderate cost.
In-situ Treatment	Effective in reducing receptor contact	Low	High	Eliminated	Implementability restricted by debris. High cost but still would require long-term care of the waste.
Removal/Disposal	Effective through removal of contaminants from unit	Moderate	High	Eliminated	Presents high costs and unnecessary risks to remedial workers.

Table A-2. ARARs and TBC Criteria for the R BPOPs and RUNKs

Citation(s)	Status	Requirement Summary	Reason for Inclusion	Remedial Alternatives Considered
Chemical-Specific				
SC R.61-107.11, Part IV, Subtitle G. Solid Waste Management: Construction, Demolition and Land-Clearing Debris Landfills, Long-Term Landfills, Closure	Applicable	Identifies regulations for closure of a debris landfill. Section 1 identifies that the closure cover must meet specifications including a two-foot-thick cover, a 1-4% slope to provide drainage, and at least a 75% vegetative ground cover. Section 6a requires a survey plat be performed and filed. Section 6b requires a deed notation.	Applicable because non-hazardous construction debris placed in landfill disposal.	No Action Institutional Controls Soil Cover
40 CFR 264, Part G, Section 116. SC R.61-79.264.116 Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal, Closure and Post-Closure, Survey Plat	Relevant & Appropriate	Mandates a survey plat indicating the location and dimensions of the waste unit. The plat must be certified by a land surveyor and filed with the local zoning authority restricting disturbance of the disposal unit.	Not Applicable because debris is not hazardous waste. Relevant & Appropriate because contamination will be left in place.	No Action Institutional Controls Soil Cover
42 USC 201, Sections 2011-2259 Atomic Energy Act	Applicable	The AEA makes the federal government responsible for regulatory control of the production, possession, and use of three types of radioactive material: source, special nuclear, and byproducts. DOE is required to maintain control over these materials.	Applicable because pit debris is byproduct material.	No Action Institutional Controls Soil Cover
10 CFR 835 Occupational Radiation Protection	Relevant and Appropriate	Establishes radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities. Establishes monitoring requirements, posting and labeling requirements. 10 CFR 835.1001 mandates as-low-as-reasonably-achievable (ALARA) principles.	Radioactive contamination is present in surface soil and at depth.	No Action Institutional Controls Soil Cover
Action-Specific				
40 CFR 50.6 National Primary and Secondary Ambient Air Quality Standards	Applicable	The concentration of particulate matter (PM_{10}) in ambient air shall not exceed 50 ug/m^3 (annual arithmetic mean) or 150 ug/m^3 (24-hour average concentration).	Dust suppression would likely be required to minimize dust emissions during construction/ remedial action.	Soil Cover
SC R.61-62.6 Fugitive Dust	Applicable	Fugitive particulate material shall be controlled.	Construction/remedial action may be required for dust suppression.	Soil Cover
SC R.72-300 Standards for Stormwater Management and Sediment Reduction	Applicable	Stormwater management and sediment control plan for land disturbances.	Construction/remedial action may require an erosion control plan.	Soil Cover
Location-Specific				
None.	--	--	--	--

Table A-3. Comparative Analysis of Alternatives – R BPOPs and RUNKs OU

EVALUATION CRITERIA	Alternative 1 **No Action**	Alternative 2 **Institutional Controls**	Alternative 3 **Soil Cover with Institutional Controls**
Overall Protection of Human Health and the Environment			
Human Health	Not Protective. Human health RCOCs remaining at unit would pose an unacceptable risk to future industrial workers and hypothetical future residents.	Protective. Institutional controls would protect against unrestricted land use (e.g., unauthorized excavation) and would provide access controls to prevent unacceptable exposure of future industrial workers to RCOCs.	Protective. Institutional controls would protect against unrestricted land use (e.g., unauthorized excavation) and would provide access controls to prevent unacceptable exposure of future industrial workers to RCOCs.
Environment	Not Protective. Although there are no ecological RCOCs under current conditions, future excavation could bring contaminants to the surface and pose an unacceptable risk to ecological receptors.	Protective. Periodic inspections and maintenance included in institutional controls will control erosion of soils and the spread of contamination.	Protective. Periodic inspections and maintenance included in institutional controls will control erosion of soils and the spread of contamination.
Compliance with ARARs			
Chemical-Specific	Does not comply.	Complies.	Complies.
Action-Specific	None.	None.	Complies.
Location-Specific	None.	None.	None.
Long-Term Effectiveness andPermanence			
Magnitude of Residual Risks	High.	Low. Institutional controls would prevent unacceptable exposure.	Low. Institutional controls would prevent unacceptable exposure. Soil cover does not significantly reduce residual risks because the action would be redundant to institutional controls. Institutional controls provide adequate risk reduction, and a soil cover would only be effective as long as maintenance (erosion control) associated with institutional controls is implemented.
Permanence	NA. Does not meet RAOs, and there are no remedy components.	High. Land use controls are considered permanent.	High. Land use controls are considered permanent. Soil cover does not add significantly greater permanence. Permanence of soil cover dependant on permanence of maintenance (erosion control) associated with institutional controls.

Table A-3. Comparative Analysis of Alternatives – R BPOPs and RUNKs OU (Continued)

EVALUATION CRITERIA	Alternative 1 No Action	Alternative 2 Institutional Controls	Alternative 3 Soil Cover with Institutional Controls
Reduction in Toxicity, Mobility, or Volume Through Treatment			
Degree of Expected Reduction in Toxicity	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes.
Degree of Expected Reduction in Mobility	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes. Because the RI/BRA determined that there is no leachability threat warranting action, the soil cover would not be specifically designed to reduce infiltration. However, some reduction in infiltration and contaminant mobility would be realized by the soil cover.
Degree of Expected Reduction in Volume	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes.	None through treatment, but reduction occurs through natural processes.
Short-Term Effectiveness			
Risk to Workers	No risk because unit does not pose an exposure threat to current workers and there are no construction activities that would result in worker exposure.	No risk because unit does not pose an exposure threat to current workers and there are no construction activities that would result in worker exposure.	No risk because unit does not pose an exposure threat to current workers. Minor safety risk associated with construction activities (heavy equipment use).
Risk to Community	No exposure concerns; unit is located several miles from the nearest SRS boundary.	No exposure concerns; unit is located several miles from the nearest SRS boundary.	No exposure concerns; unit is located several miles from the nearest SRS boundary. No increase in off-SRS traffic.
Time until Protection is Achieved	Protection not achieved.	3-6 months after ROD is approved (time required to install signs and implement procedures).	12-18 months after ROD is approved (time required to design and install cover, signs and implement procedures).
Implementability			
Availability of Materials, Equipment, Contractors	No materials, equipment, or contractors required.	Materials such as signs easily obtained.	Materials and equipment are easily obtained. Qualified contractors readily available.
Administrative Feasibility/Regulatory Requirements	None.	Implementable.	Implementable.
Technical Feasibility	Implementable. There are no remedy components to implement.	Implementable.	Implementable.
Monitoring Considerations	None.	Periodic inspection for erosion and unauthorized access will be required. Periodic erosion repair.	Periodic inspection for erosion and unauthorized access will be required. Periodic erosion repair.

Table A-3. Comparative Analysis of Alternatives – R BPOPs and RUNKs OU (Continued)

EVALUATION CRITERIA	Alternative 1 **No Action**	Alternative 2 **Institutional Controls**	Alternative 3 **Soil Cover with Institutional Controls**
Cost			
Total Present Value Cost	Five-Year Review Requirement: $32,367 Total = $32,367	Institutional Controls: $81,232 Five-Year Review Requirement: $32,367 Total = $113,599	Soil Cover $1,128,835 Institutional Controls: $81,232 Five-Year Review Requirement: $32,367 Total = $1,242,434

(This page intentionally left blank)

APPENDIX B

COST ESTIMATES

(This page intentionally left blank)

Table B-1. Cost Estimate for Five-Year Review Requirement (CERCLA ROD Reviews)

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					$0
Total Direct Capital Costs					$0
Indirect Capital Costs					
Engineering and design					$0
Project/construction management					$0
Health and safety					$0
Overhead & markups					$0
Contingency					$0
Total Indirect Capital Costs					$0
TOTAL ESTIMATED CAPITAL COSTS					$0
O&M Costs					
ROD Reviews (every five years for 30 years)		6	ea	$15,000	
Interest Rate (i)	0.07				
O&M Present Worth					$32,367
TOTAL ESTIMATED O&M COSTS					$32,367
TOTAL ESTIMATED COST					$32,367

O&M Present Worth = Sum [1/(1+i)^n_a] x periodic cost] where n_a are the years at which the periodic cost is incurred (5, 10, 15, 20, 25, & 30 yrs)

Table B-2. Cost Estimate for Institutional Controls

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					
Miscellaneous Control Items					
Documentation		1	ea	$10,000	$10,000
Access Restrictions					
Furnish and Install Signs		10	ea	$1,100	$11,000
Total Direct Capital Costs					$21,000
Indirect Capital Costs					
Engineering and design (10% of total direct capital cost)					$2,100
Project/construction management (25% of total direct capital cost)					$5,250
Health and safety					$0
Overhead & markups (30% of total direct capital cost)					$6,300
Contingency (15% of total direct capital cost)					$3,150
Total Indirect Capital Costs					$16,800
TOTAL ESTIMATED CAPITAL COSTS					$37,800
O&M Costs					
Inspection		1	/yr	$1,000	$1,000
Maintain Signs		1	ls/yr	$500	$500
Mowing		2	/yr	$250	$500
Repairs (erosion control, reseeding, etc.)		1	ac/yr	$1,500	$1,500
Subtotal Annual O&M Costs					$3,500
Interest Rate (i)	0.07				
Number of Years (n)	30				
Present Worth Factor = {[(1+i)^n]-1} / {i[(1+i)^n]}	12.409				
O&M Present Worth (Annual O&M x PWF)					$43,432
TOTAL ESTIMATED O&M COSTS					$43,432
TOTAL ESTIMATED COST					$81,232

Table B-3. Cost Estimate for Soil Cover

DESCRIPTION		QUANTITY	UNITS	UNIT COST	TOTAL COST
Direct Capital Costs					
Construction of Soil Cover					
Mobilization		1	ls	$37,000	$37,000
Site Survey		4	ac	$2,650	$10,600
General Sitework (clear and grub, grading, access controls)		1	ls	$75,000	$75,000
Sandy Soil Layer (borrow, delivery, installation)		4,000	cu. yd	$27.50	$110,000
Topsoil (purchase, delivery, installation)		1,300	cu. yd	$25.00	$32,500
Site Restoration (Fine Grading and Seeding)		20,000	sq. ft	$1.40	$28,000
Demobilization		1	ls	$27,000	$27,000
Post Construction		1	ls	$75,000	$75,000
Total Direct Capital Costs					$395,100
Indirect Capital Costs					
Engineering and design (55% of total direct capital cost)					$217,305
Project/construction management (20% of total direct capital cost)					$79,020
Health and safety (10% of total direct capital cost)					$39,510
Overhead & markups (30% of total direct capital cost)					$118,530
Contingency (20% of total direct capital cost)					$79,020
Total Indirect Capital Costs					$533,385
TOTAL CAPITAL COSTS					$928,485
O&M Costs					
Soil Cover repairs (10% of initial cost every 5 yrs for 30 yrs)		6	ea	$92,849	
Interest Rate (i)	0.07				
O&M Present Worth					$200,350
TOTAL ESTIMATED O&M COSTS					$200,350
TOTAL ESTIMATED COST					$1,128,835

O&M Present Worth = Sum [1/(1+i)^n_a] x periodic cost] where n_a are the years at which the periodic cost is incurred (5, 10, 15, 20, 25, & 30 yrs)

(This page intentionally left blank)