

**REVISED PROPOSED PLAN
FOR REMEDIAL ACTIONS
AT SILOS 1 AND 2**

40700-PL-0001

U.S. Department of Energy
Fernald Environmental Management Project



DRAFT, REV. B
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Prepared Under DOE Contract No. DE-AC24-92OR21972
By Fluor Daniel Fernald



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ACRONYMS & ABBREVIATIONS

ACA	Amended Consent Agreement
AEA	Atomic Energy Act
ARAR	applicable or relevant and appropriate requirement
AWWT	Advanced Wastewater Treatment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CAT	Critical Analysis Team
COC	constituent of concern
D&D	decontamination and demolition
DOE	U.S. Department of Energy
DOE-FEMP	U.S. Department of Energy-Fernald Environmental Management Project
DOE-NV	U.S. Department of Energy–Nevada
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
ESD	explanation of significant differences
FCAB	Fernald Citizens Advisory Board
FEMP	Fernald Environmental Management Project
FMPC	Feed Materials Production Center
FS	Feasibility Study
FS/PP-EIS	Feasibility Study/Proposed Plan – Environmental Impact Statement
ILCR	incremental lifetime cancer risk
IRT	Silos Project Independent Review Team
ISO	International Shipping Organization
LSA	low specific activity
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
NTS	Nevada Test Site
OEPA	Ohio Environmental Protection Agency
O&M	operations and maintenance
OSDF	On-site Disposal Facility
OU	operable unit
PEIC	Public Environmental Information Center
Po	polonium
POP	Proof of Principle
PP	Proposed Plan
PRL	preliminary remediation levels

ACRONYMS & ABBREVIATIONS

Ra	radium
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act, as amended
RCS	Radon Control System
RD/RA	remedial design/remedial action
RI	Remedial Investigation
Rn	radon
ROD	Record of Decision
RTS	Radon Treatment System
TBC	to be considered
TBD	ton per day
TCLP	Toxicity Characteristic Leaching Procedure
Th	thorium
TTA	Transfer Tank Area
U	uranium
VITPP	Vitrification Pilot Plant
WAC	waste acceptance criteria

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1.0 INTRODUCTION

2 DOE is issuing this Revised Proposed Plan for Remedial Actions at Silos 1 and 2
3 [hereinafter called the Proposed Plan (PP)] as part of its public participation responsibilities
4 under Section 117(a) of the *Comprehensive Environmental Response Compensation and*
5 *Liability Act* (CERCLA 1980), as amended, and 40 Code of Federal Regulations (CFR)
6 300.430(f)(2) of the NCP. The intent of this PP is to inform and solicit views of the public
7 on the recommended preferred treatment alternative for the Silos 1 and 2 material.

8 The purpose of the PP is to facilitate public participation in the remedy selection process
9 by:

- 10 • Recommending a preferred treatment alternative for the Silos 1 and 2
11 material and presenting the rationale for DOE's preference.
- 12 • Describing the alternatives that were considered in detail within the *Revised*
13 *Feasibility Study Report for Silos 1 and 2*.
- 14 • Soliciting public review and comment on the alternatives described in
15 **Section 6.0** of this PP and the preferred alternative recommendation
16 documented in **Section 8.0**.
- 17 • Providing information on how the public can be involved in the remedy
18 selection process.

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1 This PP addresses the reevaluation of the selected treatment remedy for the remediation of
2 the *Operable Unit 4* (OU4) Silos 1 and 2 material at the U.S. Department of Energy's
3 (DOE) Fernald Environmental Management Project (FEMP), formerly known as the Feed
4 Materials Production Center (FMPC). The FEMP site is included on the National Priorities
5 List (NPL) of the U. S. Environmental Protection Agency (EPA). Inclusion on the NPL
6 reflects the relative importance placed by the federal government on ensuring the
7 expedient completion of cleanup operations at the FEMP. DOE owns the facility and is
8 conducting cleanup activities at the site under its Environmental Restoration and Waste
9 Management Program with the support of the EPA and the Ohio Environmental Protection
10 Agency (OEPA). Together, the three agencies actively promote local community and
11 public involvement in the decision making process regarding the remediation of the FEMP
12 site.

13 In July 1997, the U.S. Department of Energy-Fernald Environmental Management Project
14 (DOE-FEMP) and the EPA formally entered an agreement resolving disputes concerning the
15 schedule and the path forward for the remediation of the OU4 Silos 1, 2 and 3 materials.
16 The EPA directed the DOE-FEMP to proceed with the development of a supplemental
17 Feasibility Study/Proposed Plan (FS/PP) and subsequent ROD amendment for the Silos 1
18 and 2 material and explanation of significant differences (ESD) for the Silo 3 material.

19 Consistent with the National Oil and Hazardous Substances Pollution Contingency Plan
20 (NCP), the DOE-FEMP prepared a revised Feasibility Study (FS¹) which developed and
21 evaluated a range of treatment alternatives for safely and effectively remediating the OU4
22 Silos 1 and 2 material. The results of the detailed and comparative analyses presented in
23 the revised FS have been used to develop the technical and regulatory basis for
24 recommending a preferred remedy for the Silos 1 and 2 material in this PP.

25

¹ *Revised Feasibility Study for Silos 1 and 2*, 1999, is available for review in the Administrative Record at the PEIC (refer to Section 9.0 of this PP).

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1 This PP summarizes key information that can be found in greater detail in the original
2 Remedial Investigation (RI) and FS Reports for OU4 (FEMP 1993a, 1994a), and the
3 *Revised Feasibility Study Report for Silos 1 and 2*. Information relevant to the remedial
4 selection process is in the Administrative Record. The Administrative Record is located at
5 the Public Environmental Information Center (PEIC), just south of the FEMP site. The
6 PEIC's address and business hours are as follows:

7
8 10995 Hamilton-Cleves Highway
9 Harrison, Ohio 45030
10 Monday, 7:30 a.m. to 8:00 p.m.
11 Tuesday – Thursday, 7:30 a.m. to 5:00 p.m.
12 Friday, 7:30 a.m. to 4:30 p.m.
13 Phone: (513) 648-7480
14

15 This PP, along with the revised FS, will become part of the Administrative Record pursuant
16 to 40 CFR Part 300.825(a)(2) and will be available at the PEIC.

17 It is DOE policy to integrate the National Environmental Protection Act of 1969 (NEPA)
18 into the procedural and documentation requirements of CERCLA wherever practicable.
19 The incorporation of NEPA values into the original OU4 FS and PP (FEMP 1994b) resulted
20 in a broader and more detailed analysis of the potential environmental impacts associated
21 with implementing the alternatives. The original OU4 FS and PP also included a broad
22 evaluation of cumulative impacts of all FEMP site remediation activities. The resulting
23 integrated process and documentation package for OU4 was termed a *Feasibility*
24 *Study/Proposed Plan – Environmental Impact Statement (FS/PP-EIS)* (FEMP 1993b).

1 Integrated CERCLA/NEPA documents (i.e., FS and PP) were then prepared for each of the
2 four ensuing operable units at the FEMP. These documents were "tiered" from the original
3 OU4 FS/PP-EIS. Tiering is a process allowed for in the NEPA regulations in which a project
4 that will be accomplished in a series of steps (e.g., remediation of the Fernald Site) can be
5 evaluated in stages. Since the OU4 FS/PP-EIS provided the OU4 NEPA evaluation and
6 resulted in a decision for OU4 only, cumulative impacts were evaluated and updated as
7 each remaining operable unit (i.e., 1, 2, 3, and 5) prepared its FS/PP documents.

8 The development of the revised FS and this PP for Silos 1 and 2 has incorporated the
9 same CERCLA/NEPA strategy successfully by integrating the RI/FS documentation
10 previously completed by all five operable units at the FEMP. This includes the original OU4
11 FS, PP, and Record of Decision (ROD) (EPA 1994). As documented in the NEPA
12 Supplement Analysis incorporated into the revised FS for Silos 1 and 2, the alternatives
13 evaluated in the revised FS were previously evaluated in the original OU4 FS. No
14 additional impacts were identified as a result of their reevaluation.

15 In accordance with both CERCLA and NEPA processes, these documents are made
16 available to the public for comment. Public involvement is an important factor in the
17 decision-making process for site remediation. Public comments will be considered in the
18 remedial selection for the Silos 1 and 2 material, which will be presented in a ROD
19 amendment. Applying the integrated approach for CERCLA and NEPA, DOE plans to
20 prepare and issue a single ROD amendment for OU4, which will be signed by both DOE
21 and EPA. The contents of the documents prepared for the remedial actions at the FEMP
22 site are not intended to represent a statement on the legal applicability of NEPA to
23 remedial actions conducted under CERCLA.

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1 The identification of the preferred alternative in the PP is only an initial recommendation.
2 Changes to the preferred alternative or selection of another alternative may result if public
3 and agency comments or additional data indicate such a change would result in a more
4 appropriate selection. Therefore, all interested individuals are encouraged to provide
5 comments on the alternatives presented in this PP (refer to **Section 6.0**). The EPA will
6 make the final decision regarding the selected remedy and will document it in a ROD
7 amendment after all comments from the public and OEPA have been taken into
8 consideration. A summary of DOE's responses to these comments (called a
9 Responsiveness Summary) will be included in the ROD amendment document and made
10 available in the Administrative Record.

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2.0 SITE BACKGROUND

This section provides a brief summary of the history of the FEMP and description of OU4. A more detailed discussion can be found in Section 1, Section 2, and Appendix F of the revised FS.

The FEMP is a 425-hectare (1,050 acre) former uranium processing facility located in southwestern Ohio approximately 18 miles northwest of the city of Cincinnati (see **Figure 2.1-1**). It is located just north of Fernald, Ohio a small farming community, and lies on the boundary between Hamilton and Butler Counties.

The FEMP site was constructed from 1950 to 1951 under the authority of the Atomic Energy Commission, eventually known as the DOE. Between 1952 and 1989, the DOE-FEMP facility (then called the *FMPC*) produced high purity uranium metal products for the nation's defense programs. Production ceased in the summer of 1989 due to a declining demand for uranium feed product; and, plant activities turned their focus to environmental cleanup. In June 1991, the site was officially closed for production by an act of Congress. To reflect a new mission focused on environmental restoration, the name of the facility was changed to the FEMP in August 1991.

Production operations at the facility were limited to a fenced 55-hectare (136-acre) tract of land, now known as the former Production Area, located near the center of the FEMP site. Large quantities of liquid and solid materials were generated during production operations. Before 1984, solid and slurried materials from uranium processing were stored or disposed in the on-property Waste Storage Area. This area, located west of the former Production Area, includes six low-level radioactive waste storage pits; two earthen-bermed, concrete silos containing a total of 8,012 yd³ of K-65 material and 878 yd³ of BentoGrout™ clay (Silos 1 and 2); one concrete silo containing 5,088 yd³ of cold metal oxides (Silo 3); one unused concrete silo (Silo 4); two lime sludge ponds; a burn pit; a clearwell; and a solid waste landfill (see **Figure 2.1-2**).

Figure 2.1-1

FEMP Facility Location Map

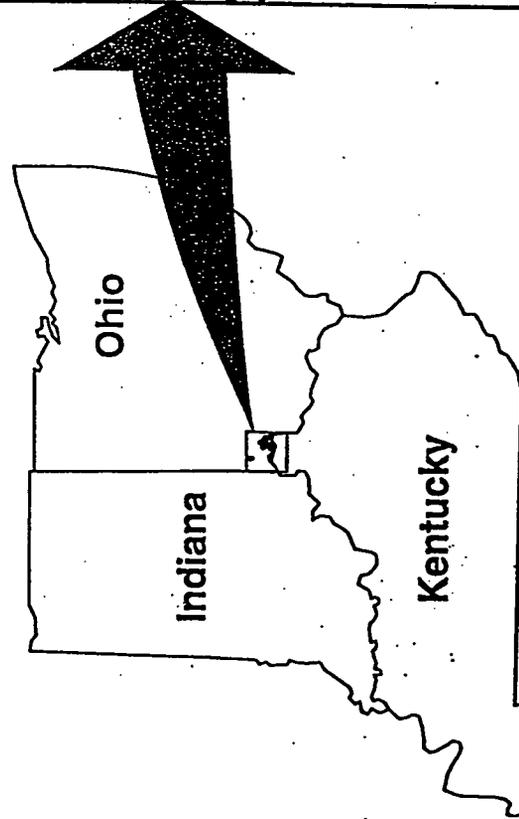
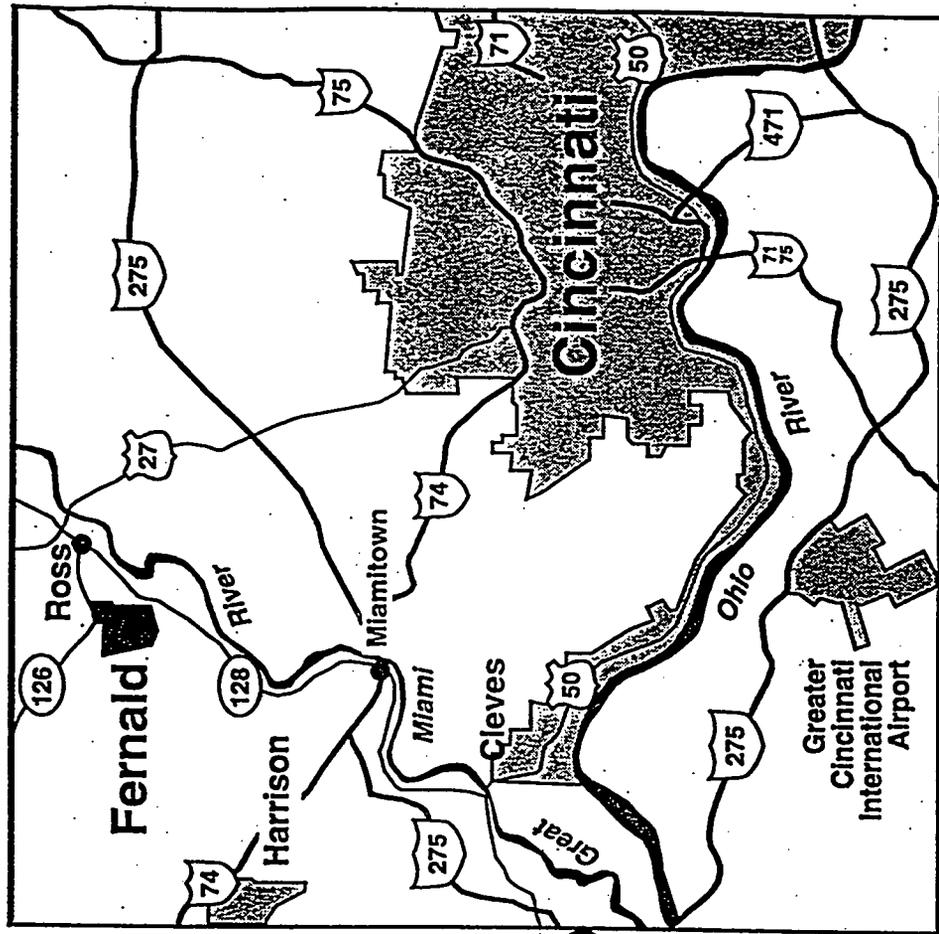
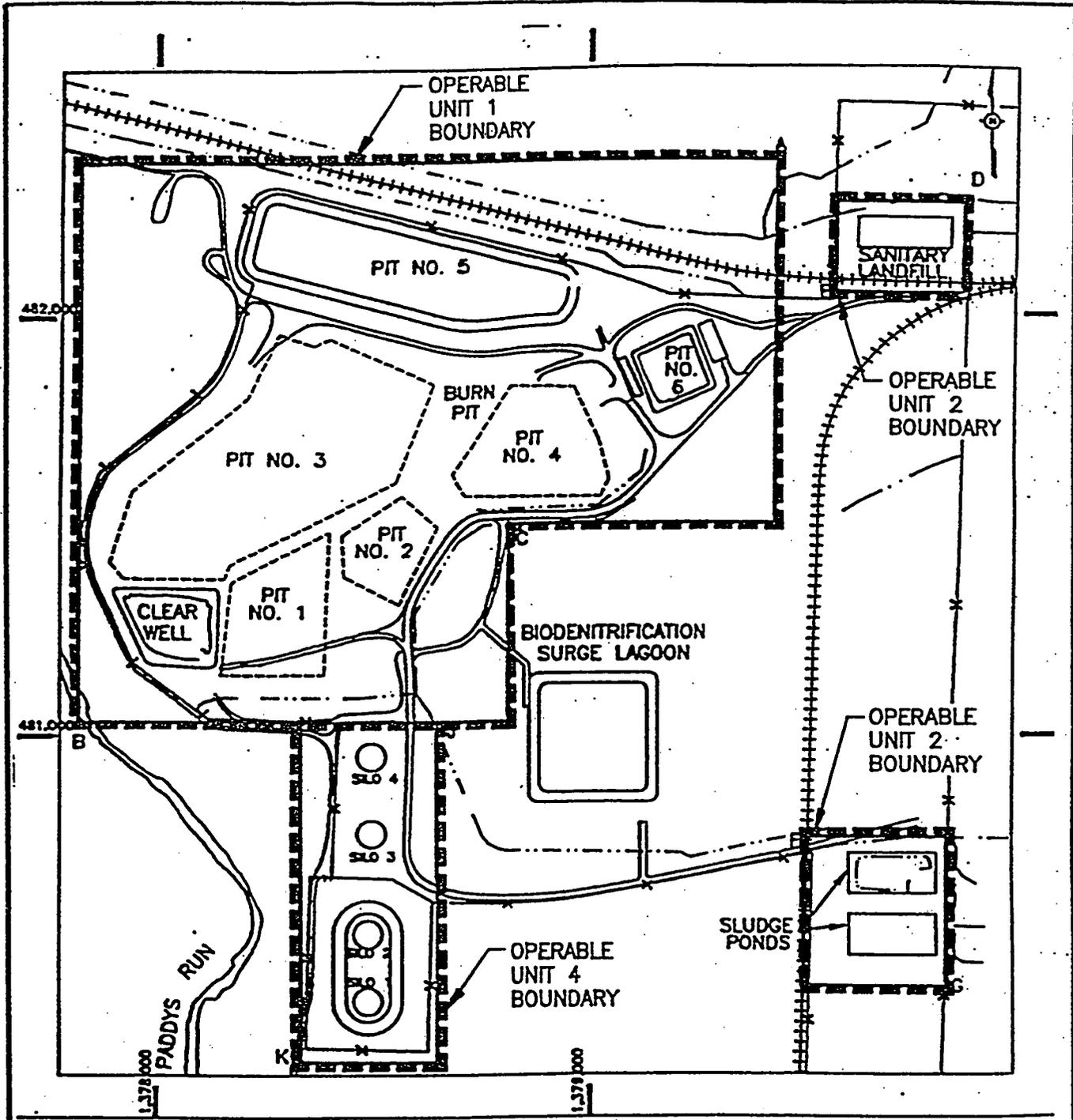


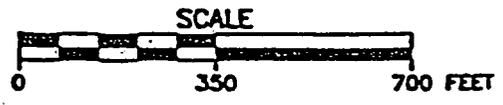
Figure 2.1-2
Waste Storage Area

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LEGEND:

- +++++ RAILROAD
- DRAINAGEWAYS
- x-x- FENCELINE
- ==== ROADWAY



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1 To establish the legal framework by which to address the releases and threats of
2 hazardous substances from containers and facilities at the FEMP, the DOE-FEMP as the
3 lead agency for the remediation of the FEMP site, and the EPA entered into a Consent
4 Agreement in 1990, as amended in 1991. The Consent Agreement as Amended Under
5 CERCLA Sections 120 and 106(a) (ACA) is the legal basis that administratively governs
6 the proper management and restoration of the FEMP site.

7 To promote a more structured and expeditious cleanup, the facility and associated
8 environmental issues of the FEMP site are being managed as five operable units (OUs).
9 An OU is a term employed under federal environmental regulation to represent a logical
10 grouping of environmental issues at a cleanup site. Separate RI/FS documentation was
11 prepared and issued for the five OUs at the FEMP. The five OUs, for which RI/FS
12 documents have been compiled, are defined within the ACA as:

- 13
- 14 • OU1: Waste Pits 1 through 6, the Clearwell, burn pit, berms, liners, and soil to a
15 determined depth (estimated to be approximately 3 feet) beneath the waste pits.
16
 - 17 • OU2: Other waste units including the flyash piles, other South Field disposal areas,
18 lime sludge ponds, solid waste landfills, berms, liners, and soil within the OU
19 boundary.
20
 - 21 • OU3: Former production area and production-associated facilities and equipment
22 (includes all above- and below-grade improvements) including, but not limited to: all
23 structures, equipment, utilities, drums, tanks, solid waste, waste product,
24 thorium (Th), effluent lines, a portion of the Silos 1 and 2 material transfer line,
25 wastewater treatment facilities, fire training facilities, scrap metal piles, feedstocks,
26 and the coal pile.
27
 - 28 • OU4: Silos 1, 2, 3, and 4, their contents, berms, and Decant Sump Tank System;
29 Radon Treatment System (RTS); a portion of concrete trench and Silos 1 and 2
30 material transfer line within the boundary of OU4; miscellaneous pads and concrete
31 structures; soils beneath and immediately surrounding Silos 1 through 4; and,
32 perched groundwater in the vicinity of the silos that may be encountered during the
33 implementation of cleanup activities.
34

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- 1 • OU5: Environmental media including groundwater (both perched and the Great
2 Miami Aquifer), surface water, soil not included in the definitions of OUs 1
3 through 4, sediment, flora, and fauna.
4

5 All five OUs (including OU4) completed the RI/FS process and initiated conducting remedial
6 actions in accordance with their respective EPA-approved final RODs. The original
7 selected remedy for Silos 1 and 2 within OU4 is being reevaluated through a revised FS.

8 2.1 Regulatory Classification of Silos 1 and Material

9 Silos 1 and 2, known as the "K-65 Silos," contain the material generated from the
10 processing of high grade uranium ores termed pitchblende. This processing was
11 performed to extract the uranium compounds from the natural ores. The Silos 1 and 2
12 material contains high activity concentrations of radionuclides, including radium (Ra)
13 and Th. The Silos 1 and 2 material was generated consequential to the processing of
14 natural uranium ores and is therefore classified as by-product material, as defined in
15 Section 11(e)(2) of the Atomic Energy Act (AEA), as amended.

16 The Silos 1 and 2 material is a complex wasteform from a regulatory perspective.
17 Applicable or relevant and appropriate requirements (ARARs) for its remediation is provided
18 in Appendix A of the revised FS.

19 2.1.1 Regulatory Classification of Silos 1 and 2 Material

20 The material contained in Silos 1 and 2 is 11(e)(2) by-product material resulting from the
21 processing of uranium ore concentrates. It is specifically exempt, as defined, from
22 regulation as solid waste under the Resource Conservation and Recovery Act, as amended
23 (RCRA) 40 CFR Part 261.4(a)(4). The referenced exclusion applies to "... source, special
24 nuclear or by-product material as defined in the Atomic Energy Act of 1954 as amended,
25 42 U.S.C. 2011 *et seq.*" Since a material must first be a solid waste in order to be a
26 hazardous waste, and since the silos material is excluded from regulation as solid waste,
27 the Silos 1 and 2 material cannot be regulated as hazardous waste under RCRA.

1 Silos 1 and 2 only contain material from the chemical extraction (beneficiation) of uranium
2 from ores. Neither solid nor hazardous wastes nor hazardous constituents (metals) were
3 added to the silos nor mixed with the Silos 1 and 2 residues. The metals found in the
4 material were present in the natural ore and were unintentionally extracted from the parent
5 ore along with the uranium during the process of beneficiation, becoming more
6 concentrated in the residue after the uranium was removed. The presence of natural
7 metals is expected in by-product material and neither invalidates the definition nor the
8 exclusion. Also, no hazardous waste or waste constituents were created at any time
9 during the beneficiation process. Although the leachability of lead in the Silos 1 and 2
10 material exceeds the RCRA toxicity characteristic level, this does not cause the material to
11 become subject to RCRA regulation, due to a hazardous waste characteristic, because the
12 metals are not from an external source, they are associated with the parent material
13 [whose residues, including any ancillary metals, are excluded from the definition of solid
14 waste pursuant to 40 CFR 261.4(a)(4)].

15 2.1.2 Packaging and Transportation

16 For purposes of proper transportation, the material is governed by the U.S. Department of
17 Transportation (DOT) regulations under 49 CFR Subtitle B Chapter I Subchapter C,
18 *Hazardous Materials Regulations*.

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1 Federal Regulations promulgated by the DOT on September 28, 1995 (60 FR 50292)
2 categorize low specific activity (LSA) material into three classifications: LSA-I, LSA-II, and
3 LSA-III. Evaluation of the radionuclide content for Silos 1 and 2 material indicates that this
4 material meets one of the criteria for LSA-II material. Specifically, Silos 1 and 2 material is
5 classified as LSA-II material because "Class 7 (radioactive) material is essentially uniformly
6 distributed and the average specific activity does not exceed $10^{-4}A_2/g$ for solids" (49 CFR
7 Part 173.403)². Therefore, the OU4 Silos 1 and 2 material is classified as LSA-II material
8 for proper transportation.

9 2.1.3 Disposal

10 As discussed in Section 6, all alternatives evaluated in the FS will dispose the treated
11 Silos 1 and 2 material at the Nevada Test Site (NTS). The NTS is a DOE-owned and
12 managed facility utilized for disposal of selected low-level radioactive wastes from other
13 DOE sites.

14 DOE derives authority from the AEA to manage small quantities of 11(e)(2) by-product
15 material as "low-level waste" so that it may dispose of such small waste quantities at DOE
16 low-level waste disposal facilities (NTS). Such quantities must not be "too large for
17 acceptance at DOE low-level waste disposal sites," and such wastes must meet the
18 requirements for low-level waste in accordance with DOE Order 435.1 Chapter IV(B)(4).

19 The treated Silos 1 and 2 material is 11(e)(2) by-product material and may be managed as
20 a low-level waste pursuant to DOE Order 435.1. As a low-level waste, it must meet the
21 NTS waste acceptance criteria (WAC) and, therefore, may not contain a RCRA listed
22 waste, or exhibit a RCRA characteristic, regardless of the exclusion defined for by-product
23 material at 40 CFR Part 261.4(a)(4).

² The A_2 value is the maximum activity, in curies, of radioactive material, other than special form, low specific activity (LSA), or surface contaminated objects permitted in a Type A package. To be classified as LSA-II material, the average specific activity must be less than one ten thousandth (10^{-4}) of the calculated A_2 value per gram of material. As an example, if a material has a calculated A_2 value of 10,000 Ci, the average specific activity must be less than 1 Ci/g.

1 DOE-FEMP will be responsible for demonstrating compliance with the NTS WAC.
2 Specifically, DOE-FEMP will document the absence of the hazardous characteristics
3 defined at 40 CFR Subpart C, especially those toxic constituents identified in Table 1 of
4 40 CFR Part 261.24 that may have been used in a process, regardless of the waste's
5 regulatory status. Official approval of the wastestream will be documented under separate
6 cover after a successful review by the Department of Energy-Nevada (DOE-NV)
7 Radioactive Waste Acceptance Program.

8 **2.2 Remediation Under CERCLA**

9 The FEMP site was placed on the NPL pursuant to the NCP in 1989. Therefore,
10 contamination at the FEMP site is undergoing remediation pursuant with CERCLA. The
11 materials in Silos 1 and 2 are considered "pollutants or contaminants," as that term is
12 defined under CERCLA and the NCP. The term includes but is not limited to:

13 "any element, substance, compound, or mixture, including disease-causing agents,
14 which after release into the environment and upon exposure, ingestion, inhalation,
15 or assimilation into any organism, either directly from the environment or indirectly
16 by ingestion through food chains, will or may reasonably be anticipated to cause
17 death, disease, behavioral abnormalities, cancer, genetic mutation, physiological
18 malfunctions (including malfunctions in reproduction) or physical deformations, in
19 such organisms or their offspring For purposes of the NCP, the term pollutant or
20 contaminant means any pollutant or contaminant that may present an imminent and
21 substantial danger to public health or welfare."
22

23 CERCLA provides guidance on the specific cleanup standards that should be applied to a
24 remedial action, or to the criteria for choosing among remedial alternatives when
25 implementing regulations for CERCLA under 40 CFR Part 300 (which is the NCP). The
26 EPA has established nine evaluation criteria for choosing among remedial actions in
27 Subpart E - *Hazardous Substance Response*, 40 CFR Part 300.430(e)(9).

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1 The NCP under 40 CFR Part 300.430(f)(1)(ii)(E) requires that "each remedial action shall
2 utilize permanent solutions and alternative treatment technologies or resource recovery
3 technologies to the maximum extent practicable." Preference shall be given to alternatives
4 that provide treatment as a principle element and bias against off-site land disposal of
5 untreated waste. The selected alternative shall provide long-term protectiveness of human
6 health and the environment, meet all ARARs that are identified in the ROD, and provide
7 the best balance of trade-offs among alternatives in terms of the five balancing criteria.

8 The CERCLA off-site rule (found in CERCLA Section 121(d)(3) and promulgated at
9 40 CFR Part 300.440) requires that waste from a remedial action that is shipped off-site
10 for treatment and/or disposal be transferred only to those units at a facility that (1) are
11 operating in compliance with RCRA and other applicable federal and state requirements,
12 and (2) do not have any uncontrolled releases of hazardous waste or constituents. The
13 rule applies to any remedial action involving the transfer of hazardous substances,
14 pollutants, or contaminants as defined under CERCLA Sections 101(14) and (33) pursuant
15 to any CERCLA authority, including cleanups at federal facilities
16 [40 CFR Part 300.440(a)(1)].

17 In a letter dated July 7, 1998, the EPA Region 9 granted approval to the NTS to dispose
18 of CERCLA waste from DOE facilities in waste management units 3 and 5 in accordance
19 with the Off-site Rule (40 CFR Part 300.440). As clarification, the EPA Region 9, in a
20 letter dated December 4, 1998, stated that the CERCLA Off-site Rule approval for the NTS
21 waste management units 3 and 5 includes management of small volumes of 11(e)(2)
22 by-product materials from Fernald OU4 as low-level waste under the provisions of
23 Chapters III and IV of DOE Order 435.1 or any subsequent applicable DOE directive.

1 2.2.1 Purpose and Need for Decision

2 Facilities and environmental media at the FEMP site, including OU4, contain radioactive
3 and chemical constituents at levels that exceed certain federal and state standards, and
4 guidelines for protecting human health and the environment. Currently, DOE-FEMP
5 maintains custody of the property and restricts access with fences and security forces,
6 precluding a member of the public from being exposed to site areas that have
7 contamination.

8 A formalized risk assessment process was established by the EPA to determine the
9 necessity for implementation of cleanup actions. Under this process, several hypothetical
10 scenarios that could expose members of the public to site contamination were examined.
11 One of these scenarios assumed that site access was not controlled (i.e., unrestricted) and
12 a member of the public could be exposed to the higher contamination areas. Results of
13 the risk assessment performed for this hypothetical, unrestricted access scenario indicated
14 that an individual establishing residence within the highly contaminated portions of the
15 OU4 area, under existing conditions, would be subjected to an increased risk of incurring
16 an adverse health effect. Risk assessment calculations performed for OU4 indicate the
17 projected level of increased risk exceeds established federal regulatory guidelines. Based
18 on the results of the baseline risk assessment, the DOE-FEMP concluded in the *Remedial*
19 *Investigation Report for Operable Unit 4* (FEMP 1993a) that existing site conditions
20 warrant remedial action. A summary of the original assessment results can be found in
21 Appendix F of the revised FS.

22 2.2.2 Original OU4 Record of Decision

23 The decision documented by the original OU4 ROD (EPA 1994) was based on the
24 information available in the Administrative Record for OU4 and maintained in accordance
25 with CERCLA. The major documents prepared through the CERLCA process include the RI,
26 the FS, and the PP for OU4.

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1 The original OU4 ROD and the supporting CERCLA documentation [e.g., FS and PP
2 (FEMP 1994 a,b)] prepared for remediation of the FEMP site (including OU4) also includes
3 the appropriate NEPA evaluations. These integrated CERCLA/NEPA evaluations considered
4 the potential impacts from remediation activities at the FEMP. The OU4 FS/PP-EIS
5 (FEMP 1993b) was the lead CERCLA/NEPA document for remediation of the FEMP.
6 Therefore, it was intended that the original OU4 ROD serve as DOE-FEMP's ROD for OU4
7 under both CERCLA and NEPA; however, it was not the intent of the DOE-FEMP to make a
8 statement on the legal applicability of NEPA to CERCLA actions.

9 The original selected remedy of vitrification was selected (after the original FS/PP-Draft EIS
10 was issued) with consideration of input received from public hearings held on
11 March 21, 1994, in Harrison, Ohio and on May 11, 1994, in Las Vegas, Nevada. In
12 preparation of the original OU4 ROD, DOE-FEMP considered the comments received both
13 during the public comment period for the original FS/PP-Draft EIS and following issuance of
14 the final EIS. The original OU4 ROD was approved by the EPA in December 1994.

<END OF PAGE>

1 2.2.3 Description of the Original Selected Remedy

2 On the basis of the evaluation of remedial alternatives conducted in the original FS/PP, the
3 major components of the selected remedy documented in the original OU4 ROD
4 (EPA 1994) are as follows:

- 5 • Removal of the contents of the Silos 1, 2, 3 and the decant sump tank sludge.
- 6
- 7 • Treatment of the Silos 1, 2, and 3 material and sludges removed from the silos and
8 the decant sump tank by vitrification to meet disposal facility WAC.
- 9
- 10 • Off-site shipment of the vitrified contents of Silos 1, 2, 3 and the decant sump tank
11 for disposal at the NTS.
- 12
- 13 • Demolition of Silos 1, 2, 3 and 4 and decontamination, to the extent practicable, of
14 the concrete rubble, piping, and other generated construction debris.
- 15
- 16 • Removal of the earthen berms and excavation of the contaminated soils within the
17 boundary of OU4, to achieve remediation levels. Placement of clean backfill to
18 original grade following excavation.
- 19
- 20 • Demolition of the remediation and support facilities after use. Decontamination or
21 recycling of debris before disposition.
- 22
- 23 • On-property interim storage of excavated contaminated soils and contaminated
24 debris in a manner consistent with the approved *Work Plan for FEMP Removal*
25 *Action No. 17 - Improved Storage of Soil and Debris* (DOE 1996)³, pending final
26 disposition of soil and debris in accordance with the RODs of OUs 5 and 3,
27 respectively.
- 28
- 29 • Continued access controls and maintenance and monitoring of the stored waste
30 inventories.
- 31
- 32 • Institutional controls of the OU4 area such as deed and land-use restrictions.
- 33
- 34 • Potential, additional treatment of stored OU4 soil and debris using OU5 and OU3
35 waste treatment systems.
- 36

³ This component of the selected remedy was documented in the original Operable Unit 4 Record of Decision in 1994. However, for purposes of this revised Proposed Plan, the reference has been updated to the most recent revision.

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- 1 • Pumping and treating, as required, of any contaminated perched groundwater
2 encountered during remedial activities.
- 3
- 4 • Disposal of the OU4 FEMP contaminated debris and soils consistent with the RODs
5 for OUs 3 and 5, respectively.
- 6

7 Although the selected remedy documented in the original OU4 ROD specifies on-site
8 disposal for the OU4 soil and debris, the final decision regarding the final disposition of the
9 OU4 debris and soils was placed in abeyance, until the OU3 and OU4 RODs were
10 completed. This approach allowed DOE to take full advantage of planned waste
11 management and treatment strategies by these OUs and enabled the integration of
12 disposal decisions for contaminated soils and debris on a site-wide basis.

13 2.2.4 Need for Modifying the Record of Decision

14 Following final approval and upon the effective date of the original OU4 ROD, the
15 DOE-FEMP prepared and submitted the *Work Plan for the Operable Unit 4 Remedial Design*
16 (RDWP) that identified the approach for the implementation of the selected remedy
17 (FEMP 1995a). The RDWP was approved by the EPA in June 1995. As part of the OU4
18 remedial design process, a treatability study program was initiated in May 1996 to collect
19 quantitative performance data to support full-scale application of the joule-heated
20 vitrification technology to the silos material.

21 The joule-heated Vitrification Pilot Plant (VITPP) treatability study program involved
22 processing non-radioactive surrogate material with selected chemical and physical
23 properties of the combined Silos 1, 2, and 3 materials. The joule-heated VITPP testing
24 program consisted of three campaigns with the following objectives: (1) to determine
25 (using surrogates) whether it was more economical to vitrify the Silos 1, 2, and 3
26 materials together or separately; (2) to gain experience vitrifying silos material and
27 handling high-sulfate, barium and lead concentrations and BentoGrout™; and (3) and to
28 determine maximum production rates through induced agitation (via bubbling tubes) in a
29 molten glass bath to increase production.

1 During the joule-heated VITPP testing program, many technical and operational difficulties
2 were encountered which resulted in documented schedule delays and cost increases. The
3 DOE-FEMP recognized that the technical path forward for remediation of the Silos 1, 2,
4 and 3 materials needed to be reassessed in order to address the issues experienced. In
5 September 1996, DOE formally requested extension of enforceable milestones associated
6 with implementing the OU4 remedy.

7 In October 1996, EPA denied DOE's request for extension of the milestones. EPA and
8 DOE then initiated informal dispute resolution and began reevaluation of the technical path
9 forward for the remediation of the silos material. The DOE-FEMP determined that
10 additional independent technical expertise would prove beneficial to reevaluation of the
11 path forward for remediation of the silo material. In November 1996, the DOE-FEMP
12 convened the Silos Project Independent Review Team (IRT) as a technical resource to
13 assist the DOE-FEMP in this reevaluation. The IRT was comprised of technical
14 representatives, from throughout the DOE complex and private industry, with expertise in
15 various aspects of chemical stabilization, vitrification, and other treatment technologies.
16 VITPP technical and operational difficulties culminated with suspension of VITPP testing
17 following a melter hardware failure in December 1996. The recommendations of the IRT
18 and other evaluations on the part of the DOE-FEMP and FEMP stakeholders (Silos Project
19 IRT 1997) - along with the evaluation of the December 26, 1996, melter hardware failure
20 (FEMP 1997) - supported a decision that vitrification of the Silo 3 material (although
21 possible) would not be practical because of its significant cost and extension to the
22 cleanup schedule. Also, the concentrations of hazardous and radiological constituents in
23 Silo 3 material are low compared to the levels present in the Silos 1 and 2 material; this is
24 an additional key factor for deciding to treat the Silo 3 material separately from the Silos 1
25 and 2 material.

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1 In addition, the evaluations concluded that separating the Silos 1 and 2 material from
2 Silo 3 material would significantly reduce the technical uncertainties and programmatic
3 risks of developing an effective treatment process for the separate wastestreams.
4 Together DOE-FEMP and stakeholders decided that an alternate remedy should be
5 considered for treatment and disposal of the Silo 3 material. On July 22, 1997, the DOE-
6 FEMP and the EPA formally entered an "Agreement Resolving Dispute Concerning Denial
7 of Request for Extension of Time for Certain OU4 Milestones," hereinafter referred to as
8 the *Settlement* between the EPA and DOE-FEMP (EPA 1997), resolving disputes
9 concerning the schedule and path forward for the remediation of the Silos 1, 2, and 3
10 materials. In the Settlement, the EPA directed DOE-FEMP to proceed with the
11 development of a revised FS, PP, and ROD amendment to reevaluate the treatment remedy
12 for Silos 1 and 2 material, and ESD documenting the change in remedy for Silo 3 material.
13 The EPA's basis for directing DOE to proceed with the ROD amendment is discussed in
14 **Section 2.2.5.**

15 Consistent with the Settlement and in support of the technical basis for the alternatives
16 being evaluated in the revised FS, the DOE-FEMP performed the Proof of Principle (POP)
17 Testing Program. This testing was scoped and implemented to address agency and
18 stakeholder concerns that the detailed evaluation of the alternatives and comparative
19 analysis would be supported by commercial data provided by pilot-scale testing the
20 alternative remedial technologies.

21 An ESD was completed by DOE-FEMP and approved by the EPA in March 1998 to
22 document the change in remedy for treatment of the Silo 3 material to chemical
23 stabilization and off-site disposal (FEMP 1998b).

1 Similarly, DOE-FEMP has prepared a revised FS and this revised PP to recommend the final
2 treatment technology for the Silos 1 and 2 material. The Settlement specified an
3 enforceable milestone of February 1, 2000 for submittal of a draft supplemental FS and PP
4 to the EPA for review and approval. The revised FS will be available for stakeholder
5 inspection and comment and the revised PP will be formally issued for stakeholder review.
6 These revised documents will provide the basis for selection of the final treatment remedy,
7 which will be documented and approved in an amendment to the original OU4 ROD for the
8 Silos 1 and 2 material.

9 2.2.5 Basis for Path Forward

10 Pursuant with Section 117 of CERCLA and the NCP at 40 CFR Part 300.435(c)(2)(ii), a
11 ROD amendment should be processed when "differences in the remedial or enforcement
12 action, settlement, or consent decree fundamentally alter the basic features of the
13 selected remedy [in the ROD] with respect to scope, performance, or cost."

14 The EPA's position requiring a ROD amendment for the Silos 1 and 2 material was based
15 upon the specific circumstances surrounding this situation. The EPA noted that some
16 increase in remedial cost can be reasonably expected; but, whether the cost increase is
17 considered *not significant, significant and requires an ESD, or fundamentally alters the*
18 *selected remedy and must be addressed by a ROD amendment*, has to be determined on a
19 case-by-case basis. The EPA emphasized that, in this specific case where the final
20 remedial cost estimated by DOE-FEMP for the Silos 1 and 2 material increased significantly
21 [i.e., approximately 5 times greater than the original estimate], a ROD amendment was
22 required. Therefore, it was EPA's position that the anticipated increase in the cost of
23 implementing joule-heated vitrification for treatment of the Silos 1 and 2 material
24 constituted a fundamental change to the selected remedy and therefore requires a
25 re-examination of the selected remedy and a ROD amendment (EPA 1997).

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1 As part of the path forward, a service contract was entered into to remove material from
2 Silos 1 and 2 and place the material into a Transfer Tank Area (TTA). This will allow for
3 storage of the material in a more controllable and safer configuration pending remediation
4 by the selected treatment alternative. In conjunction with the TTA, a Radon Control
5 System (RCS) is being constructed to collect and control radon emissions from the TTA
6 and the remediation facility.

7 2.2.6 Scope of the Revised FS Evaluation

8 The scope of the revised FS for Silos 1 and 2 is more specific than a traditional FS. Based
9 upon the Settlement with the DOE-FEMP and the EPA (EPA 1997), the scope of the
10 revised FS is to supplement the original FS/PP to evaluate vitrification and other potential
11 alternatives for remediation of Silos 1 and 2. Other portions of the selected remedy
12 (removal, off-site disposal, and disposition of the silos structures, soil, and debris) for OU4
13 are not being re-evaluated. New components are not being added to the remedy identified
14 in the approved ROD. Therefore, the general RAs and remedial action objectives (RAOs),
15 and the performance objectives for Silos 1 and 2 material identified in the original OU4 FS
16 and ROD remain the basis for the revised FS.

17 In addition to removal, treatment and disposal, general response actions evaluated in the
18 original OU4 FS included: no action, containment, and institutional control. Based upon
19 these general response actions, potential remedial technologies and process options were
20 evaluated and combined into remedial alternatives. A wide range of alternatives were
21 originally evaluated for the remediation of the Silos 1 and 2 material, including several
22 removal/treatment with off-site disposal alternatives, removal/disposal without treatment,
23 removal/treatment with on-site disposal, and no action. Based upon detailed and
24 comparative analyses of these alternatives, removal of the Silos 1 and 2 material followed
25 by remediation through vitrification, and off-site disposal at the NTS was selected as the
26 remedy.

1 The revised FS was prepared to reevaluate the implementation of the treatment
2 technology selected in the original OU4 ROD using data compiled for the original OU4 RI
3 and FS reports, as well as updated information (i.e., cost, implementability, etc.) from
4 post-ROD treatability studies. The portions of the original RI/FS that determined that the
5 remedial action for Silos 1 and 2 material was to include retrieval from the silos,
6 treatment, and off-site disposal were not reevaluated. Alternatives to the selected remedy
7 that were evaluated in the original FS, such as no action, on-site disposal, or disposal
8 without treatment for the COCs, were not reevaluated in the revised FS.

9 Therefore, the methodology and approach adopted by the revised FS has been tailored to
10 address the specific circumstances (e.g., regulatory, technical, administrative) surrounding
11 the revised decision-making process for the *treatment* of the Silos 1 and 2 material. The
12 revised FS has been prepared consistent with the requirements of the CERLCA, the ACA,
13 DOE orders and guidance, and EPA guidance. Consistent with the NCP and EPA guidance
14 (EPA 1988), the FS examines an appropriate range of treatment alternatives.

15 As required by the NCP, each treatment alternative has been developed to the extent
16 necessary to facilitate the fair comparison of the alternatives against established
17 regulatory-based evaluation criteria. To establish a basis for the development of
18 alternatives, the revised FS relies upon the data compiled for the original OU4 RI and FS
19 reports, post-ROD treatability testing, commercial and DOE-complex experience, POP
20 testing of alternative treatment technologies, and lessons learned involving the
21 technologies being evaluated. The best available assumptions have been employed in the
22 revised FS to define the basis of the development and evaluation of the alternatives.

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1 The NCP requires that nine criteria be used in evaluating the remedial alternatives to the
2 extent necessary to support the balanced and objective comparison of these alternatives
3 against established criteria in the revised FS. The nine criteria are subdivided into two
4 threshold criteria (overall protection of human health and the environment and compliance
5 with ARARs), five primary balancing criteria (long-term effectiveness and permanence;
6 reduction of toxicity, mobility, or volume through treatment; short-term effectiveness;
7 implementability; and cost), and two modifying criteria (state acceptance and community
8 acceptance). These nine criteria help in evaluating the alternatives against each other in
9 order to select the preferred alternative.

10 For evaluating cost, remedial alternatives are typically developed to the extent necessary
11 to produce cost estimates with a range of accuracy of +50% to -30%. The conceptual
12 design level of information presented in the FS will be refined for the selected alternative
13 following closer examination during the remedial design process.

<END OF SECTION>

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1 The significant concerns associated with the Silos 1 and 2 material include:

- 2 • High concentrations of radionuclides, including radium and thorium, that are present in
3 the material.
- 4 • An elevated, gamma radiation field in the vicinity of the silos due to the material in the
5 silos.
- 6 • Chronic emissions of radon (a radioactive gas from the decay of radium) from Silos 1
7 and 2 material into the atmosphere.
- 8 • The structural instability of the silos domes and the age of the remaining portions of
9 the structures.
- 10 • The potential threat of the silos material leaching RCRA metals and radionuclides into
11 the underlying sole-source aquifer.

12 **3.2 Decant Sump Tank System**

13 The decant sump tank was an integral part of the former operations associated with
14 Silos 1 and 2 and continues to collect groundwater beneath the two silos. Samples from
15 the water within the decant sump tank during 1991 revealed elevated concentrations of
16 Pb-210, Po, Ra, and U. Analytical results also revealed the presence of above background
17 concentrations of strontium and technetium. With the exception of these latter two
18 constituents, radiological contaminants present in the decant sump tank system are
19 consistent with the relative concentrations of constituents found in Silos 1 and 2. This
20 result confirms that the decant sump tank system is continuing to collect leachate from
21 the underdrains in Silos 1 and 2, as it was designed to do. Strontium and technetium are
22 by-products of nuclear fission and are not present in the Silos 1 and 2 material. Strontium
23 and technetium are present in the environment due to fallout from past atmospheric
24 world-wide nuclear weapons testing. Their presence in the decant sump tank system
25 indicates that some surface water has leached into the decant sump tank system.

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1 The metals found in liquid samples from the decant sump tank system include aluminum,
2 antimony, arsenic, chromium, copper, lead, molybdenum, selenium, silver, vanadium, and
3 zinc. In addition, 18 organic compounds were detected in the decant sump tank system
4 liquids at low concentrations. With the exception of toluene, all volatile compounds
5 detected were at or below concentrations that allow a laboratory to accurately quantify
6 the level of the constituents.

7 **3.3 Radon Treatment System**

8 The RTS was installed in November 1987, to reduce the radon inventory within the
9 headspace of Silos 1 and 2. Following RI/FS sampling of Silos 1 and 2 material in 1989,
10 the RTS was abandoned in place. The RTS was sampled during a removal site evaluation
11 in January 1992. The predominant contaminant present is Pb-210 and its associated
12 decay products. Periodic surveys for direct radiation and removable fixed radioactive
13 contamination reveal that only isolated contamination is present in accessible portions of
14 the RTS.

15 **3.4 Contaminated Environmental Media**

16 In addition to the waste areas described, contamination is present in environmental media
17 within the OU4 area, such as surface and subsurface soil, soils within the earthen berm
18 surrounding Silos 1 and 2, groundwater, surface water, and perched water.

<END OF PAGE>

1 Principal Threats

2 The NCP describes principal threats as those involving liquids, areas contaminated with
3 high concentrations of toxic compounds, and highly mobile materials. Consistent with the
4 NCP, the original OU4 RI provided a detailed characterization of the source term within
5 OU4 and identified those contaminants that contributed to an incremental lifetime cancer
6 risk (ILCR) value greater than the CERCLA criterion of 1×10^{-6} and a hazard quotient
7 greater than the CERCLA criterion of 1.0. The original OU4 RI identified that the principal
8 threats to human health and the environment posed by the Silos 1 and 2 material are from
9 the following contaminant/transport pathways:

- 10 • Direct radiation
 - 11 - Direct exposure to gamma radiation from radioactive constituents within the
 - 12 silos.
 - 13 - Direct exposure to gamma radiation from radioactive constituents in surface
 - 14 soil.
 - 15
- 16 • Air emissions
 - 17 - Dispersion of radon that escapes from the silos into the atmosphere.
 - 18 - Dispersion of volatile organic compounds or fugitive dust generated from soil.
 - 19
- 20 • Surface water runoff
 - 21 - Erosion of contaminated soils into Paddys Run from the vicinity of the silos.
 - 22
- 23 • Groundwater transport
 - 24 - Leaching of contaminants from the silos contents via soils to underlying
 - 25 groundwater.
 - 26 - Leaching of contaminants from the silos contents via soil to a sand silty/clay
 - 27 lens in the glacial till, which could carry contaminants to surface water and
 - 28 sediment in Paddys Run.

29 Potential remedial alternatives for OU4 were developed in order to: mitigate the short-term
30 and long-term exposure and associated risks from gamma radiation; reduce radon
31 emanation rates from the Silos 1 and 2 material; minimize the leachability of contaminants
32 from the waste material; eliminate potential of air dispersion from a silo collapse; eliminate
33 the dispersion of fugitive dust generated from the soil; and, eliminate contaminated
34 surface water runoff from contaminated soils into Paddys Run.

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1 **3.5 Overview of the Nature and Extent of Contamination**

2 This section summarizes the nature and extent of contamination within environmental
3 media in the OU4 study area. Also included in this section is an overview of the levels of
4 direct radiation associated with the current conditions within OU4. Additional detail on
5 these conditions is provided in Section 4.0 of the original OU4 RI.

6 Surface Soils

7 Sampling performed as part of the RI/FS and other site programs in the vicinity of OU4
8 indicates the occurrence of above background concentrations of uranium, and to a lesser
9 degree other radionuclides, in the surface soils within and adjacent to the OU4 study area.
10 These above background concentrations appear to be generally limited to the upper six
11 inches of soil. Available survey data and process knowledge do not indicate a direct
12 relationship between the surface soil contamination in the OU4 study area and the silos
13 contents.

14 Soil samples were also collected from the soils contained in the earthen embankment
15 (berm) surrounding Silos 1 and 2. The analytical data from the berm fill show only slightly
16 elevated radionuclide activity concentrations.

17 Subsurface Soils

18 As part of the original OU4 RI, samples were collected from the subsurface soils located
19 under and adjacent to Silos 1 and 2. Analytical results revealed elevated concentrations of
20 radionuclides from the uranium decay series in the soils at the interface between the berm
21 and the original ground level. Elevated concentrations (up to 53 pCi/g for U-238, about 40
22 times background) were also noted in slant boreholes, which passed in close proximity to
23 the silos underdrains.

1 Groundwater

2 With the exception of perched groundwater encountered during potential remedial action,
3 groundwater within the Great Miami Aquifer underlying the silos area is not within the
4 scope of OU4. Groundwater in the Great Miami Aquifer underlying the entire FEMP site is
5 being addressed as part of OU5.

6 Uranium was the major radionuclide contaminant found in the perched water. Elevated
7 concentrations of total uranium were detected in the slant boreholes under and around
8 Silos 1 and 2.

9 Great Miami Aquifer

10 The concentration of total uranium in the upper portion of the Great Miami Aquifer, based
11 on analysis of samples from the 2000-series wells, ranged from less than 1 µg/L to
12 40.3 µg/L. Both upgradient and downgradient wells contain above background
13 concentrations of total uranium. Therefore, other sources of contamination must exist
14 besides Silos 1 and 2.

15 **3.6 Overview of the Baseline Risk Assessment**

16 Baseline Risk Assessments were performed in 1994 to determine the potential human
17 health effects and ecological risks that could result from exposure to the contaminants
18 present in OU4.

19 The baseline assessment of human health risks quantified the health risks to hypothetical
20 human receptors due to exposure from radioactive and chemical sources in OU4, under the
21 no-action alternative. The process analyzed the potential, human health consequences
22 under different scenarios if no remedial actions were taken to address identified
23 environmental concerns.

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1 The major constituents of concern (COCs) related to the silos material are heavy metals
2 such as, arsenic, cadmium, chromium, and lead, and radionuclides in the U-238, U-235,
3 and Th-232 decay chains such as, Ra-226, Th-230, and Pb-210. [Appendix E of the *RI*
4 *Report for OU4* (FEMP 1993a) provides full details of the process for selecting COCs.]
5 COCs were detected in Silos 1 and 2, the surrounding surface soil and subsurface soil, and
6 the silos berm soils. Baseline Risk Assessment source term concentrations were
7 determined for the COCs in these media. Fate and transport modeling were then
8 conducted to estimate the exposure point concentrations of contaminants in environmental
9 media (e.g., groundwater, air, and surface water).

10 Results of the risk assessment performed for this hypothetical, unrestricted access
11 scenario indicated that an individual establishing residence within the highly contaminated
12 portions of the OU4 area, under existing conditions, would be subjected to an increased
13 risk of incurring an adverse health effect. Risk assessment calculations performed for OU4
14 indicate that the projected level of increased risk exceeds established federal regulatory
15 guidelines. On the basis of the results of the baseline risk assessment, the DOE-FEMP
16 concluded in the OU4 RI that existing site conditions warrant remedial action.

17 Appendix D and Section 6.0 of the OU4 RI provide detailed information on the baseline
18 assessment of human health risks.

<END OF PAGE>

1 **3.7 Overview of the Baseline Ecological Risk Assessment**

2 A Sitewide Baseline Ecological Risk Assessment was completed and included in the
3 *Site-wide Characterization Report* (FEMP 1993c). Its purpose was to estimate the
4 potential and future risks of FEMP contaminants to ecological receptors if no remediation
5 was implemented. The following is a summary of the Baseline Ecological Risk Assessment
6 found in the Sitewide Characterization Report.

7 The EPA and DOE agreed in the September 1991 ACA that the Site-wide Ecological Risk
8 Assessment would be performed as part of the *Remedial Investigation Report for Operable*
9 *Unit 5* (FEMP 1994c). The Site-wide Ecological Risk Assessment in the RI for OU5
10 quantifies and assesses the possible risks from current concentrations of site contaminants
11 to ecological receptors inhabiting on-property and off-site areas not presently targeted for
12 remediation based on human-health concerns.

13 Although radionuclides are the most ubiquitous contaminants at the FEMP, estimated
14 ecological risks to both terrestrial and aquatic organisms are primarily associated with
15 nonradioactive inorganic chemicals. Although estimated risks are substantial in some
16 instances, they are based on soil inorganic chemical concentrations comparable to
17 background levels; and, deleterious effects have not been observed in the field. This
18 suggests that FEMP site-specific ecological risks are low. However, remedial actions are
19 appropriate to address contaminants that have potential to cause harm in the future.

20 More discussion on the Risk Assessment and Ecological Risk issues specific to OU4 can be
21 found in Appendix F of the revised FS for Silos 1 and 2 and in the original *Proposed Plan*
22 *for Remedial Actions at Operable Unit 4* (FEMP 1994b).

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4.0 SCOPE AND ROLE

4.1 Scope of OU4

OU4 is commonly referred to as the "Silos Project," as distinguished by the four concrete silos, three of which contain low-level waste. OU4, as depicted in **Figure 4.1-1**, consists of the following FEMP facilities and associated environmental media:

- Silos 1 and 2 and their contents (also termed *K-65 Silos*).
- Silo 3 and its contents (also termed *cold metal oxide silo*).
- Silo 4 (empty).
- Silos 1 and 2 decant sump tank, its contents, and associated silo underdrain system.
- The RTS.
- The portion of a concrete pipe trench within the boundaries of OU4, and other concrete structures.
- An earthen berm surrounding Silos 1 and 2.
- Soils beneath and immediately adjacent to Silos 1, 2, 3 and 4.
- Perched groundwater in the vicinity of the silos that may be encountered during the implementation of cleanup activities.

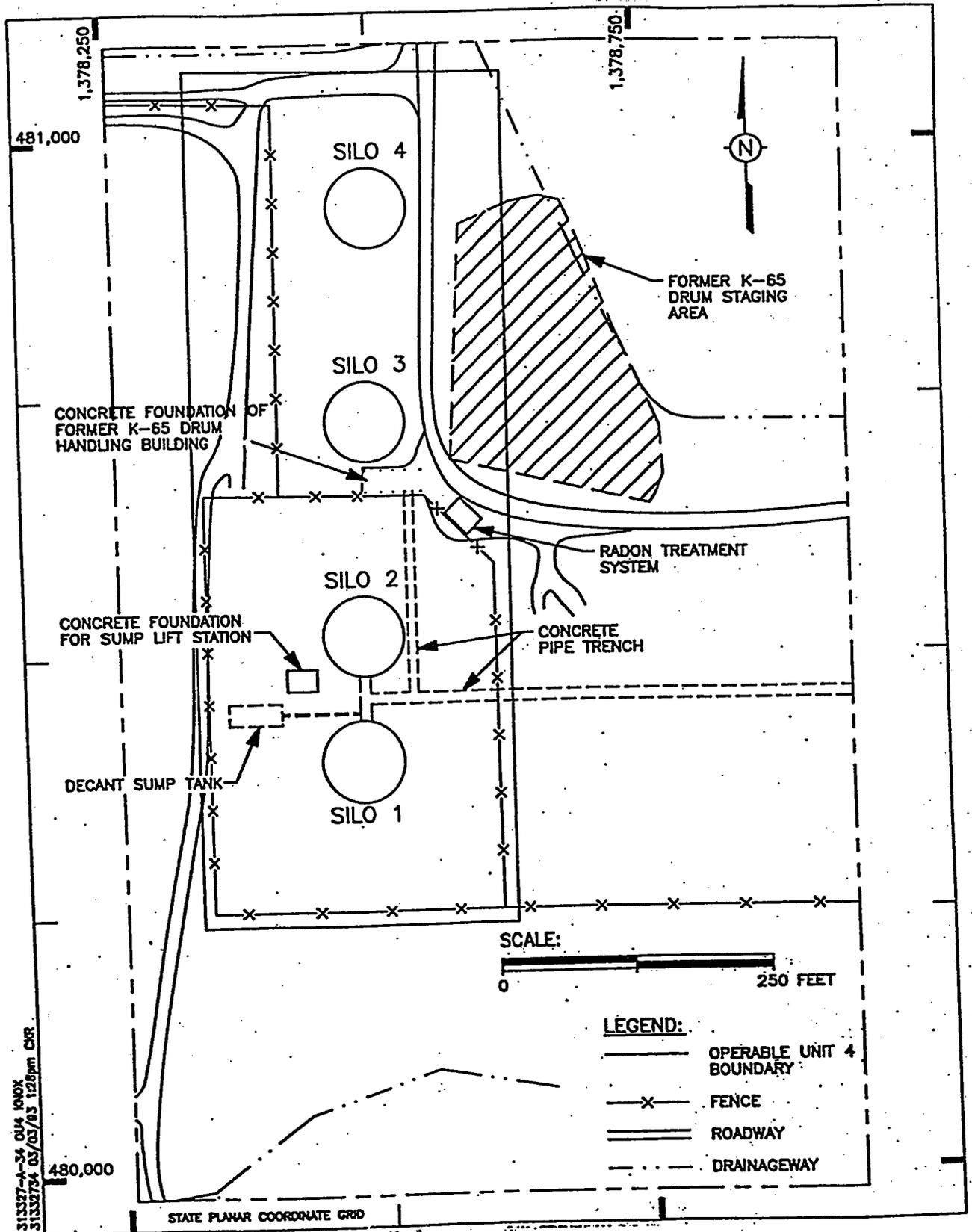
1 The goal of the OU4 remedial action is to safely remediate the OU4 components in a
2 timely, efficient, and cost-effective manner, that ensures compliance with all ARARs and
3 that would be protective of human health and the environment. After the OU4 remedial
4 actions are complete, the former waste storage area will be restored to a natural habitat in
5 accordance with the *Natural Resource Restoration Plan, Draft* (FEMP 1998a). The
6 complete remediation of the OU4 area will eliminate the FEMP's most significant inventory
7 of contaminated (activity) material and chronic source term of radon emissions at the
8 FEMP site.

<END OF PAGE>

Figure 4.1-1

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Operable Unit 4



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1 The objective of the revised FS is to gather and present information to support an informed
2 risk management decision regarding which technology appears to be the most appropriate
3 for the treatment of the Silos 1 and 2 material.

4 This PP recommends a preferred technology for treating Silos 1 and 2 material based on
5 the information presented in the revised FS. In addition, this PP presents a preferred
6 alternative for remediating the structures associated with treating Silos 1 and 2 material,
7 including the TTA and the RCS, and for remediating OU4 soils within Area 7.

8 The remedial actions proposed in the revised FS are similar to those evaluated in the
9 detailed analysis of the original OU4 FS. Because these proposed remedial actions identify
10 off-site disposal as the remedy for treated Silos 1 and 2 material, the FEMP on-site residual
11 risk from Silos 1 and 2 material is virtually nonexistent.

12 Integration with OU3

13 The decontamination and demolition (D&D) of the OU4 silos and the above-grade
14 remediation facilities will be planned and performed in accordance with the FEMP OU3
15 ROD (FEMP 1996a) and the OU3 implementing remedial action documents (i.e., the
16 Facility Closure and Demolition Project's "Project Execution Plan"). The hierarchy of
17 regulatory and site requirements that govern the performance of OU4 D&D activities, flow
18 down directly from the OU3 regulatory process by the OU3 Integrated Remedial
19 Design/Remedial Action (RD/RA) Work Plan and the OU3 Project-specific Implementation
20 Plan.

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1 Integration with OU5

2 Discrete data points were collected as part of the OU5 RI (FEMP 1994c) to characterize
3 the nature and extent of contamination in environmental media at the site; the results of
4 the data analyses are summarized in the OU5 FS (FEMP 1995b) and are discussed below.

5 The OU5 RI/FS examined soil on a site-wide basis. All soil at the FEMP, not contemplated
6 to be exhumed as part of a remedy for OUs 1 through 4, is considered within the scope of
7 OU5. This approach has been adopted to examine soil on a site-wide basis to formulate
8 and evaluate comprehensive remedial alternatives that are consistent with presentations in
9 the FS reports for OUs 1, 2, and 4. The ROD for OU4 established OU-specific soil
10 preliminary remediation levels (PRLs) that were revisited by OU5. The OU5 ROD
11 (FEMP 1996b) established final remediation levels for the site-wide soils, including OU4,
12 based on a future land-use scenario. The OU5 ROD modified the OU4 soil remediation
13 levels, which are in some cases more restrictive than the original OU4 PRLs. A more
14 detailed discussion is provided in Appendix F of the revised FS.

15 The OU5 RI/FS process examined perched groundwater on a site-wide basis. It should be
16 noted, however, that the ACA provides that each OU address perched groundwater
17 envisioned to be encountered as a consequence of conducting RAs. Perched groundwater
18 collected as a result of remediation activities will be directed to OU5 wastewater
19 treatment systems.

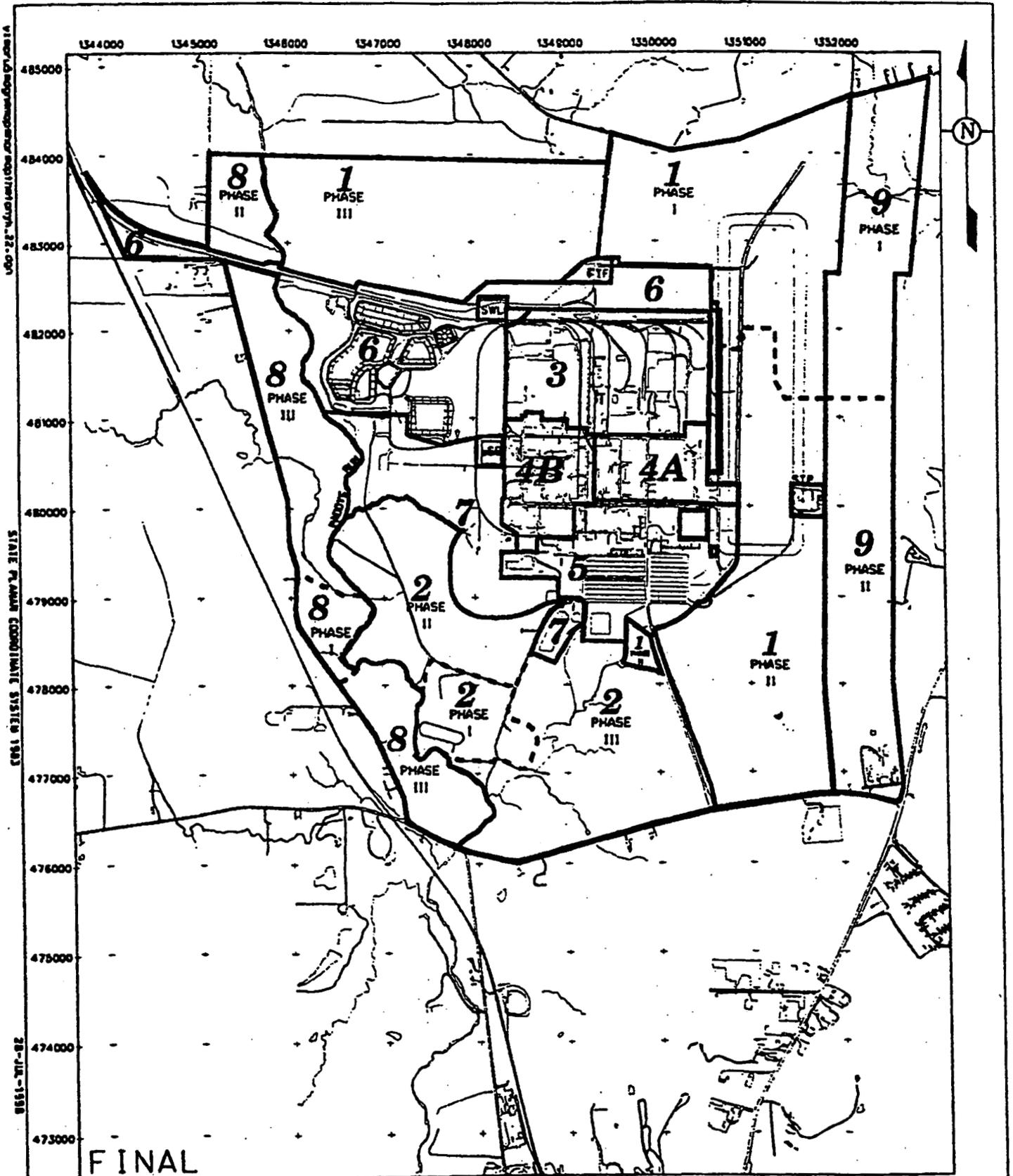
20 Process wastewaters generated during RAs conducted by all OUs will be directed to OU5
21 treatment systems [i.e., Advanced Wastewater Treatment (AWWT) Facility]. OU5 has
22 established pretreatment requirements to ensure that available treatment capabilities will
23 not be exceeded by incoming wastewater streams. These requirements have been
24 included in the Design Basis and Description for the alternatives (Appendix G of the
25 revised FS). These projected process wastewater streams have been factored into each of
26 the OU4 remedial alternatives presented in this report.

1 Integration with OU2

2 The FEMP On-site Disposal Facility (OSDF) has a WAC for soils and debris that ensures
3 that materials disposed within its confines are protective of human health and the
4 environment. The OSDF will be available for disposal of the existing Silos 3 and 4
5 structures and associated facilities (i.e., treatment facilities, superstructures, RTS). Soil
6 and debris from D&D activities associated with these facilities will be disposed in the
7 OSDF if they meet the WAC for disposal. Any soils and debris that do not satisfy the
8 OSDF WAC will be disposed at the NTS or an appropriately licensed commercial facility.

9 Due to prolonged contact of the Silos 1 and 2 concrete with the Silos 1 and 2 material,
10 the likelihood of contaminant migration to the interior of the concrete, and the uncertainty
11 in the cost and effort required to adequately decontaminate it, the concrete from Silos 1
12 and 2 is more appropriately managed in the same manner as "Category C,
13 Processed-related Metals" as defined in the OU3 ROD. Therefore, concrete from Silos 1
14 and 2 will be administratively excluded from disposal at the FEMP OSDF. The interior
15 surface of Silos 1 and 2 will be gross decontaminated to remove visible Silos 1 and 2
16 material before the structures are demolished, size reduced, and packaged for off-site
17 disposal.

18 Based on the current operating schedule, the FEMP OSDF will not be available for disposal
19 of soil and debris generated from D&D of the OU4 remediation facilities, which include the
20 Decant Sump Tank System, other below-grade appurtenances, and OU4 Area 7 soils.
21 Therefore, the revised FS and PP assumed for costing purposes that all soil and debris
22 from D&D of the OU4 remediation facilities, including treatment facilities, the Transfer
23 Tank Area, Radon Control System, and Pilot Plant, will be disposed at the NTS. However,
24 should programmatic changes occur and the OSDF become available, soil and debris
25 meeting the OSDF WAC will be disposed in the OSDF.



Legend:

- Remediation Area Boundary
- - - Phase Boundary Within A Remediation Area

- Generalized Sitewide Remediating Areas -
- Sitewide Characterization and Excavation Project

Figure 4.1-2

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1 **4.2 Integration of OU4 with the National Environmental Policy Act**

2 As previously stated, it is DOE policy to integrate NEPA requirements into the procedural
3 and documentation requirements of CERCLA, wherever practicable. This policy is
4 embodied within DOE Order 5400.4 defining the roles and responsibilities of the
5 Department regarding compliance with CERCLA and the integration of the remedial
6 process with NEPA.

7 The revised FS contains the NEPA environmental impact analysis as part of the detailed
8 analysis of each remedial alternative. The evaluation of environmental impacts includes a
9 discussion of the impacts to biotic resources, socioeconomics, cultural resources,
10 wetlands, and floodplains. The NEPA impact analysis is factored into the detailed and
11 comparative analysis of alternatives presented in Sections 3 and 4 of the revised FS and
12 the identification of the preferred alternative in this PP. Additionally, the revised FS has
13 been supplemented to incorporate the results of a NEPA Supplement Analysis (Appendix D
14 of the revised FS) that assesses the potential environmental impacts associated with the
15 alternatives being considered in the revised FS against the results of the original OU4
16 FS/PP-EIS.

- 1 • Prevent direct contact with or ingestion of Silos 1 and 2 material.
- 2
- 3 • Prevent release or migration of waste materials to soil, groundwater, surface water
- 4 or sediment.
- 5
- 6 • Prevent exposures to Silos 1 and 2 material that may cause an individual to exceed
- 7 applicable dose limits.
- 8

<END OF SECTION>

1 The cost estimates in the revised FS were prepared in accordance with the Design Basis
2 and Description (Appendix G of the revised FS), which incorporated technology-specific
3 data generated during the POP Testing Project. The estimates employ a wide variety of
4 cost-estimating methods and techniques such as generic unit costs, contractor-supplied
5 information, DOE guidance, conventional cost-estimating guides, commercial remedial
6 costs, and cost information based on actual FEMP operation and maintenance experience
7 on jobs of similar magnitude and complexity. The cost elements were developed for:
8 (1) capital costs; (2) engineering costs; (3) operation and maintenance costs; (4)
9 decontamination and decommissioning costs; (5) project management costs; (6) waste
10 disposal costs; and (7) cost of money. A more detailed discussion of the cost-estimating
11 methods, basis, and assumptions for these cost components is presented in Appendix C of
12 the revised FS.

13 Section 121 of CERCLA requires that RAs achieve a standard or level of control that is
14 consistent with environmental laws or regulations, which are termed ARARs. ARARs
15 pertain to all aspects of a RA, including the establishment of cleanup levels and the
16 operation and performance of treatment systems.

17 ARARs consist of two sets of requirements, those that are *applicable* and those that are
18 *relevant and appropriate*. Applicable requirements are those substantive standards or
19 requirements that specifically address a situation at a CERCLA site. Relevant and
20 appropriate requirements are standards or requirements that address problems sufficiently
21 similar to the situation at a CERCLA site that their use is well suited to the site. In certain
22 cases, standards may not exist in the promulgated regulation that address the proposed
23 action or COCs. In these cases, nonpromulgated advisories, criteria, or guidance that
24 were developed by the EPA, other federal agencies, or states are to be considered (TBC) in
25 establishing RAOs that are protective of human health and the environment.

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1 A detailed discussion of all ARARs and TBC criteria associated with the remedial
2 alternatives being evaluated for Silos 1 and 2 material is presented in Appendix A of the
3 revised FS. From these detailed lists, certain key ARARs and TBCs were identified to have
4 significant impact on evaluating the alternatives. These include those associated with the
5 control of radionuclide emissions, the management of RCRA hazardous waste, and
6 compliance with NEPA.

7 These key ARARs associated with the remedial alternatives evaluated in this section are
8 presented in **Tables A-1 through A-3 in Appendix A** of this PP. A complete identification
9 of all ARARs associated with remediation of the Silos 1 and 2 material is found in
10 Appendix A of the revised FS.

11 The tables identify the remedial alternatives associated with the major regulatory
12 requirements, the rationale for designation of the regulatory requirement as an ARAR/TBC,
13 and the mechanism by which the remedial alternative will comply with the requirement.
14 All of the alternatives discussed in **Sections 6.1 through 6.4**, would meet all pertinent
15 ARARs identified for these alternatives.

16 **6.1 On-site Joule-heated Vitrification, Off-site Disposal at the NTS (VIT1)**

17 **Figure 6.1-1** presents a simplified process flow diagram of a proposed VIT1 process. A
18 detailed discussion of this alternative is available in Section 3.2.1 of the revised FS.

19 The treatment system described in this section is based upon data and other information
20 compiled from POP testing and has been developed as a viable way to implement this
21 alternative. Equivalent systems may exist and are not precluded from consideration,
22 consistent with the final selected remedy, during remedial design.

1 This alternative (VIT1) involves the removal, on-site treatment through joule-heated
2 vitrification, and off-site disposal of the treated silos material at the NTS. The Silos 1
3 and 2 material is removed from the TTA as a slurry containing approximately 10 wt%
4 solids for the VIT1 process. The VIT1 process involves dewatering of the Silos 1 and 2
5 material slurry to minimize the volume of material to be vitrified. The process used to
6 demonstrate this alternative during POP testing produced a solid, stabilized wastefrom that
7 has a waste loading of approximately 90 wt% Silos 1 and 2 material. The treated material
8 is packaged in shielded shipping and disposal containers designed to meet the
9 requirements under DOT for shipping LSA-II solid material.

10 Data from the POP testing of the VIT1 alternative on surrogate Silos 1 and 2 material
11 indicate that the original 6,797 m³ (8,890 yd³) of material in Silos 1 and 2 could be
12 reduced to a monolithic wastefrom with a volume of approximately 3,274 m³ (4,283 yd³).

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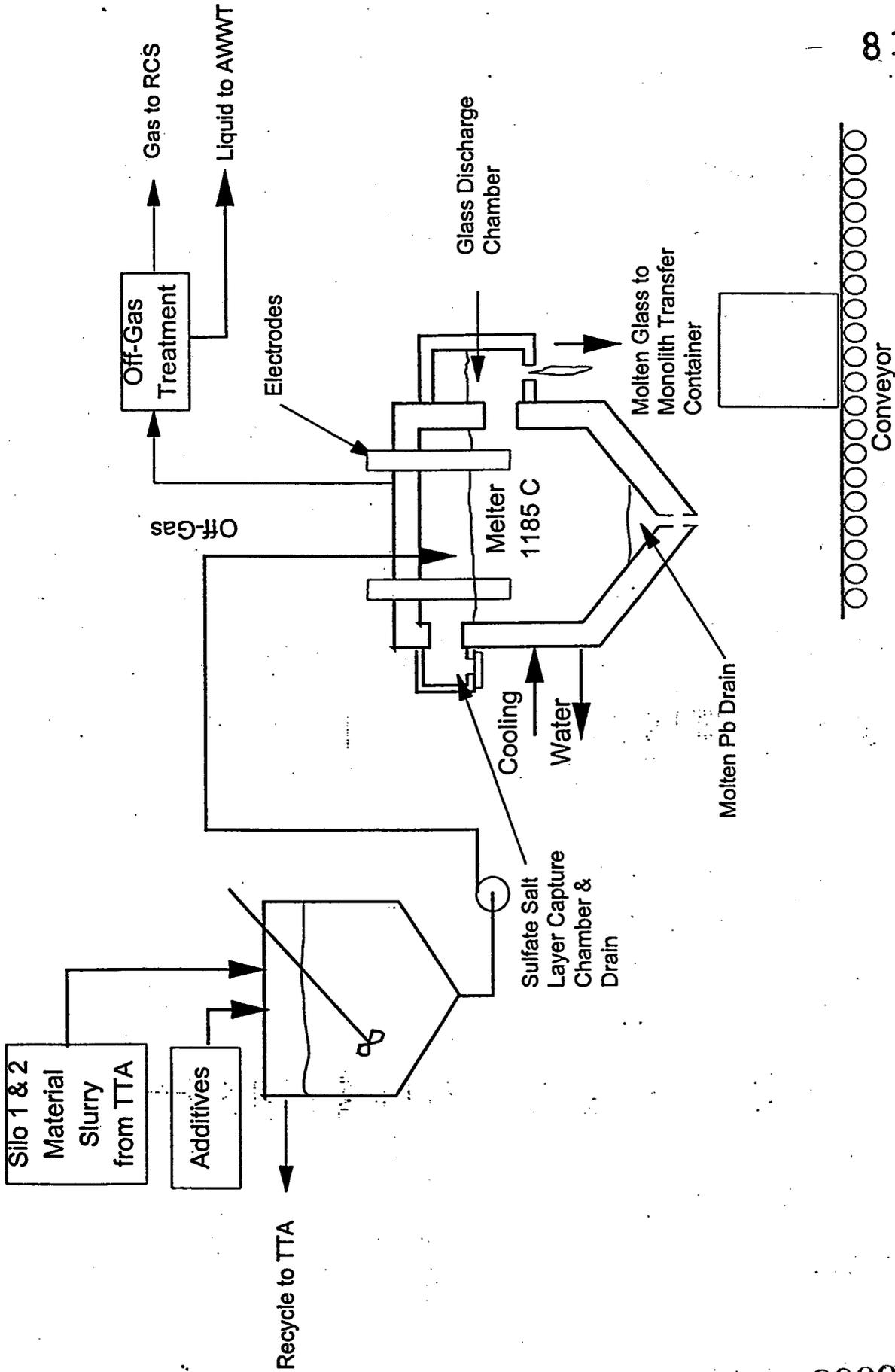


Figure 6.1-1

Simplified Process Diagram Vitrification - Joule-heated

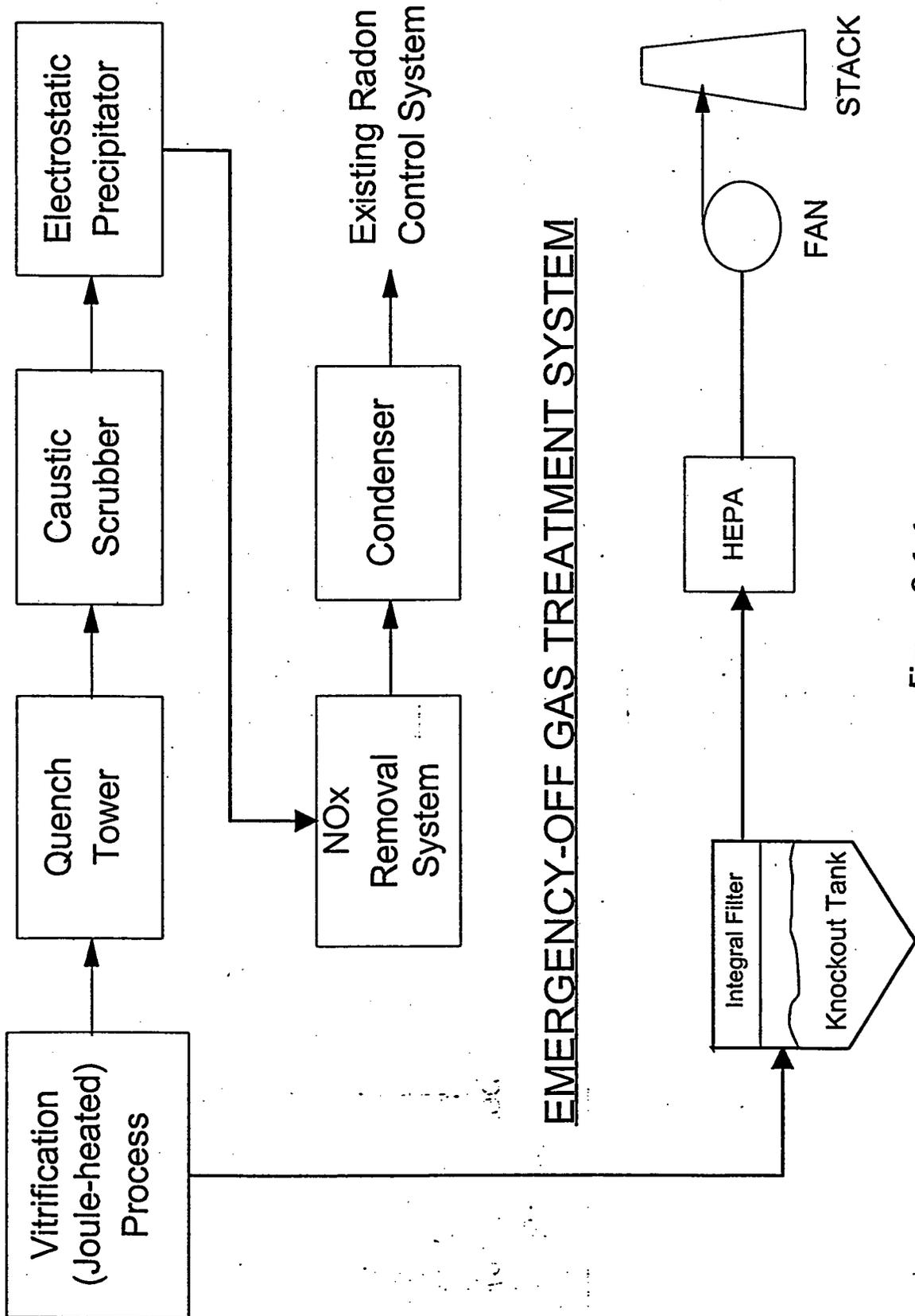


Figure 6.1-1a

Off-Gas Treatment System
Vitrification - Joule-heated

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1 However, due to the shielding necessary for protection of workers and the general public
2 and for meeting DOT requirements, containerization of the treated material results in an
3 overall disposal volume of approximately 8,895 m³ (11,635 yd³). In addition, the VIT1
4 process operations and maintenance (O&M) activities will generate approximately 1,430
5 m³ (1,870 yd³) of solid secondary waste. The total estimated disposal volume of the
6 treated Silos 1 and 2 material and all secondary wastestreams is 10,325 m³ (13,505 yd³),
7 equating to an overall volume increase of 52%, compared to the original volume of
8 material in Silos 1 and 2.

9 This alternative involves construction of a feed preparation system to prepare and deliver a
10 feed slurry containing both silos material and glass-formers to the melter, a nominal 15-ton
11 per day (TPD) joule-heated melter, and a melter off-gas system to provide necessary
12 treatment of effluent gases. The full-scale treatment facility also includes many support
13 systems such as product cooling, wastewater treatment, off-specification material rework,
14 building ventilation, and personnel support facilities. Additionally, the remediation facility
15 includes an interim storage facility capable of handling 45 days of production capacity in
16 order to accommodate the waste verification process and intermittent disruptions in the
17 FEMP shipping program.

18 This alternative involves the packaging, loading, and shipping (via truck or intermodal
19 transportation) of vitrified material for disposal at the NTS. Approximately 2,398 shipping
20 and disposal containers would be shipped to the NTS. If two containers were placed on
21 one truck per shipment, approximately 1,199 direct truck shipments to the NTS would be
22 required. For intermodal transport, two containers would be placed in an International
23 Shipping Organization (ISO) container. One ISO container would be placed on a truck and
24 two ISO containers would be placed on a railcar. This would result in 1,199 truck
25 shipments from the FEMP to an intermodal facility, 600 railcar shipments by regular freight
26 from an intermodal facility in the east to an intermodal facility in the west, and 1,199
27 truck shipments from the intermodal facility to the NTS.

1 The estimated cost for this alternative is summarized below:

2	Capital Cost	\$69 million (M)
3	Engineering Cost	\$25 M
4	O&M Cost	\$134 M
5	D&D Cost	\$35 M
6	Project Management Cost	\$22 M
7	Waste Disposal Cost	\$25 M
8	Cost of Money	\$46 M
9	Summary Cost	\$356 M

10

11 **6.2 On-site Vitrification other than Joule-heated, Off-site Disposal at the NTS (VIT2)**

12 **Figure 6.2-1** presents a simplified process flow diagram of the proposed VIT2 process. A
13 detailed discussion of this alternative is available in Section 3.3.1 of the revised FS.

14 The treatment system described in this section is based upon data and other information
15 compiled from POP testing and has been developed as a viable way to implement this
16 alternative. Equivalent systems may exist and are not precluded from consideration,
17 consistent with the final selected remedy, during remedial design.

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1 This alternative (VIT2) involves the removal, on-site treatment through vitrification by a
2 process other than joule-heated (combustion melter), and off-site disposal of the treated
3 silos material at the NTS. The Silos 1 and 2 material is removed from the TTA as a slurry
4 containing approximately 10 wt% solids for the VIT2 process. The VIT2 process involves
5 dewatering and drying of the Silos 1 and 2 material slurry to minimize the volume of
6 material to be vitrified. The process used to demonstrate this alternative during POP
7 testing produced a solid stabilized wasteform that has a waste loading of approximately
8 87 wt% Silos 1 and 2 material. The treated material is packaged in shielded shipping and
9 disposal containers designed to meet the requirements under DOT for shipping LSA-II solid
10 material.

11 Data from the POP testing of the VIT2 alternative on surrogate Silos 1 and 2 material
12 indicate that the original 6,797 m³ (8,890 yd³) of material in Silos 1 and 2 could be
13 reduced to a frit wasteform with a volume of approximately 6,643 m³ (8,689 yd³).
14 However, due to the shielding necessary for protection of workers and the general public
15 and for meeting DOT requirements, containerization of the treated material results in an
16 overall disposal volume of approximately 12,756 m³ (16,450 yd³). In addition, the VIT2
17 process O&M activities will generate approximately 1,644 m³ (2,150 yd³) of solid
18 secondary waste.

19 The total estimated disposal volume of the treated Silos 1 and 2 material and all secondary
20 wastestreams is 14,220 m³ (18,600 yd³), equating to an overall volume increase of
21 109%, compared to the original volume of material in Silos 1 and 2.

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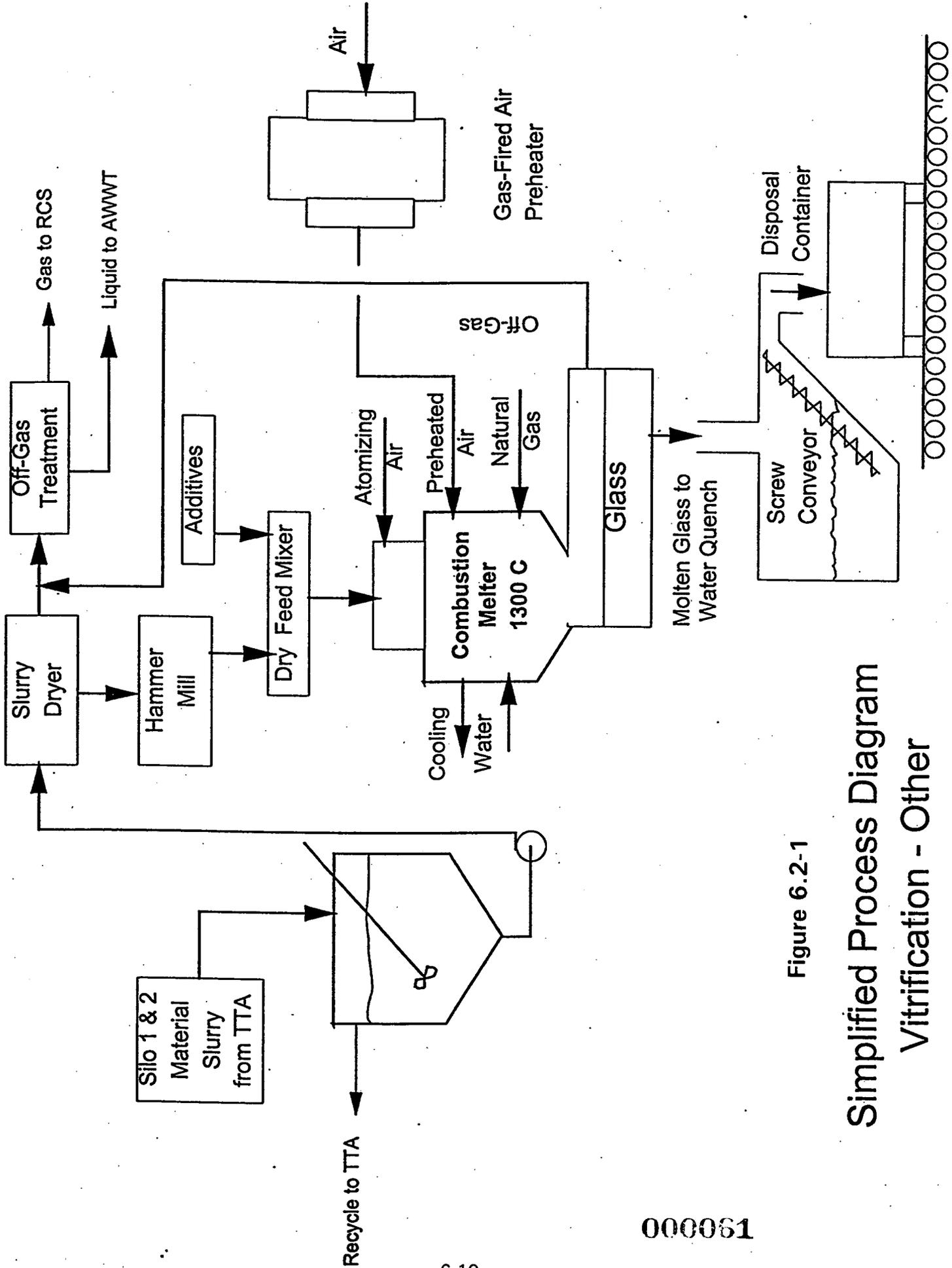
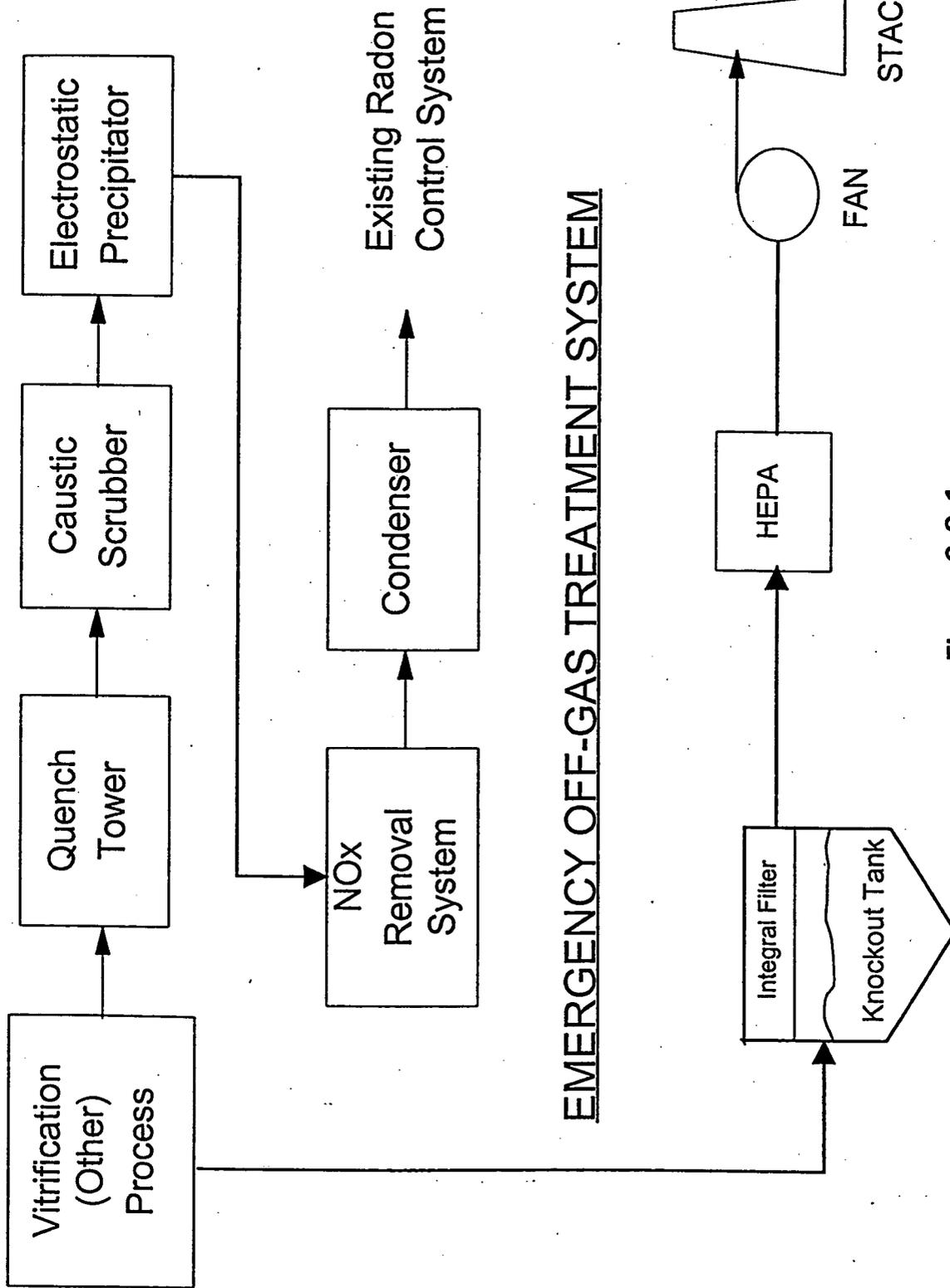


Figure 6.2-1

Simplified Process Diagram Vitrification - Other

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EMERGENCY OFF-GAS TREATMENT SYSTEM

Figure 6.2-1a

Off-Gas Treatment System
Vitrification - Other

1 This alternative involves construction of a feed preparation system to prepare and deliver a
2 dry feed containing both silos material and glass-formers to the melter, a nominal 15-TPD
3 combustion-heated melter, and a melter off-gas system to provide necessary treatment of
4 effluent gases. The full-scale treatment facility also includes many support systems such
5 as product forming, wastewater treatment, off-specification material rework, building
6 ventilation, and personnel support facilities. Additionally, the remediation facility includes
7 an interim storage facility capable of handling 45 days of production capacity in order to
8 accommodate the waste verification process and intermittent disruptions in the FEMP
9 waste shipping program.

10 This alternative involves the packaging, loading, and shipping (via truck or intermodal
11 transportation) of vitrified material for disposal at the NTS. Approximately 2,162 shipping
12 and disposal containers would be shipped to the NTS. If two containers were placed on
13 one truck per shipment, approximately 1,081 direct truck shipments to the NTS would be
14 required. For intermodal transport, two containers would be placed in an ISO container.
15 One ISO container would be placed on a truck and two ISO containers would be placed on
16 a railcar. This would result in 1,081 truck shipments from the FEMP to an intermodal
17 facility, 541 railcar shipments by regular freight from an intermodal facility in the east to
18 an intermodal facility in the west, and 1,081 truck shipments from the intermodal facility
19 to the NTS.

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1 The estimated cost for this alternative is summarized below:

2

3	Capital Cost	\$67 M
4	Engineering Cost	\$25 M
5	O&M Cost	\$133 M
6	D&D Cost	\$38 M
7	Project Management Cost	\$22 M
8	Waste Disposal Cost	\$20 M
9	Cost of Money	\$37 M
10	Summary Cost	\$342 M

11 **6.3 On-site Chemical Stabilization Cement-based, Off-site Disposal at the NTS (CHEM1)**

12 **Figure 6.3-1** presents a simplified process flow diagram of the proposed CHEM1 process.

13 A detailed discussion of this alternative is available in **Section 3.4.1** of the revised FS.

14 The treatment system described in this section is based upon data and other information
15 compiled from POP testing and has been developed as a viable way to implement this
16 alternative. Equivalent systems may exist and are not precluded from consideration,
17 consistent with the final selected remedy, during remedial design.

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1 This alternative (CHEM1) involves the removal, on-site treatment through chemical
2 stabilization by a cementation process, and off-site disposal of the treated silos material at
3 the NTS. The Silos 1 and 2 material is removed from the TTA as a slurry containing
4 approximately 10 wt% solids for the CHEM1 process. The CHEM1 process involves
5 dewatering of the Silos 1 and 2 material slurry to minimize the volume of material to be
6 stabilized. The process used to demonstrate this alternative during POP testing produces a
7 solid stabilized wasteform that has a waste loading of approximately 40 wt% Silos 1
8 and 2 material. However, a 30 wt% waste loading was used for the evaluation of the
9 CHEM1 alternative to enhance the ease of operability. The treated material is packaged in
10 shielded shipping and disposal containers designed to meet the requirements under DOT
11 for shipping LSA-II solid material.

12 Data from the POP testing of the CHEM1 alternative on surrogate Silos 1 and 2 material
13 indicate that the original 6,797 m³ (8,890 yd³) of material in Silos 1 and 2 would be
14 increased to a wasteform with a volume of approximately 20,836 m³ (27,254 yd³).
15 However, due to the shielding necessary for protection of workers and the general public
16 and for meeting DOT requirements, containerization of the treated material results in an
17 overall disposal volume of approximately 36,431 m³ (47,652 yd³). In addition, the CHEM1
18 process O&M activities will generate approximately 1,388 m³ (1,815 yd³) of solid
19 secondary waste. The total estimated disposal volume of the treated Silos 1 and 2
20 material and all secondary wastestreams is 37,819 m³ (49,500 yd³), equating to an overall
21 volume increase of 456%, compared to the original volume of material in Silos 1 and 2.

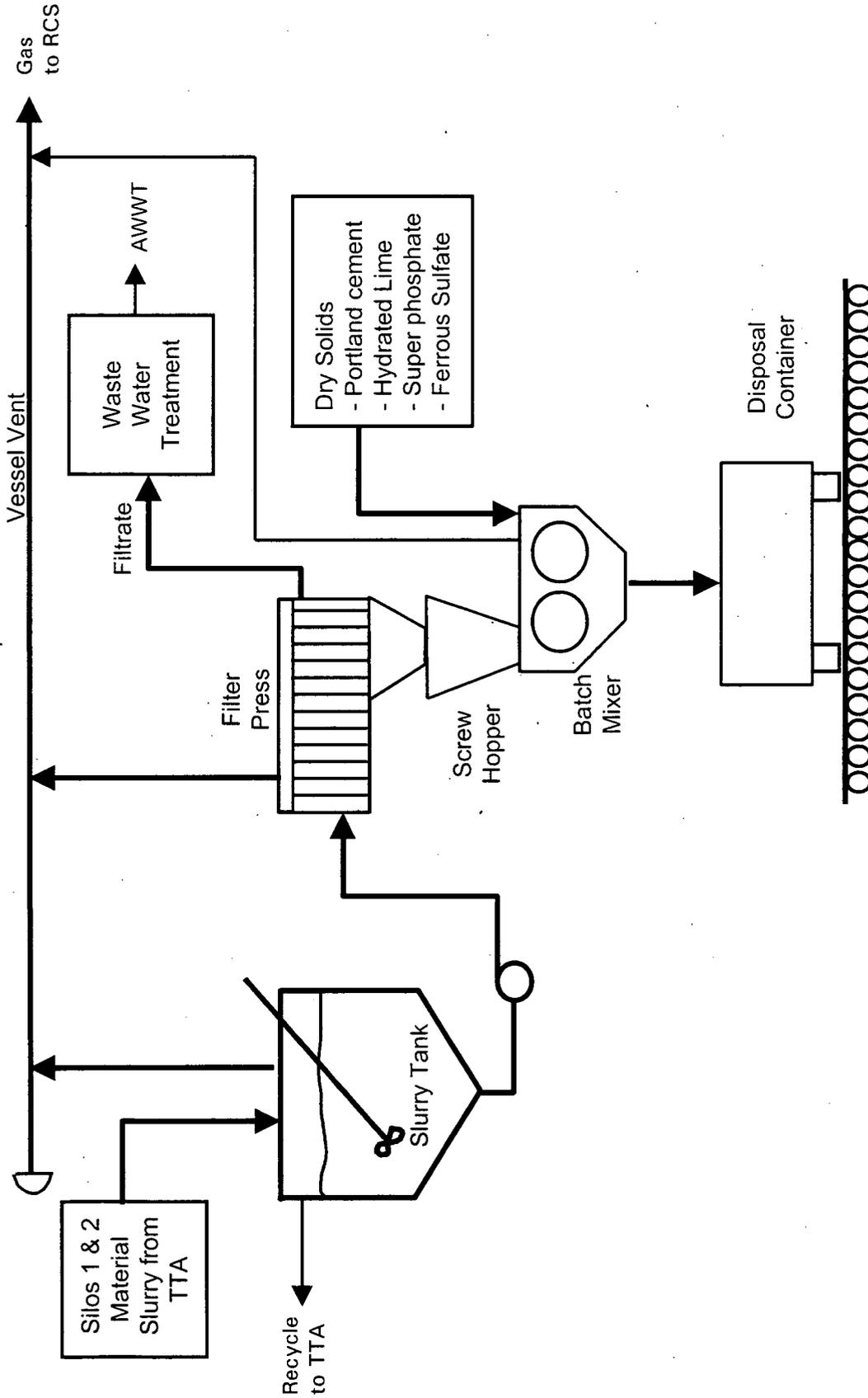


Figure 6.3-1

Simplified Process Diagram
Chemical Stabilization - Cement-based

1 This alternative involves construction of a feed preparation system to prepare and deliver a
2 feed slurry containing both silos material and cement-based additives to the mixer, a
3 nominal 80-TPD mixer, and an air emissions system to provide necessary treatment of
4 radionuclide particulate. The full-scale treatment facility also includes many support
5 systems such as product curing, off-specification material rework, building ventilation, and
6 personnel support systems. Additionally, the remediation facility includes an interim
7 storage facility capable of handling 45 days of production capacity in order to
8 accommodate the waste verification process and intermittent disruptions in the FEMP
9 waste shipping program.

10 This alternative involves the packaging, loading, and shipping (via truck or intermodal
11 transportation) of stabilized material for disposal at the NTS. Approximately 6,078
12 shipping and disposal containers would be shipped to the NTS. If two containers were
13 placed on one truck per shipment, approximately 3,039 direct truck shipments to the NTS
14 would be required. For intermodal transport, two containers would be placed in an ISO
15 container. One ISO container would be placed on a truck and two ISO containers would
16 be placed on a railcar. This would result in 3,039 truck shipments from the FEMP to an
17 intermodal facility, 1,520 railcar shipments by regular freight from an intermodal facility in
18 the east to an intermodal facility in the west, and 3,039 truck shipments from the
19 intermodal facility to the NTS.

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1 The estimated cost for this alternative is summarized below:

2		
3	Capital Cost	\$55 M
4	Engineering Cost	\$24 M
5	O&M Cost	\$77 M
6	D&D Cost	\$34 M
7	Project Management Cost	\$21 M
8	Waste Disposal Cost	\$58 M
9	Cost of Money	\$28 M
10	Summary Cost	\$297 M
11		
12		

13 **6.4 On-site Chemical Stabilization other than Cement-based, Off-site Disposal at the NTS**
14 **(CHEM2)**

15 **Figure 6.4-1** presents a simplified process flow diagram of the proposed CHEM2 process.
16 A detailed discussion of this alternative is available in Section 3.5.1 of the revised FS.

17 The treatment system described in this section is based upon data and other information
18 compiled from POP testing and has been developed as a viable way to implement this
19 alternative. Equivalent systems may exist and are not precluded from consideration,
20 consistent with the final selected remedy, during remedial design.

1 This alternative (CHEM2) involves the removal, on-site treatment through chemical
2 stabilization by a process that is not cement-based, and off-site disposal of the treated
3 silos material at the NTS. The Silos 1 and 2 material is removed from the TTA as a slurry
4 containing approximately 10 wt% solids for the CHEM1 process. The CHEM2 process
5 involves combining the Silos 1 and 2 material as a liquid slurry with a binder and other
6 chemical additives in a carbon steel cylindrical shipping and disposal container with a
7 built-in agitator. The process used to demonstrate this alternative during POP testing
8 produced a solid stabilized wasteform that has a waste loading of approximately 24 wt%
9 Silos 1 and 2 material. The treated material is packaged in shielded shipping and disposal
10 containers designed to meet the requirements under DOT for shipping LSA-II solid material.

11 Data from the POP testing of CHEM2 alternative on surrogate Silos 1 and 2 material
12 indicate that the original 6,797 m³ (8,890 yd³) of material in Silos 1 and 2 would be
13 increased to a wasteform with a volume of approximately 22,855 m³ (29,895 yd³).
14 However, due to the shielding necessary for protection of workers and the general public
15 and for meeting DOT requirements, containerization of the treated material results in an
16 overall disposal volume of approximately 33,144 m³ (43,352 yd³). In addition, the CHEM2
17 process O&M activities will generate approximately 1,300 m³ (1,700 yd³) of solid
18 secondary waste. The total estimated disposal volume of the treated Silos 1 and 2
19 material and all secondary wastestreams is 34,444 m³ (45,050 yd³), equating to an overall
20 volume increase of 407%, compared to the original volume of material in Silos 1 and 2.

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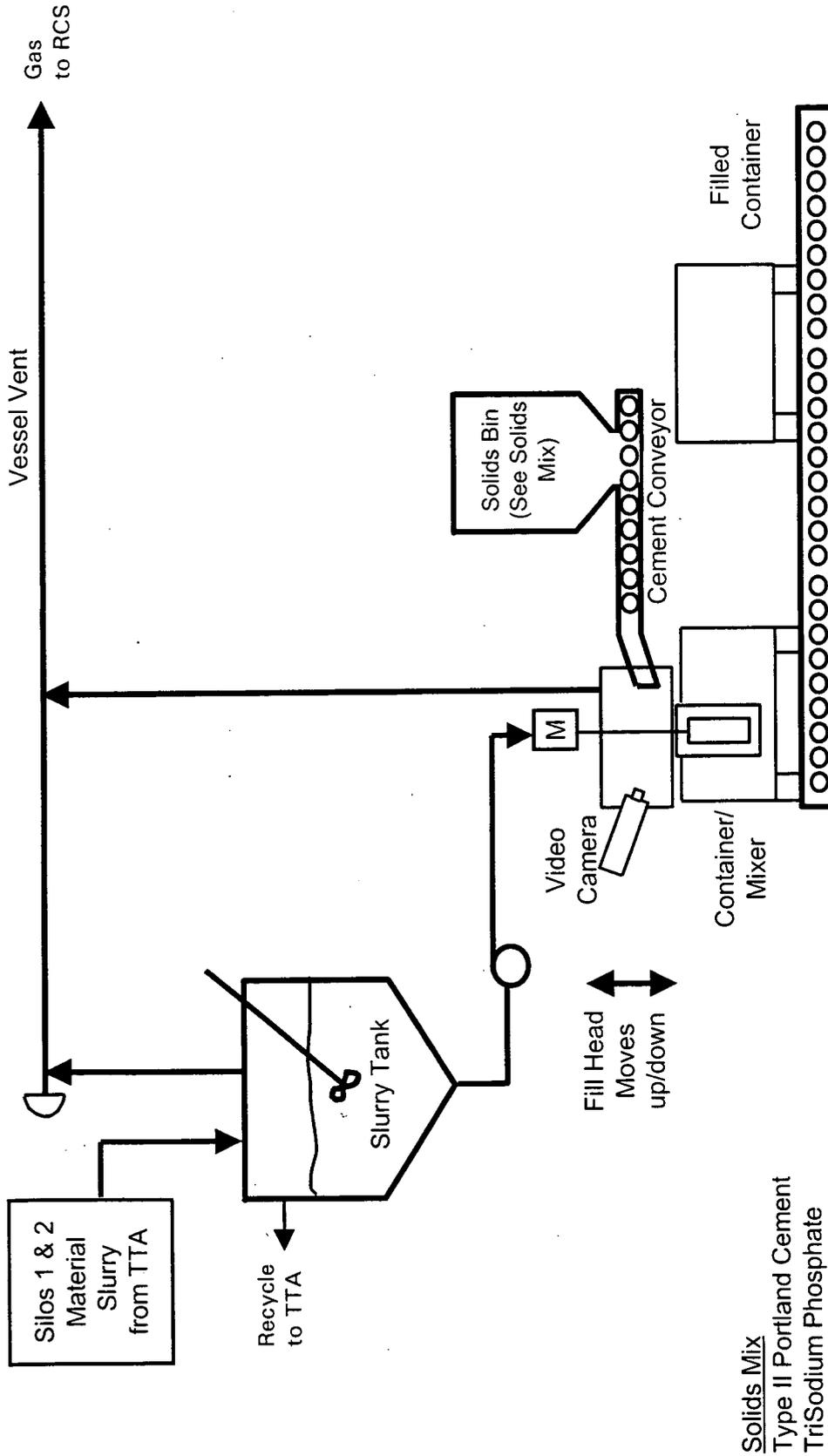


Figure 6.4-1
Simplified Process Diagram
Chemical Stabilization - Other

1 This alternative involves construction of a feed preparation system to prepare and deliver a
2 feed slurry containing both silos material and chemical additives to the container with
3 built-in agitation, three container lines make up the nominal 105-TPD processing plant, and
4 an air emissions system to provide necessary treatment of radionuclide particulate. The
5 full-scale treatment facility also includes many support systems such as product curing,
6 wastewater treatment, off-specification material rework, building ventilation, and
7 personnel support facilities. Additionally, the remediation facility includes an interim
8 storage facility capable of handling 45 days of production capacity in order to
9 accommodate the waste verification process and intermittent disruptions in the FEMP
10 waste shipping program.

11 This alternative involves the packaging, loading, and shipping (via truck or intermodal
12 transportation) of chemically stabilized material for disposal at the NTS via truck or
13 intermodal transportation. Approximately 6,106 shipping and disposal containers would
14 be shipped to the NTS. If two containers were placed on one truck per shipment,
15 approximately 3,053 direct truck shipments to the NTS would be required. For intermodal
16 transport, two containers would be placed in an ISO container. One ISO container would
17 be placed on a truck and two ISO containers would be placed on a railcar. This would
18 result in 3,053 truck shipments from the FEMP to an intermodal facility, 1,527 railcar
19 shipments by regular freight from an intermodal facility in the east to an intermodal facility
20 in the west, and 3,053 truck shipments from the intermodal facility to the NTS.

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1 The estimated cost for this alternative is summarized below:

2		
3	Capital Cost	\$56 M
4	Engineering Cost	\$24 M
5	O&M Cost	\$83 M
6	D&D Cost	\$36 M
7	Project Management Cost	\$21 M
8	Waste Disposal Cost	\$55 M
9	Cost of Money	\$28 M
10	Summary Cost	\$303 M

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1 **7.0 EVALUATION OF ALTERNATIVES**

2 **7.1 Treatment Alternatives for the Silos 1 and 2 Material**

3 The four alternatives evaluated in the revised FS for Silos 1 and 2 consist of two
4 treatment technologies (vitrification and chemical stabilization), each represented by two
5 specific processes (VIT1, VIT2 and CHEM1, CHEM2). Two processes for each treatment
6 technology were chosen in order to provide a balanced analysis of each technology against
7 the CERCLA evaluation criteria. Throughout the detailed analysis, discrete differences of
8 each process design were identified. However, no fundamental differences in any of the
9 CERCLA evaluation criteria were identified to exist between the two vitrification
10 processes, or between the two chemical stabilization processes. It is clear from the
11 detailed evaluation that the discriminating differences between the four original
12 alternatives are associated with differences between the two treatment technologies
13 (vitrification versus chemical stabilization), as opposed to differences between the
14 individual processes evaluated under each technology.

15 No significant differences were identified in the detailed analysis of alternatives that
16 provide a compelling reason to select a given process option over the other in either
17 treatment technology. For this reason, the final remedial selection decision will be
18 between the vitrification and chemical stabilization technologies. The treatment systems
19 described in the revised FS are based upon data and other information compiled from POP
20 testing and have been developed as viable ways to remediate the Silos 1 and 2 material.
21 Equivalent vitrification or chemical stabilization processes that are consistent with the
22 selected remedy may become commercially available and are not precluded from
23 consideration, consistent with the final selected remedy, during remedial design. As
24 previously stated, in addition to the treatment technology, the selected remedy for the
25 Silos 1 and 2 material will also include retrieval of the Silos 1 and 2 material from the TTA,
26 on-site treatment, off-site disposal of the treated material at the NTS, and the disposal of
27 remediated soil and D&D debris consistent with the OSDF WAC.

1 **7.2 Evaluation Criteria**

2 Section 4 of the revised FS presents a comparative analysis of alternatives for the
3 treatment of the Silos 1 and 2 material with respect to the nine evaluation criteria
4 specified by the NCP to meet the requirements of CERCLA. This analysis is the second
5 stage of the detailed evaluation process and forms the basis for identifying the preferred
6 remedial alternative for the Silos 1 and 2 material.

7 The NCP divides the evaluation criteria used in this comparative analysis into three
8 categories: threshold, primary balancing, and modifying. More detailed definitions of the
9 evaluation criteria can be found in Section 3.1, Overview of the Detailed Analysis of the
10 revised FS.

11 *Threshold* criteria consist of the two criteria that must be satisfied by the selected
12 alternative:

- 13 • Overall protection of human health and the environment; and
14 • Compliance with ARARs.

15

16 These criteria are of greatest importance in the comparative analysis because they reflect
17 the key statutory mandates of CERCLA, as amended. An alternative must satisfy both of
18 these *threshold criteria* before it is eligible to be selected as the final remedy.

19 *Primary balancing* criteria consist of the five criteria under which the relative advantages
20 and disadvantages of the alternatives are compared to determine the best overall remedy:

- 21 • Long-term effectiveness and permanence;
22 • Reduction of toxicity, mobility, or volume through treatment;
23 • Short-term effectiveness;
24 • Implementability; and
25 • Cost.

26

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1 The first and second balancing criteria reflect the statutory preference for treatment as a
2 principal element of the remedy and the bias against off-site land disposal of untreated
3 material. Together with the third and fourth balancing criteria, they form the basis for
4 determining the general feasibility of each potential remedy. In addition, the primary
5 balancing criteria are used to determine whether costs are proportional to the overall
6 protectiveness, considering both the remediation activity and the time period following
7 restoration of the OU4 area. By this approach, it can be determined whether a potential
8 remedy is cost-effective.

9 The final two criteria, identified in the NCP as *modifying criteria*, will be evaluated
10 following public and agency comments on the revised FS and PP and will be addressed in
11 the ROD amendment once a final proposed remedy is selected. The modifying criteria are:

- 12 • State acceptance; and
- 13 • Community acceptance.

14 Figure 7.2-1 summarizes the comparative analysis of the alternatives.

15 7.2.1 Threshold Criteria

16 7.2.1.1 Overall Protection of Human Health and the Environment

17 Both vitrification and chemical stabilization provide overall protection of human health and
18 the environment, as defined by the NCP. Each alternative limits exposure to contaminants
19 by removing the sources of contamination, effectively treating the source materials to
20 minimize the mobility of contaminants, and disposing the treated material in a protective
21 manner off-site at the NTS.

1 The *Environmental Assessment for Proposed Final Land Use at the Fernald Environmental*
2 *Management Project* (DOE 1999) establishes the future land use of the FEMP to be
3 continued under federal ownership with the area of OU4 being restored to a riparian and
4 upland forest. This scenario is similar to that which was evaluated in the original OU4 FS
5 (FEMP 1994a). In addition, the two technologies being compared in this evaluation are the
6 same as those evaluated in the original OU4 FS. Similar to the original OU4 FS, all
7 alternatives specify that the Silos 1 and 2 material will be treated and removed from the
8 FEMP to the NTS for disposal, and all surrounding soil will be excavated, removed and
9 disposed to meet final remediation levels documented in the OU2 ROD (FEMP 1995c) and
10 the OU5 ROD (FEMP 1996b). Therefore, the residual risk outlined in the original OU4 FS
11 are still applicable to evaluation of the current alternatives. The results of the original
12 analysis state that long-term risk to the public is within CERCLA guidelines because the
13 Silos 1 and 2 material and contaminated soil are treated and removed from the OU4 area.

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**FIGURE 7.2-1
COMPARATIVE ANALYSIS SUMMARY**

ITEM	VIT1/VIT2		CHEM1/CHEM2	
	Strongly Favors	Favors	Neutral	Strongly Favors
Overall Protection of Human Health and the Environment			↓	
Compliance with Applicable or Relevant and Appropriate Requirements			↓	
Long-Term Effectiveness and Permanence			↓	
Reduction of Toxicity, Mobility, or Volume Through Treatment	↓			
Short-Term Effectiveness				↓
Implementability				↓
Cost			↓	
State Acceptance - TBD				
Community Acceptance - TBD				

1 Both technologies produce a stabilized material that resists leaching and therefore reduces
2 the potential for contaminant migration. As discussed in **Section 7.2.2.2, Toxicity**
3 **Characteristic Leaching Procedure (TCLP)** results demonstrate prevention of contaminant
4 mobility even in the event that the integrity of the original wastefrom is degraded.

5 Overall protection at the NTS is provided by a combination of treatment to reduce the
6 mobility of contaminants and exposure potential with a disposal configuration that isolates
7 the treated waste from potential contaminant transport mechanisms and exposure
8 pathways. Again, the basic difference between the alternatives is the treatment
9 technology (vitrification or chemical stabilization).

10 The nature and extent of impacts to biota from implementing the technologies are similar.
11 Each alternative involves site preparation and construction for a processing facility,
12 removal of the silos material from the TTA, remediation of the silos material, and transport
13 of the treated material to the NTS for disposal. Short-term impacts include the temporary
14 loss of habitats at the FEMP site and possible impacts from accidental spills of
15 construction and operation materials. Mitigative measures would be employed to minimize
16 these short-term risks.

17 The off-site disposal location is the NTS facility, which has been used by the DOE for
18 disposal of low-level radioactive waste. The NTS incorporates engineering and
19 institutional controls to isolate the treated waste from exposure pathways and is located in
20 a climatic, demographic, and hydrogeologic setting that favors minimization of
21 contaminant migration to both human and environmental receptors. In the event of
22 long-term degradation of engineered features or loss of institutional controls, these site
23 characteristics coupled with the reduction in contaminant leachability provided by the
24 treatment process ensure that protectiveness of human health and the environment is
25 maintained.

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1 7.2.1.2 Compliance with ARARs

2 The vitrification and chemical stabilization technologies attain the threshold criterion of
3 compliance with ARARs. A comprehensive list of ARARs is presented in Appendix A of
4 the revised FS. Key requirements are discussed in Section 3 of the revised FS within the
5 evaluation of each alternative against this criterion. The following paragraphs summarize
6 those evaluations.

7 Chemical-specific ARARs

8 Both vitrification and chemical stabilization technologies meet the chemical-specific ARARs
9 associated with potential releases to groundwater, surface water, and air. The most
10 critical chemical-specific ARAR relative to airborne releases relates to radon. The primary
11 limit on radon emanation is the flux limit specified in National Emissions Standards for
12 Hazardous Air Pollutants, 40 CFR Part 61 Subpart Q, of 20 picoCuries per square
13 meter-second ($\text{pCi}/\text{m}^2\cdot\text{s}$). This limit applies to interim storage or final disposal of Silos 1
14 and 2 material. Both alternatives meet this ARAR during interim storage and after
15 disposal. Both alternatives meet requirements for control of radon, particulate, and other
16 air emissions from remediation activities through incorporation of necessary air-emission
17 treatment. The impact of radon emissions during remediation is evaluated as part of the
18 short-term effectiveness criterion.

19 Location-specific ARARs

20 Vitrification and chemical stabilization technologies meet the location-specific ARARs as
21 they relate to floodplains, wetlands, and endangered species and their habitats.
22 Compliance with these alternatives is met through proper planning, siting, design, and
23 operational procedures.

1 Action-specific ARARs

2 Vitrification and chemical stabilization technologies meet the action-specific ARARs
3 identified for these alternatives. Appropriate engineering controls are implemented for
4 each alternative to comply with Ohio Water Quality Standards and Air Quality Standards.
5 Hazardous material transportation requirements are complied with by following the
6 regulations under 40 CFR Parts 262 and 263, and the appropriate DOT shipping standards
7 under 49 CFR Subchapter C Hazardous Materials regulations.

8 7.2.2 Primary Balancing Criteria

9 7.2.2.1 Long-term Effectiveness and Permanence

10 Both vitrification and chemical stabilization technologies ensure long-term protectiveness
11 of human health and the environment through treatment. TCLP analysis indicates that all
12 four processes evaluated in POP testing produced wasteforms that consistently met the
13 NTS WAC and were durable based on leach rate data. The TCLP test is used to simulate
14 the leaching effects of acidic groundwater infiltrating the disposal cell and contacting
15 disposed waste. This test measures the ability of the stabilized waste particles to resist
16 leaching, even if the original wasteform (e.g., monolith) has been compromised.

17 Both alternatives include treatment that permanently reduces the leachability of COCs.
18 Off-site disposal at the NTS provides additional protection by eliminating access to the
19 treated materials and preventing migration of constituents from the materials. Location of
20 the NTS disposal facility in a sparsely populated, arid environment reduces potential for
21 leachate generation, contaminant migration, and prevents direct contact with
22 contaminants. Because the NTS is owned and maintained by DOE and used for the
23 disposal of low-level wastes from other DOE sites, the uncertainties associated with
24 institutional controls are minimal. As the result of a low average annual precipitation and
25 depth to groundwater, impacts to human health and the environment from possible
26 engineering and institutional controls failure are minimal.

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1 There are no long-term environmental impacts at the FEMP site pertaining to the removal
2 of Silos 1 and 2 material and treatment processes. The projected FEMP site residual risk to
3 viable receptors is less than the NCP criterion of 10^{-6} ILCR, and non-carcinogenic effects
4 are expected to be below 0.2 (HI) specified by the NCP for both alternatives. Long-term
5 environmental impacts at the NTS involve some permanent disturbance of soils
6 (i.e., acquisition of borrow material) associated with disposal activities. Significant long-
7 term impacts are not expected to water quality or hydrology, air quality, biotic resources,
8 socioeconomics or land use, or cultural resources. Wetland or floodplain areas have not
9 been delineated at the NTS.

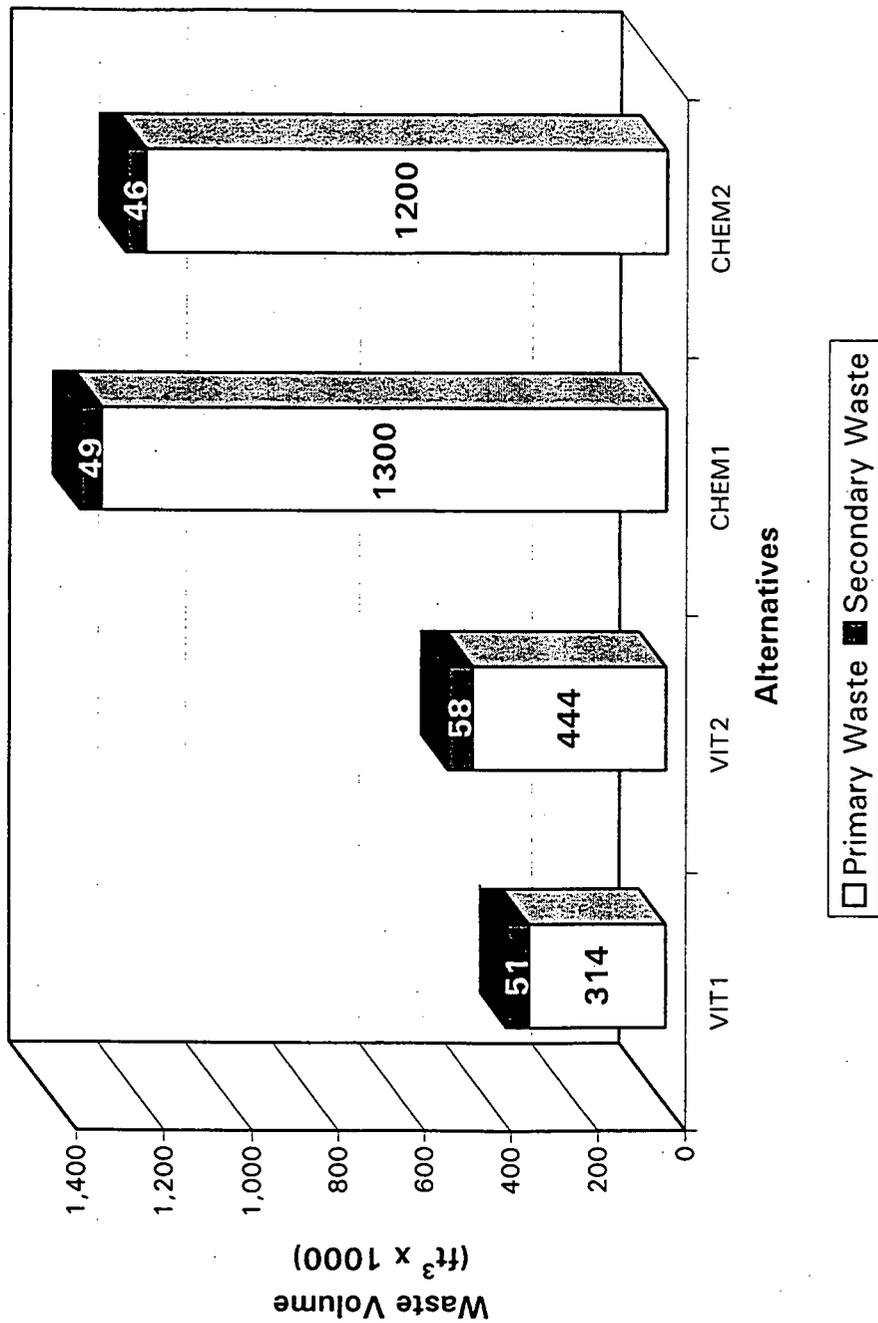
10 7.2.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

11 Overall, this criterion favors vitrification due to the reduction in treated material volume.

12 **Figure 7.2-2** presents a comparison of the expected primary and secondary waste disposal
13 volumes associated with the vitrification and chemical stabilization alternatives.

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Figure 7.2-2
Total Solid Waste Volume Summary



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1 Both of the technologies are effective in reducing the mobility of COCs in the Silos 1 and 2
2 material through treatment. TCLP tests conducted on the treated surrogate material during
3 POP testing indicate that either alternative can reduce the leachate concentrations of
4 hazardous metals to below regulatory limits established under 40 CFR Part 261.24.
5 Vitrification chemically binds the contaminants in a glass-like matrix that significantly
6 reduces contaminant mobility. Chemical stabilization reduces the mobility of contaminants
7 by either converting the contaminants into a less soluble form or by chemically binding
8 them into a stabilized matrix.

9 POP testing of the vitrification alternative has demonstrated that the treatment method
10 results in a reduction in volume of the Silos 1 and 2 material. The wide range in volume
11 associated with the vitrified material is due to the wastefrom produced in the vitrification
12 process. A monolith has very little void space, approximately 2% resulting from air
13 pockets. However, the frit wastefrom has a sizeable amount of void space, approximately
14 50% due to the inefficiency in packaging non-uniform material. An overall increase in
15 disposal volume, compared to the original volume of material in Silos 1 and 2, results from
16 placing the treated material in thick-walled, concrete disposal containers which are
17 required to provide the shielding necessary for protection of the public and workers during
18 transportation activities.

19 Because of the chemical additives and fixatives added to the Silos 1 and 2 material for the
20 chemical stabilization alternative, there is a resultant increase in volume of the treated
21 material compared to the original volume of material in Silos 1 and 2. The volume increase
22 is dependent on the waste loading of the Silos 1 and 2 material in the treatment
23 formulation. An additional increase in overall disposal volume results from placing the
24 treated material in thick-walled disposal containers.

1 The consideration of a solid secondary wastestream does not significantly affect the
2 differences in the total volume of treated waste requiring disposal between the
3 technologies. However, the vitrification alternatives have the greater potential to generate
4 secondary wastestreams, which although their volume is relatively small, are more difficult
5 to handle and to treat for disposal (i.e., salts, reduced metals, spent refractory, mixed
6 waste).

7 The vitrified Silos 1 and 2 material reduces radon emanation more effectively than does
8 the chemically stabilized material. However, the combination of radon mitigation provided
9 by the chemically stabilized material plus the engineered barriers and packaging associated
10 with the disposal of treated materials, effectively controls radon emanation. Both
11 alternatives provide effective control of radon emanation from the treated Silos 1 and 2
12 material. The impact of radon emissions during remediation is evaluated as part of the
13 short-term effectiveness criterion.

14 7.2.2.3 Short-term Effectiveness

15 The NCP identifies the components of short-term effectiveness as short-term risks to the
16 community during implementation of the alternative; potential impacts to workers during
17 RA; potential environmental impacts during implementation; and time until protection is
18 achieved. Although each alternative is favorable in individual aspects of short-term
19 effectiveness, from an overall perspective, this criterion favors chemical stabilization due
20 to lower on-site worker risk and higher schedule certainty. The basis for determination of
21 risks is detailed in Appendices B and E of the revised FS.

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1 Worker Risk

2 Vitrification presents an increased non-radiological risk to the worker during on-site
3 operations due to the greater number of person-hours estimated to complete remediation
4 and increased physical hazards in the work place. An occupational hazard analysis was
5 performed on the proposed design for each alternative (Appendix B of the revised FS).
6 The hazard analysis evaluated the potential physical and chemical hazards to the workers
7 involved with the on-site O&M activities. Table 7.2-1 presents a summary of the
8 discriminating hazards posed to workers as determined by the analyses of the alternatives.

9 The vitrification process liberates essentially all of the radon from the Silos 1 and 2
10 material during treatment process. Chemical stabilization liberates less radon during the
11 treatment process, but continues to generate radon during subsequent product handling
12 operations. In both cases, sufficient radon control is provided to mitigate radon releases
13 and attain environmental and worker protection limits. The calculated radon
14 concentrations due to projected routine emissions for either alternative show no
15 measurable impact to FEMP fence line radon concentrations.

16 Both vitrification and chemical stabilization are able to meet the radon flux limit of
17 20 pCi/m²·s during interim storage at the FEMP and after disposal. Sufficient attenuation
18 of radon is provided by the vitrified material without reliance on the packaging or disposal
19 configuration. Although the chemical stabilization process provides attenuation of radon,
20 it is reliant on packaging to meet the radon flux limit.

**TABLE 7.2-1
SUMMARY OF KEY HAZARDS TO ON-SITE WORKERS**

Physical hazards due to vehicle and container movement	Greater hazard for chemical stabilization due to greater number of containers
Fall Hazards	Greater hazard for vitrification - more elevated equipment
Exposure to hazardous chemicals and toxicants	Greater hazard for vitrification - toxic constituents (SO _x , NO _x , lead - storage of caustic for scrubber, and gases)
Electrical shock	Greater hazard for vitrification - higher power requirements, more complex electrical system
Human hazards	Greater hazard for vitrification - greater number of work hours
High or changing pressure	Greater hazard for vitrification - remote potential for over-pressurization of the melter; potential releases from Emergency Off-gas System
Thermal hazards	Greater hazard for vitrification - high temperature in melter; handling of molten glass; high temperature off-gas
Spills/loss of containment	Greater hazard for vitrification - molten glass, toxic off-gas constituents, higher radon concentrations and caustic storage result in greater consequences for spills, leaks, etc.

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1 Transportation Risk

2 Appendix E of the revised FS evaluates the short-term risks associated with the
3 transportation, both by direct truck and intermodal shipments, of the treated silos material
4 to the NTS. The implementation of either transportation option presents a minimal risk to
5 the public, within the CERCLA target risk range of 1×10^{-4} to 1×10^{-6} . However, due to the
6 greater number of shipments required to ship the larger volume of treated material, the
7 transportation risk is incrementally higher for chemical stabilization.

8 For both technologies, transportation to the NTS complies with DOT regulations and DOE
9 guidelines. The transportation of the Silos 1 and 2 material to the NTS by either truck or
10 intermodal shipments is protective of human health and the environment. In addition, the
11 anticipated shipping rate of 7 to 20 shipments per week does not represent a significant
12 impact on total highway traffic.

13 Off-site Environmental Impact

14 Short-term impacts associated with both technologies includes temporary disruption of
15 several acres of land at the FEMP site for construction of the treatment facility and
16 material handling. There is a potential for increased fugitive dust during construction
17 activities; however, appropriate controls minimize the potential short-term impacts.

18 Time to Achieve Protection

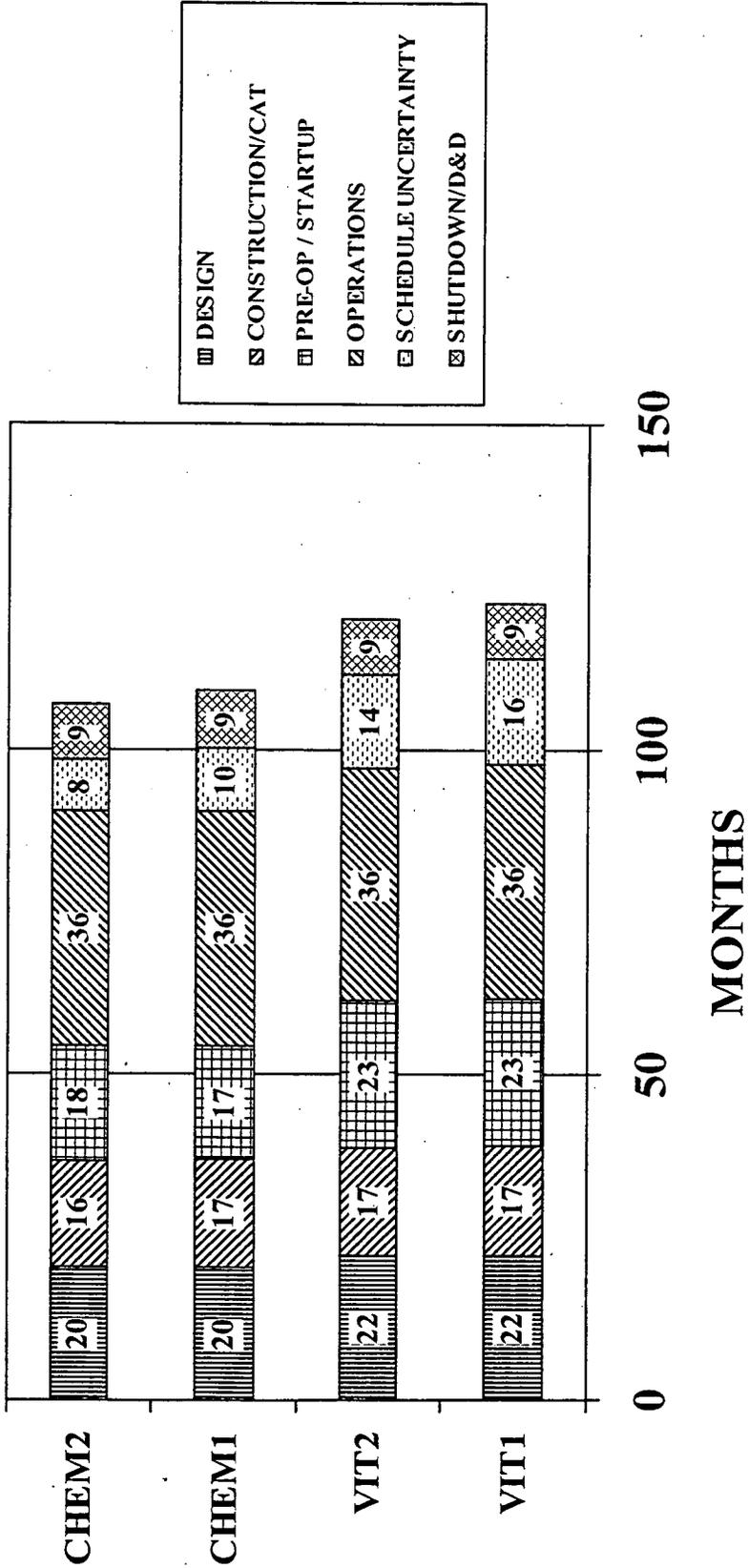
19 Due to a shorter design-construction start-up period, and more feasible schedule
20 acceleration, chemical stabilization is preferred with respect to time to achieve
21 protectiveness. Figure 7.2-3 presents a comparative summary of the schedules for each
22 alternative.

1 The time period between the approval of the ROD amendment and the initiation of
2 treatment operations (i.e., design, construction, construction acceptance testing,
3 preoperations, and start-up) for the Silos 1 and 2 remediation is estimated to be 62
4 months for vitrification, compared to 54 months for chemical stabilization. The difference
5 of eight months between the two schedules is primarily attributed to the time required,
6 based upon lessons learned during start-up of DOE vitrification facilities, to perform Proof
7 of Process testing during start-up of the vitrification facility. In addition, the technical risk
8 evaluation results in a calculated schedule uncertainty of 14-16 months for vitrification
9 compared to 8-10 months for chemical stabilization.

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FIGURE 7.2-3

TIME TO ACHIEVE PROTECTION
SCHEDULE COMPARISON



1 While vitrification requires full-time (24 hr/day, 7 days/week) operation to complete
2 treatment within the specified three-year period, the chemical stabilization can complete
3 treatment within three years with less than full-time operation. Less than full-time
4 operation would leave 'excess' operating time (shifts per day or days per week) available
5 to recover from unplanned downtime. This excess operating time results in higher
6 confidence in the ability of the chemical stabilization alternative to complete treatment
7 within a given timeframe. **Figure 7.2-4** presents the total operating hours required to treat
8 the Silos 1 and 2 material in three years at the scale proposed by the POP vendors.

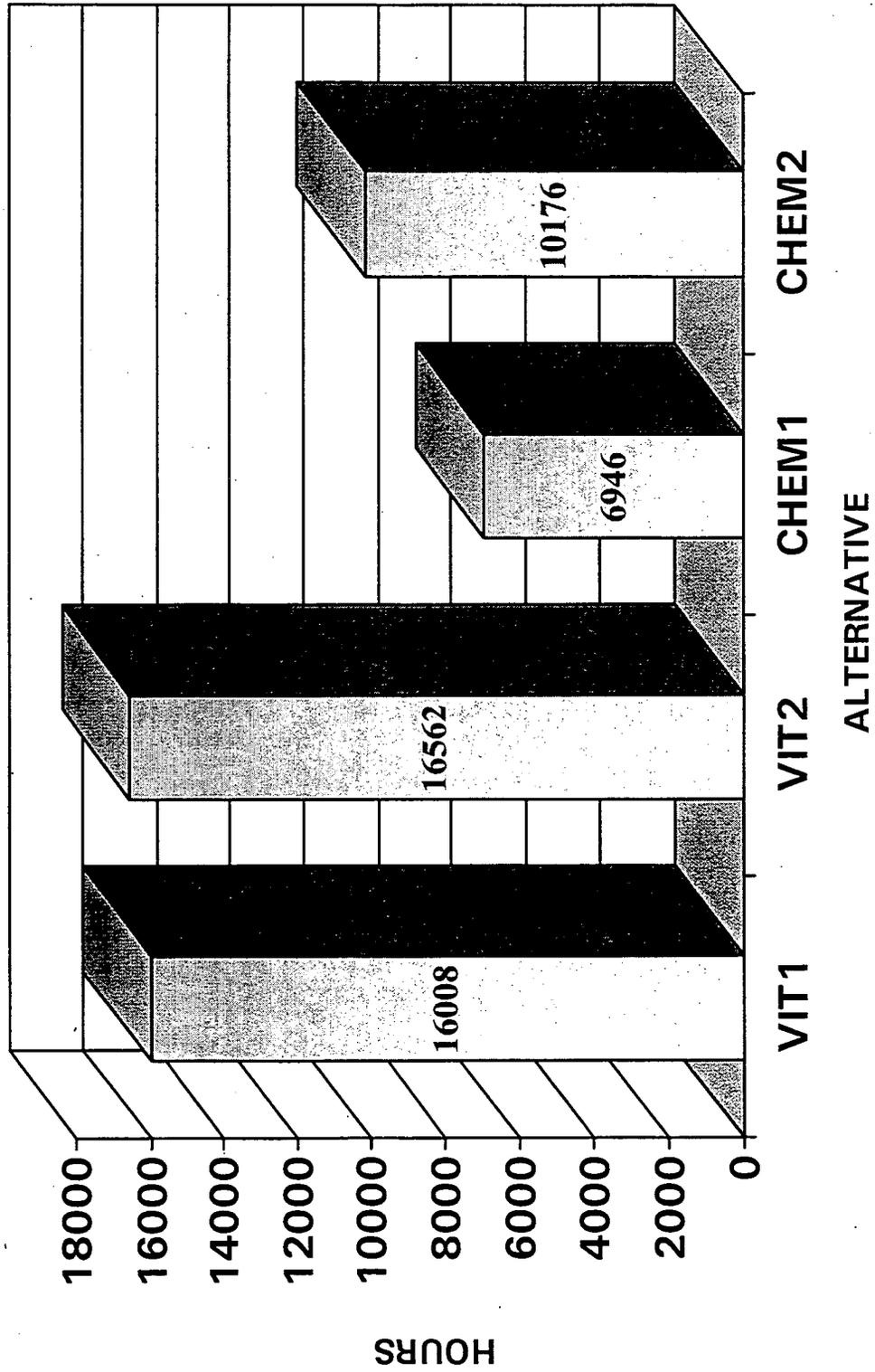
9 7.2.2.4 Implementability

10 Overall this criterion favors chemical stabilization due to a greater degree of commercial
11 demonstration of the treatment technology, less complexity of integrated systems, and
12 greater confidence in its ability to be successfully implemented.

13 **Figure 7.2-5** summarizes the implementability analysis.

14 The evaluation of implementability indicates that although both vitrification and chemical
15 stabilization are feasible and can be successfully implemented, there are significant
16 technical challenges such as process control, adaptation of the process to remote
17 operation, feed preparation, and product handling that apply to each alternative. The
18 operability characteristics of vitrification increase the uncertainty in its ability to be
19 successfully implemented.

TABLE 7.2-4
SUMMARY OF TOTAL REQUIRED OPERATING HOURS



**FIGURE 7.2-5
 IMPLEMENTABILITY SUMMARY TABLE**

ITEM	VIT1/VIT2		CHEM1/CHEM2		
	Strongly Favors	Favors	Neutral	Favors	Strongly Favors
Technical Feasibility					
Scaleup	↓				
Commercial Demonstration	↓				
Operability					
Ease of Operation	↓				
Reliability	↓				
Maintainability	↓				
Complexity	↓				
Ease of Acceleration	↓				
Constructability (Ease of Construction/Fabrication, Ease of D&D)	↓				
Administrative Feasibility (Licensing and Programmatic)	↓				
Availability of Services (Contractors, Equipment and Utilities)	↓				

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1 7.2.2.4.1 Technical Feasibility

2 Scaleup

3 Based on the results of the POP testing, both technologies can be scaled up to achieve the
4 proposed full-scale treatment capacity required to remediate the Silos 1 and 2 material
5 within the three-year operating period (see **Glossary**). The exception is the Vitrification —
6 Joule-heated process option that has not been demonstrated at the required scale on
7 radioactive or hazardous materials.

8 Scaleup issues exist for both technologies for the balance of plant systems. Chemical
9 stabilization requires modification of specialized process equipment (e.g., filter press,
10 mix-fill head) to be suitable for nuclear applications. Vitrification processes require
11 designing a complex Off-gas System to scrub particulates and acid gases, and condition
12 emissions before radon abatement. Similarly, a significant level of development to
13 demonstrate systems such as feed stream drying and lead partitioning in the off-gas is
14 required for some vitrification processes.

15 Commercial Demonstration

16 On a commercial basis, chemical stabilization and vitrification have been successfully
17 implemented to treat hazardous wastestreams. However, there is significantly more
18 demonstrated experience in the commercial sector with the chemical stabilization
19 technology for hazardous and radioactive waste treatment.

1 Three of the four process options have been demonstrated on a limited basis with material
2 reasonably similar to Silos 1 and 2 material, at the scale being proposed by the POP
3 Contractors. The only exception is Vitrification — Joule-heated, which would require a
4 scaleup by a factor of 3 from that which has been demonstrated at the Savannah River,
5 M-Area Site (5 TPD) on radioactive or hazardous material to achieve the 15 TPD proposed
6 by the POP Contractor. The Vitrification — Other process option has been demonstrated
7 at limited commercial facilities (ORMET Aluminum Inc., Hannibal, OH). The Chemical
8 Stabilization — Cement-based technology has been applied above the proposed scale
9 (Weldon Spring, MO). The Chemical Stabilization — Other process option has been
10 demonstrated at one location (Barnwell, SC) at the proposed capacity.

11 Operability

12 Regarding ability to operate successfully, chemical stabilization has greater certainty than
13 vitrification due to its ease of process control, less complexity and fewer unit operations
14 (air emissions), and its greater ability to recover from upset conditions.

15 The operability characteristics of vitrification increase uncertainty in its ability to be
16 successfully implemented. The integrated operation of complex systems increases the
17 likelihood of process upsets and resulting downtime for VIT1 and VIT2. Complex process
18 control parameters (e.g., viscosity, electrical conductivity, liquidus temperature, and
19 sulfate formation) complicate melter operation. The hazards inherent to the vitrification
20 process (high temperature) increase risks during maintenance and make recovery from
21 upsets more difficult. For the same reasons, chemical stabilization is easier to maintain
22 and less complex overall.

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1 Both technologies are comprised of reliable individual components. However, the reliability
2 of the integrated systems adapted for remote operation has not been demonstrated. DOE
3 vitrification projects (Defense Waste Processing Facility, West Valley, NY and Savannah
4 River M-Area) have experienced significant reliability concerns during start-up and initial
5 operations. The vitrification alternative includes additional unit operations (off-gas) that
6 have unknown reliability as an integrated system. For these reasons, chemical
7 stabilization is favored for reliability.

8 From the standpoint of ease of schedule acceleration/recovery, chemical stabilization is
9 favored. Chemical stabilization could accelerate/recover schedule by increasing the
10 operating schedule to 24 hr/day, 7 days/week. Acceleration would result in additional
11 costs to increase the plant capacity by increasing curing and storage space. The
12 vitrification alternative would require additional melter trains or increased melter capacity
13 combined with increased feed drying/preparation components, larger Off-gas System, as
14 well as additional cooling and storage space to increase plant capacity.

15 Constructability

16 Constructability of chemical stabilization is considered easier than vitrification. This is due
17 to the need for field assembly of the melter (i.e., custom refractory installation) compared
18 to modularized components for chemical stabilization (mixer, filter press, mix-fill head) that
19 can be fabricated and tested off-site. Additionally, there are greater quantities of piping,
20 electrical and controls for the vitrification process.

21 7.2.2.4.2 Administrative Feasibility

22 Because remediation activities will be performed at the FEMP, permits and licenses are not
23 required for either alternative. However, remediation activities will comply with the
24 substantive requirements that would otherwise be required for permitting.

1 Treated material from each alternative is disposed at the NTS. Because the NTS is a
2 DOE-owned facility, no special permits for disposal of treated Silos 1 and 2 material at the
3 NTS are required. The DOE-NV has indicated that silos material, treated by either
4 alternative, that meets the NTS WAC will be approved for disposal at the NTS. An
5 addendum to the NTS performance assessment for the selected disposal location will
6 determine the final depth and configuration for disposal.

7 7.2.2.4.3 Availability of Services

8 Contractors are available to competitively bid the design, procurement of materials and
9 equipment, as well as construct and operate the remediation facilities needed to implement
10 each alternative.

11 The NTS is an approved off-site disposal facility that has the equipment and facilities to
12 safely dispose and manage the treated Silos 1 and 2 material.

13 7.2.2.5 Cost

14 The cost evaluation is based on estimates that were developed on information from the
15 four preconceptual designs presented in Appendix G of the revised FS and the
16 technology-specific POP testing information presented in Appendix H of the revised FS
17 using a variety of cost-estimating methods.

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1 The cost estimates were developed for (1) capital costs; (2) O&M costs; (3) waste
2 shipping and disposal costs; (4) D&D costs; (5) engineering costs; (6) project management
3 costs; and (7) cost of money. The cost estimates are prepared as "bottom up" estimates,
4 which evaluate and estimate each cost element identified in the preconceptual design.
5 Therefore, the accuracy of the estimates is a function of the preconceptual designs. The
6 accuracy of all four estimates is considered +50/-30%, consistent with CERCLA
7 guidance. Given the fact that potential contractors will be given the opportunity to
8 propose their unique designs based on their commercial experience, the actual design may
9 change significantly. The subject accuracy establishes a range that is likely to capture
10 that which is ultimately bid in response to a request for proposal to remediate the Silos 1
11 and 2 material and baselined following the ROD amendment. All estimates were
12 developed in fiscal year 1999 (FY99) dollars so that the alternatives with costs incurred
13 over differing time periods can be evaluated on an equivalent basis.

14 **Table 7.2-2 and Figure 7.2-6** summarize the major cost elements for the four alternatives.

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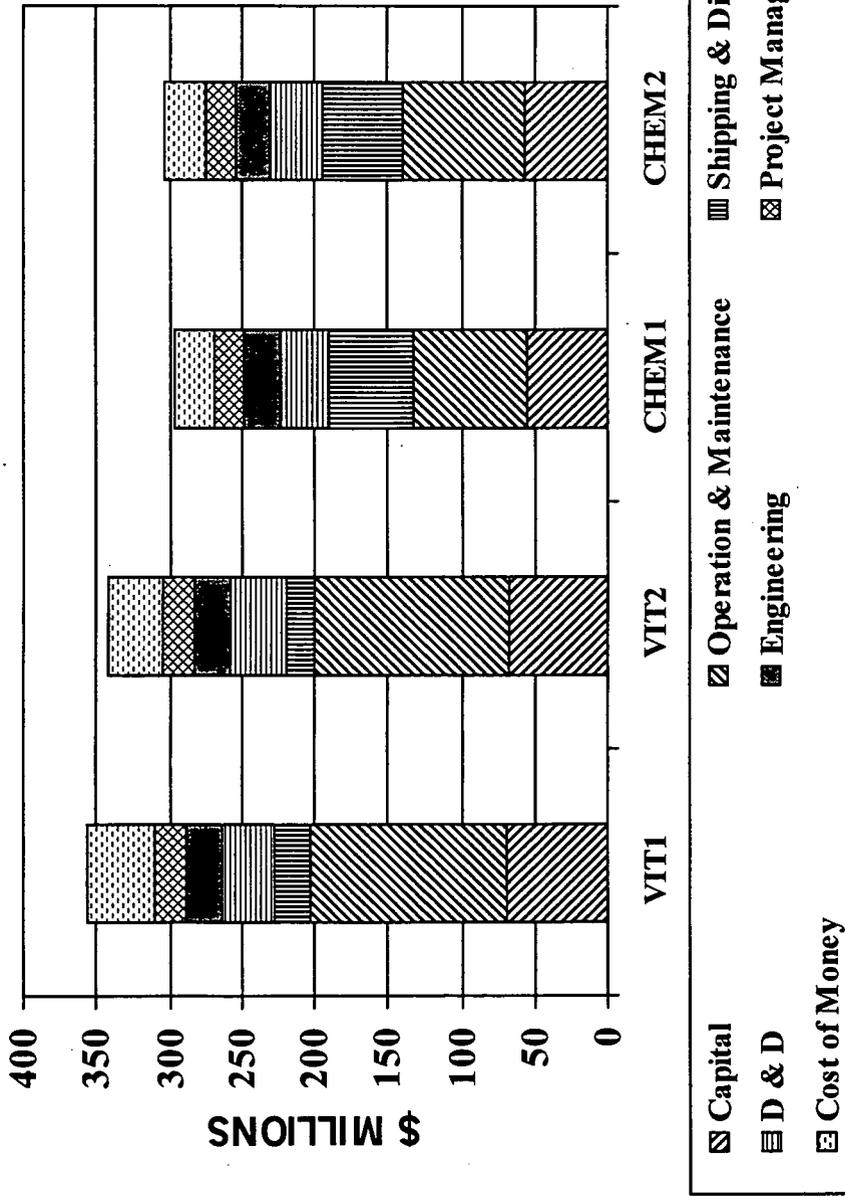
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TABLE 7.2-2
FEASIBILITY STUDY SUMMARY COST DATA (ALL ALTERNATIVES)

Alternative	Vitrification		Chemical Stabilization	
	VIT1	VIT2	CHEM1	CHEM2
Capital Cost	\$69	\$67	\$55	\$56
Operation and Maintenance Cost	\$134	\$133	\$77	\$83
Waste Disposal Cost	\$25	\$20	\$58	\$55
D&D Cost	\$35	\$38	\$34	\$36
Engineering Cost	\$25	\$25	\$24	\$24
Project Management Cost	\$22	\$22	\$21	\$21
Cost of Money	\$46	\$37	\$28	\$28
Summary cost (un-escalated)	\$356	\$342	\$297	\$303

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**FIGURE 7.2-6
FEASIBILITY STUDY COST COMPARISON**



1 In general, all four process options are cost effective. That is, the costs appear
2 proportional to the overall protectiveness provided by the alternatives, both during and
3 following the remediation period. The cost differential between the vitrification and
4 chemical stabilization alternatives is approximately 16%, with the cost of chemical
5 stabilization being lower. The following discussion identifies the differences between the
6 four alternatives for the key cost elements.

7 Capital Cost

8 The vitrification capital cost is higher than the chemical stabilization capital cost due to the
9 complexity of the process equipment. The need for sizeable interim storage areas for
10 chemical stabilization partially off-sets the higher equipment costs of the vitrification
11 alternative.

12 Operations and Maintenance Cost

13 Vitrification has a higher O&M cost than chemical stabilization for the following reasons:

14 Vitrification operations are on a 24 hr/day, 7 days/week schedule;

15 Vitrification requires an additional 8 month proof of process testing (full-scale surrogate
16 operations);

17 Vitrification has more expensive spare parts (specialized). Melter refractory life is limited
18 and may need to be replaced during the 3 years of operation; and

19 Vitrification uses more costly consumables (chemicals, supplies) and utilities (electricity,
20 natural gas).

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1 Waste Shipping and Disposal Cost

2 Chemical stabilization has higher packaging, transportation, and disposal costs than
3 vitrification. The lower waste loading (chemical stabilization) produces a greater volume of
4 treated material resulting in an increased number of disposal containers, shipments, and
5 disposal volume.

6 D&D Cost

7 The D&D costs are roughly equivalent for both alternatives.

8 In general, vitrification has a higher D&D cost due to the more complicated plant layout
9 (multiple floors, equipment). However, the difference is offset by the D&D cost of the
10 chemical stabilization having more building debris to handle due to the larger interim
11 storage facility.

12 Engineering Cost

13 Vitrification has a slightly higher engineering cost than chemical stabilization due to the
14 complexity of the process design.

15 Project Management Cost

16 Vitrification has a higher project management cost than chemical stabilization due to the
17 vitrification schedule being longer, with project management being a level-of-effort based
18 on the schedule duration.

1 Cost of Money

2 Based on the contracting strategy adopted for the remediation of the Silos 1 and 2
3 material, the contractor must borrow money to finance the design and construction effort,
4 well in advance of being reimbursed in accordance with a predetermined pay item
5 schedule. Since vitrification has a higher upfront capital cost investment, vitrification has
6 a higher cost of money than chemical stabilization.

7 7.2.2.6 State Acceptance

8 State acceptance of the preferred alternative will be addressed following the public
9 comment period for the PP and will be included in the Responsiveness Summary of the
10 ROD document.

11 7.2.2.7 Community Acceptance

12 Community acceptance of the preferred alternative will be addressed following the public
13 comment period for the PP and will be included in the Responsiveness Summary of the
14 ROD document.

<END OF SECTION>

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1

8.0 PREFERRED ALTERNATIVE

2 In accordance with the CERCLA process, the preferred alternative and the basis for its
3 preference must be identified to allow the public an opportunity to provide input with
4 regard to its acceptance. The preferred alternative can change in response to state or
5 public comment or new information. This section identifies the preferred remedial
6 alternative for the OU4 Silos 1 and 2 material based upon the detailed and comparative
7 analysis discussion in **Sections 6.0** and **7.0**, respectively.

8 The preferred RA for the Silos 1 and 2 material is the complete removal of all material from
9 Silos 1 and 2, on-site treatment by chemical stabilization, and off-site disposal of treated
10 Silos 1 and 2 waste at the NTS. In addition, the preferred alternative includes the
11 decontamination and dismantlement of all structures and remediation facilities and
12 appropriate treatment and disposal of all secondary wastes. In the event secondary
13 wastes generated during the treatment operations of the Silos 1 and 2 material or D&D
14 activities cannot be disposed at the NTS, without additional treatment, these secondary
15 wastes may be treated and/or disposed at an appropriately licensed off-site facility.
16 Concrete from Silos 1 and 2 structures will undergo gross decontamination, demolition,
17 size reduction, and packaging for shipment for off-site disposal at the NTS or an
18 appropriately licensed commercial disposal facility. Contaminated soils and debris,
19 excluding concrete from Silos 1 and 2 structures, will be disposed in accordance with
20 either the FEMP OSDF WAC or an appropriately licensed commercial facility, such as the
21 NTS or a permitted commercial disposal facility. Perched water encountered during
22 remediation activities will be collected and directed to the FEMP OU5 water treatment
23 facilities.

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1 **8.1 Removal Treatment by Chemical Stabilization, and Disposal at the NTS**

2 Chemical stabilization is proposed as the preferred alternative, based on the conclusion
3 that chemical stabilization has an overall advantage over vitrification when evaluated
4 against the five primary balancing criteria. Specifically, the advantages of chemical
5 stabilization in implementability and short-term effectiveness (worker risk and time to
6 achieve protection) are judged to outweigh the advantages of vitrification due to its lower
7 treated waste volume.

8 Both alternatives provide long-term protection of human health and the environment. This
9 is achieved by treatment to immobilize the COCs present in the material, followed by
10 off-site disposal at the NTS. Because the NTS is maintained by DOE and used for the
11 disposal of low-level wastes from other DOE sites, the uncertainties associated with
12 institutional controls are minimal. As the result of a low average annual precipitation and
13 depth to groundwater, impacts to human health and the environment from possible
14 engineering and institutional controls failure are minimal.

15 The cost estimates associated with the four alternatives differed by approximately 10%,
16 where the accuracy of the estimates is considered +50/-30% (consistent with CERCLA).
17 Therefore, cost is not deemed to be a significant discriminator for evaluation of the
18 alternatives.

19 The three discriminating criteria for comparison of the vitrification and chemical
20 stabilization technologies were determined to be reduction of toxicity, mobility, and
21 volume; short-term effectiveness; and implementability. **Figure 8.1-1** presents a summary
22 of the comparison of the vitrification and chemical stabilization technologies against these
23 criteria, as well as each criterion's subcriteria.

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1 8.1.1 Reduction of Toxicity, Mobility, or Volume through Treatment

2 Vitrification is preferred when evaluating the criterion of reduction of toxicity, mobility, and
3 volume. Vitrification results in approximately one-third the disposal volume of that
4 produced by chemical stabilization. This results in fewer truck shipments to the NTS and
5 a resultant decrease in risk to the public during transportation compared to chemical
6 stabilization. Transportation to the NTS complies with DOT regulations and DOE
7 guidelines and transportation of the Silos 1 and 2 material to the NTS by either truck or
8 intermodal shipments is protective of human health and the environment per CERCLA
9 guidelines. In addition, the anticipated shipping rate of 7 to 20 shipments per week does
10 not represent a significant impact on total highway traffic.

<END OF PAGE>

FIGURE 8.1-1
SUMMARY OF DISCRIMINATING CRITERIA AND THEIR COMPONENTS

ITEM	VIT1/VIT2			CHEM1/CHEM2	
	Strongly Favors	Favors	Neutral	Favors	Strongly Favors
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Treated Waste Volume					
Secondary Waste Generation					
Reduction in Mobility of COCs					
Radon Attenuation by Treated Waste Form					
SHORT-TERM EFFECTIVENESS					
Worker Risk					
Transportation Risk					
Off-site/Environmental Impact					
Time to Achieve Protection					
IMPLEMENTABILITY					
Scaleup					
Commercial Demonstration					
Operability					
Ease of Acceleration					
Constructability					
COST					

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1 8.1.2 Short-term Effectiveness

2 Chemical stabilization is preferred over vitrification under the criteria of short-term
3 effectiveness due to the additional physical hazards posed to the worker by vitrification
4 (see Table 7.2-1) and the advantage of chemical stabilization in time to achieve protection.
5 As stated previously, the chemical stabilization process results in a greater volume of
6 treated waste that must be handled, transported, and disposed at the NTS. However, the
7 additional exposure risks and physical hazards to the worker and the public posed by the
8 handling and shipping of the additional containers are within CERCLA guidelines and are
9 outweighed by the additional physical hazards posed to the worker by vitrification.

10 The vitrification processes are estimated to operate for three years at 24 hr/day,
11 7 days/week. The chemical stabilization processes are estimated to operate for three
12 years between 16 - 24 hr/day, 5 days/week. Based on government estimates in general
13 industry, one worker is injured for approximately every 29,410 person-hours worked and
14 one worker is fatally injured for every 2,000,000 person-hours worked. Although
15 engineering and administrative controls will be in place for both alternatives to minimize
16 risk to workers, the additional work hours necessary for vitrification to complete
17 remediation of the Silos 1 and 2 material in three years results in a greater hazard to the
18 worker.

19 Because vitrification is a high temperature process, it presents a thermal hazard to the
20 worker doing maintenance work on the melter or the off-gas system, or handling molten
21 glass in the event of a spill. In contrast, chemical stabilization operates at ambient
22 temperature and, therefore, does not present a thermal hazard to the workers performing
23 maintenance on the treatment system or the air emissions system.

24 In addition, the vitrification process has higher power requirements and a more complex
25 electrical system than the chemical stabilization process. Therefore, vitrification presents
26 a greater electrical shock hazard to the worker than chemical stabilization.

1 Both vitrification and chemical stabilization processes have treatment systems to manage
2 radon and radionuclide particulate. However, because vitrification is a thermal process, it
3 has a more complex off-gas treatment system than the chemical stabilization process.
4 This not only presents a thermal hazard, mentioned previously, to the worker but also a
5 potential chemical hazard. Workers performing maintenance on the off-gas treatment
6 system associated with the vitrification process are at risk of exposure to toxicants in the
7 off-gas (i.e., SO_x, NO_x, lead, acid gases) and hazardous chemicals used in the off-gas
8 treatment system (i.e., storage and handling of caustic for scrubber).

9 8.1.3 Implementability

10 Both vitrification and chemical stabilization are difficult to implement because of the nature
11 of the Silos 1 and 2 material requiring remote operations. However, operational risks for
12 both can be controlled. Chemical stabilization is preferred because there is more
13 demonstrated commercial experience with this technology, it is less complex than
14 vitrification and therefore more certain in its ability to be successfully implemented, and it
15 offers the opportunity for schedule acceleration and recovery in the event of unplanned
16 downtime.

17 Both vitrification and chemical stabilization have encountered difficulties in treating
18 radioactive wastes in the DOE-complex. However, there is significantly more
19 demonstrated experience in the commercial sector with the chemical stabilization
20 technology than with the vitrification technology. In addition, based on evaluation of
21 existing facilities, the production rate proposed for the vitrification process is at the limit of
22 the current capacity of existing vitrification facilities treating radioactive material, while the
23 production rate proposed for the chemical stabilization process is within limits of the
24 current capacity of existing chemical stabilization facilities.

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1 To treat Silos 1 and 2 material within a three-year time period, the vitrification process
2 would have to produce 15 tons of vitrified material per day. Within the limited experience
3 of the vitrification technology, there are no facilities in the DOE-complex and only two
4 facilities in the commercial sector operating at the required capacity. This limited
5 experience at the required capacity results in increased uncertainty as to whether the
6 current technology has the capability to treat Silos 1 and 2 material at the required
7 capacity. In comparison, to treat Silos 1 and 2 material within a three-year time period,
8 the chemical stabilization process would have to process 12 cubic yards of Silos 1 and 2
9 material per day. There have been a number of chemical stabilization facilities in both the
10 DOE-complex and the commercial sector that have operated at the required capacity.
11 Because there is a greater degree of commercial demonstration of the chemical
12 stabilization process at the required capacity, there is less uncertainty in its ability to treat
13 Silos 1 and 2 at the required capacity.

14 Vitrification has more unit operations associated with it than chemical stabilization and is
15 therefore considered to be more complex to operate than chemical stabilization. The
16 integrated operation of complex systems associated with the vitrification process increases
17 the likelihood of process upsets and resulting downtime. In addition, the complexity of
18 process control associated with vitrification complicates melter operation. Included in the
19 complexity of the process control are critical parameters that are not readily measured,
20 such as viscosity, electrical conductivity, liquidus temperature, and sulfate formation.
21 Furthermore, as stated under the discussion of short-term effectiveness, the hazards
22 inherent to the vitrification process increase the risk to the worker during maintenance
23 activities.

1 The two vitrification processes propose to operate 24-hours per day for seven days per
2 week for three years. The two chemical stabilization processes propose to operate 16 to
3 24 hr/day for 5 days/week for three years. Based on the current designs, the chemical
4 stabilization process has a better opportunity to improve schedule and accelerate
5 remediation. In addition, based on current designs, the chemical stabilization has a better
6 opportunity to recover from process upsets or other downtime.

7 Based on the above evaluation, chemical stabilization is the preferred alternative to
8 implement. Chemical stabilization has a greater degree of commercial demonstration at
9 the required capacity, is less complex to operate, and provides more opportunity to
10 recover from process upsets and other downtime, as well as more opportunity to improve
11 schedule.

12 **8.2 Soils and Debris**

13 The OSDF will be available for disposal of debris from the existing Silos 3 and 4 structures
14 and associated facilities (superstructures and RTS). Soil and debris from D&D activities
15 associated with these facilities will be disposed in the OSDF if they meet the OSDF WAC
16 for disposal. Any soils and debris that do not satisfy the OSDF WAC would be disposed at
17 the NTS or an appropriately licensed commercial facility.

18 Criteria for disposal of waste materials into the OSDF are documented in the *Waste*
19 *Acceptance Criteria Attainment Plan for the On-site Disposal Facility* (FEMP 1998c). The
20 current version was issued in June 1998 following approval by the EPA and Ohio EPA.
21 The OSDF WAC for debris were established in the OU3 ROD (FEMP 1996a). The OSDF
22 WAC Attainment Plan provides that these criteria can be applied to debris for other OUs,
23 including OU4, consistent with provisions of the ROD for each OU.

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1 The OU3 ROD classified debris into ten distinct material categories based upon similar or
2 inherent properties and configuration. Two categories, Category C – Process-related
3 Metals and Category J – Product, Residues, and Special Materials, were administratively
4 excluded from on-site disposal. In evaluating on-site disposal for concrete (Category E),
5 the OU3 ROD evaluated primarily structural concrete. The evaluation did not consider the
6 potential impact of prolonged contact with residues or other contaminants, such as a
7 concrete storage silo.

8 The concrete in Silos 1 and 2 has been in contact with contaminated material for over 30
9 years. Because of the relatively mobile COCs and the high moisture content associated
10 with Silos 1 and 2 material, there is a significant potential for migration of contaminants
11 into the concrete. The depth and extent of the migration of the COCs into the concrete
12 and the effort and cost of adequately decontaminating the concrete is uncertain.

13 Therefore, the concrete from Silos 1 and 2 has been administratively excluded from
14 disposal in the OSDF. The concrete from Silos 1 and 2 will undergo gross
15 decontamination followed by demolition, size reduction, and packaging for off-site
16 disposal. Disposal of concrete from Silos 1 and 2 will be at the NTS or an appropriately
17 licensed commercial facility.

18 Based on the current operating schedule, the FEMP OSDF will not be available for disposal
19 of soil and debris generated from D&D of the Silos 1 and 2 remediation facilities.
20 Therefore, for costing purposes, the revised FS and PP assume that all soil and debris from
21 D&D of the OU4 remediation facilities will be disposed at the NTS. However, should
22 programmatic changes occur and the OSDF become available, soil and debris meeting the
23 OSDF WAC would be disposed in the OSDF in the same manner as discussed above for
24 Silos 3 and 4 and associated facilities.

1 **8.3 Perched Water**

2 The OU5 RI/FS process examined perched groundwater on a site-wide basis. It should be
3 noted, however, that the ACA provides that each OU address perched groundwater
4 envisioned to be encountered as a consequence of conducting RAs. An example of such
5 an incidence is the collection of perched groundwater in deep excavations completed to
6 remove underground tank systems (Silos 1 and 2 decant sump tank), pits, or foundations.
7 This collected water will be directed to the OU5 wastewater treatment systems.

8 Process wastewaters generated during RAs conducted by all OUs will be directed to the
9 OU5 treatment systems [i.e., AWWT facility]. Operable Unit 5 has established
10 pretreatment requirements to ensure that incoming wastewater streams do not exceed
11 available treatment capabilities.

12 **8.4 Summary**

13 Chemical stabilization is recommended because it will achieve a substantial risk reduction
14 in removing and treating the Silos 1 and 2 source material constituting the primary
15 principal threats at the site, and provide for the safe disposition of the secondary threats
16 (i.e., contaminated structures and environmental media).

17 The preferred alternative meets the threshold criteria and provides the best balance of
18 tradeoffs among the other alternatives with respect to the balancing and modifying
19 criteria. The DOE expects the preferred alternative to satisfy the following statutory
20 requirements of CERCLA §§ 121(b): (1) be protective of human health and the
21 environment; (2) comply with ARARs; (3) be cost-effective; (4) use permanent solutions
22 and alternative treatment technologies to the maximum extent practicable; and (5) satisfy
23 the preference for treatment as a principal element.

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**TABLE 9.1-1
SUMMARY OF PUBLIC INVOLVEMENT OPPORTUNITIES**

Meeting Topic	Location/Date
Preliminary Screening of Alternatives	FEMP/December 1998
Presentation of Proof of Principle testing data	FEMP/July 13, 1999
Summary of Detailed Analysis of Silos 1 and 2 FS	FEMP/October 12, 1999
Fernald Citizens Advisory Board (FCAB)	FEMP/October 14, 1999
FS overview with FCAB	FEMP/November 4 and 6, 1999
Summary of Comparative Analysis of Silos 1 and 2 FS	FEMP/November 17, 1999
Nevada Test Site Citizens Advisory Board Summary of Silos 1 and 2 FS Comparative Analysis	Las Vegas, Nevada/December 1, 1999
FCAB Proposed Plan Summary	FEMP/December 6, 1999

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1 The public is encouraged to review and comment on both alternatives (i.e., not just the
2 preferred alternative) considered for remediation of the Silos 1 and 2 material,. Both
3 alternatives are discussed in detail in **Section 7.0** of this PP. Additional details on the
4 remedial alternatives can be found in Sections 3 and 4 of the revised FS. The FS is
5 available in the Administrative Record file at the PEIC.

6 The actual selection of the alternative to be implemented will be made only after
7 comments received during the public comment period have been reviewed and analyzed.
8 The DOE and EPA will consider all public comments on this PP in preparing the ROD
9 amendment. Depending on comments received, the selected final remedy for the Silos 1
10 and 2 material presented in the ROD amendment could be different from the preferred
11 alternative. All written and verbal comments received during the public comment period
12 will be summarized and responded to in the *Responsiveness Summary* section of the ROD
13 amendment. The ROD amendment for Silos 1 and 2 material is scheduled to be issued in
14 the spring of 2000.

15 **9.2 Community Participation**

16 The community is encouraged to read and provide comments on the revised FS for Silos 1
17 and 2 and this PP. The revised FS describes the RA alternatives that were considered for
18 treatment of the Silos 1 and 2 material and describes the merits and shortcomings of each.
19 This PP puts forth a preferred RA alternative for the Silos 1 and 2 material based upon the
20 content and conclusions of the FS.

21 A final remedy will be made only after hearing and considering community comments and
22 concerns. Based upon those comments, the preferred alternative may be modified,
23 another alternative presented in this PP selected, or a new alternative selected based on
24 information gathered from the community before and during the comment period.

1 The revised FS for Silos 1 and 2 and this PP and other supporting documents are available
2 from the Administrative Record, located at the PEIC and at the EPA offices in Chicago,
3 Illinois. Addresses for these Administrative Record locations are provided below.

4 Your comments may either be presented publicly at a community meeting or submitted by
5 mail to:

6 Mr. Gary Stegner
7 U.S. Department of Energy
8 Fernald Area Office
9 P.O. Box 398705
10 Cincinnati, Ohio 45239-8705

Mr. James A. Saric
U.S. EPA, 5HRE 8J
77 W. Jackson Blvd.
Chicago, Illinois 60604

11
12 513-648-3131

312-886-0992

13
14
15 The date, time and location of the public meeting and dates for the comment period have
16 been announced in the local media and are posted at the Administrative Record locations;
17 addresses and hours are as follows:

18
19 Public Environmental Information Center
20 10995 Hamilton-Cleves Highway
21 Harrison, Ohio 45030

U.S. EPA Region V
77 W. Jackson Blvd.
Chicago, Illinois 60604

22
23 513-648-7480

312-886-0992

24
25 Monday, 7:30 a.m. to 8 p.m.
26 Tuesday – Thursday, 7:30 a.m. to 5 p.m.
27 Friday, 7:30 a.m. to 4:30 p.m.
28

Monday – Friday, 8 a.m. to 5 p.m.

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1 The OEPA is participating in the RI/FS and RA processes at the FEMP. For additional
2 information concerning the state's role in the cleanup process at the FEMP or regarding the
3 specifics of the revised FS and this PP contact:

4 Tom Schneider
5 Ohio Environmental Protection Agency
6 401 E. Fifth Street
7 Dayton, Ohio 45402-2911
8
9 513-285-6466.

10

11 For additional information on public participation activities related to the revised Silos 1
12 and 2 FS, PP, or the FEMP site, visit the DOE-FEMP website at <http://www.fernald.gov/>.

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— 1993b. *Feasibility Study/Proposed Plan – Final Environmental Impact Statement (FS/PP-EIS) for Remedial Actions at Operable Unit 4*. DOE/EIS-0195D. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index No. Vol. I-IV: U-006-404.8 - 11; also includes *FS* Vol. I-IV U-006-404.13 - 16; *PP* U-006-405.3; and *RI* Vol. I-III U-006-304.15 - 17)

— 1993c. *Site-Wide Characterization Report*. Part of the *Remedial Investigation and Feasibility Study (RI/FS), Final*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index Numbers Vol. I-V: G-000-105.43 - 47)

— 1994a. *Feasibility Study for Operable Unit 4*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index Numbers Vol. I-IV: No. U-006-404.13 - 16)

— 1994b. *Proposed Plan for Remedial Actions at Operable Unit 4*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index No. U-006-405.3)

— 1994c. *Remedial Investigation Report for Operable Unit 5*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index Numbers Vol. I-V: U-007-304.27 - 30 and U-006-304.47)

— 1995a. *Work Plan for the Operable Unit 4 Remedial Design (RDWP)*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (¹AR Index No. U-006-409.27)

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- 1995b. *Feasibility Study Report for Operable Unit 5*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (1AR Index No. U-007-404.9 - 11)
 - 1995c. *Operable Unit 2 Record of Decision*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (1AR Index No. U-004-501.3)
 - 1996a. *Operable Unit 3 Record of Decision for Final Remediation Action*. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (1AR Index No. U-005-501.9)
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 - 1998b. *Final Explanation of Significant Differences for Operable Unit 4 Silo 3 Remedial Action at the Fernald Environmental Management Project*. 40400-RP-0004. Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (1AR Index No. U-006-503.11)
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U.S. Environmental Protection Agency (EPA). Office of Emergency and Remedial Response. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. EPA540G89004. Washington, D.C.: Dept. of Commerce National Technical Information Service (NTIS)*. (1AR Index No. G-000-1101.2)

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APPENDIX A

SUMMARY OF KEY

APPLICABLE OR RELEVANT AND

APPROPRIATE REQUIREMENTS

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INTRODUCTION

This appendix presents a summary of the key applicable or relevant and appropriate requirements (ARARs) and to be considered (TBC) criteria that pertain to the remedial alternatives which were retained in the Detailed Analysis of Alternatives (Section 3) of the *Revised Feasibility Study for Silos 1 and 2*¹. A summary of the description and evaluation of the alternatives is presented in **Sections 7 and 8** of this Proposed Plan (PP). The tables presented in this appendix include both ARARs established under federal and state environmental laws, and TBCs that were determined to be necessary to ensure protection of human health and the environment.

This appendix has three tables in accordance with the three types of ARARs: Chemical-specific, Location-specific, and Action-specific. The tables list the retained alternatives in the first column, followed by the regulatory citation and classification as applicable, relevant and appropriate, or TBC. Next the basis for selection and determination of the class of ARAR is described, followed by the strategy for compliance with the ARAR during implementation of the alternative. This format and contained information is consistent with the U.S. Environmental Protection Agency's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (OSWER 9200.1-23P, July 1999).

A detailed listing and discussion of compliance with ARARs is provided in *Appendix A* of the *Revised Feasibility Study for Silos 1 and 2*. A list of acronyms presented in the tables are defined below.

¹ *Revised Feasibility Study for Silos 1 and 2*, 1999, is available for review in the Administrative Record at the PEIC (refer to **Section 9.0** of this PP).

LIST OF ACRONYMS

ARAR	- Applicable or Relevant and Appropriate Requirement
CFR	- Code of Federal Regulations
DOE	- U.S. Department of Energy
FEMP	- Fernald Environmental Management Project
OAC	- Ohio Administrative Code
RCRA	- Resource Conservation and Recovery Act
TBC	- to be considered
TSD	- Treatment, Storage, and Disposal Facility

TABLE A-1
KEY ARARS FOR SILOS 1 AND 2 MATERIAL
REMEDIAL ACTION ALTERNATIVES, CHEMICAL-SPECIFIC

Alternative Number	Regulatory Title and Citation	ARAR/TBC	Rationale for Implementation	Basis for Compliance
VIT1 VIT2 CHEM1 CHEM2	Radionuclide Emissions (Except Airborne Radon-222), 40 Code of Federal Regulations (CFR) Part 61 Subpart H.	Applicable	Radioactive materials within Silos 1 and 2 might contribute to the dosage to members of the public from the air pathway during implementation of remedial actions since the National Emissions Standards for Hazardous Air Pollutants applies to operating units.	The pollution control equipment for the silos and treatment system off-gas emissions will be designed to limit discharge of radionuclides to acceptable levels.
VIT1 VIT2 CHEM1 CHEM2	Radon-222 Emissions, 40 CFR Part 61 Subpart Q.	Applicable	Facilities such as Silos 1 and 2 qualify as sources since they contain radium-226 in sufficient concentrations to emit radon-222. This requirement is applicable only to storage and disposal of radium-bearing by-product material.	The radon-222 flux rate standard of 20 pCi/m ² •s would be met during storage. This is due to stabilization followed by containerization of the treated Silos 1 and 2 material.
VIT1 VIT2 CHEM1 CHEM2	Residual Radioactive Material Proposed 10 CFR Part 834.	To be Considered	Management of radium and thorium bearing waste might result in the release of radon to the environment.	The pollution control equipment for the silos and treatment system will be designed to limit emanation of radon to acceptable levels.

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TABLE A-2
KEY ARARS FOR SILOS 1 AND 2 MATERIAL
REMEDIAL ACTION ALTERNATIVES, LOCATION-SPECIFIC

Alternative Number	Regulatory Title and Citation	ARAR/TBC	Rationale for Implementation	Basis for Compliance
VIT1 VIT2 CHEM1 CHEM2	Compliance with Floodplain/Wetlands Environmental Review Requirements, 10 CFR Part 1022 (Executive Order 11990).	Applicable	This requirement is applicable because the Fernald Environmental Management Project (FEMP) is a U.S. Department of Energy (DOE) facility. Several alternatives might result in destruction or modification of wetland areas.	These alternatives would comply with all National Environmental Policy Act (NEPA) evaluation and documentation requirements. NEPA documentation will also specify public notice requirements, wetland assessments, and any mitigative measures that may be required.

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TABLE A-3
KEY ARARS FOR SILOS 1 AND 2
REMEDIAL ACTION ALTERNATIVES, ACTION-SPECIFIC

Alternative Number	Regulatory Title and Citation	ARAR/TBC	Rationale for Implementation	Basis for Compliance
VIT1 VIT2 CHEM1 CHEM2	NEPA Implementation 10 CFR Part 1021.2	Applicable	This requirement is applicable because the FEMP is a DOE facility, and this requirement requires NEPA evaluation for specific actions at DOE facilities.	NEPA evaluations will be prepared for the selected remedial alternative in accordance with established procedures.
VIT1 VIT2 CHEM1 CHEM2	Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-level and Transuranic Radioactive Wastes. 40 CFR Part 191.03(b)	Relevant and Appropriate	Radiation levels associated with the Silos 1 and 2 material are similar to those associated with waste regulated by this requirement.	Remediation activities will have the necessary controls in place to ensure protection of the public.
VIT1 VIT2 CHEM1 CHEM2	Implementation of Health and Environmental Protection Standards for Uranium Mill Tailings, 40 CFR Part 192 Subpart C.	Relevant and Appropriate	Radioactive materials in Silos 1 and 2 are primarily by-product residues from uranium processing. Requirements for design of controls should be consistent with design of controls for other residual radioactive materials such as mill tailings.	Remediation activities will have the necessary controls in place to ensure protection of human health and the environment.
VIT1 VIT2 CHEM1 CHEM2	Treatment, Storage, or Disposal Facility Standards; 40 CFR Part 264 Subpart B (Ohio Administrative Code (OAC) 3745-54-13 through 16).	Relevant and Appropriate	Residues that exhibit a characteristic similar to Resource Conservation and Recovery Act (RCRA) hazardous waste removed from Silos 1 and 2 might be treated, stored, and disposed in accordance with treatment, storage, and disposal (TSD) facility standards. These requirements are relevant and appropriate because the residues are sufficiently similar to hazardous waste.	These alternatives would undertake actions to comply with the TSD Facility general standards.

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TABLE A-3
KEY ARARS FOR SILOS 1 AND 2
REMEDIAL ACTION ALTERNATIVES, ACTION-SPECIFIC

Alternative Number	Regulatory Title and Citation	ARAR/TBC	Rationale for Implementation	Basis for Compliance
VIT1 VIT2 CHEM1 CHEM2	Closure, 40 CFR Part 264 Subpart G. 40 CFR Part 264.111 (OAC 3745-55-11). 40 CFR Part 264.114 (OAC 3745-55-14). 40 CFR Part 264.116 (OAC 3745-55-16).	Relevant and Appropriate	These requirements are relevant and appropriate because the residues are sufficiently similar to hazardous waste and some remedial alternatives might require closure as outlined in this standard.	These alternatives would undertake actions to comply with the closure requirements for the treatment facility.
VIT1 VIT2 CHEM1 CHEM2	Container Storage, 40 CFR Part 264 Subpart I 40 CFR Part 264.171 - 178 (OAC 3745-55-71 through -78).	Relevant and Appropriate	These requirements are relevant and appropriate for alternatives using containers for temporary storage or storage before disposal. These requirements are relevant and appropriate because the residues in the silos are sufficiently similar to hazardous waste.	These alternatives would take measures to comply with the hazardous waste container requirements.
VIT1 VIT2 CHEM1 CHEM2	Tank Systems, 40 CFR Part 264 Subpart J (OAC 3745-55-91 through 96).	Relevant and Appropriate	Design criteria, operating standards, and inspections for tank treatment units might be relevant and appropriate for alternatives using treatment or storage in a tank before disposal. These requirements are relevant and appropriate because the residues in the silos are sufficiently similar to hazardous waste.	All process tanks will be constructed with durable material that is compatible with the Silos 1 and 2 material and the treatment process for which the tank is designed. The design will include secondary containment capable of detecting and collecting releases. Approved inspection and maintenance procedures will be established before management of material in the tanks.

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TABLE A-3 (continued)

Alternative Number	Regulatory Title and Citation	ARAR/TBC	Rationale for Implementation	Basis for Compliance
VIT1 VIT2 CHEM1 CHEM2	Radiation Dose Limit (All Pathways), Proposed 10 CFR Part 834.	To be Considered	Radiation sources from this OU (i.e., a DOE-owned facility) might contribute to the total dosage to members of the public.	Where appropriate, the treatment facility design will include high efficiency particulate air filters to control radioactive particulate emissions. Excavations, excavated soil, and other sources of particulate emissions will be controlled, as appropriate, through good construction practices. Releases to water will be controlled by design and operation of secondary containment features and treatment in the FEMP Advance Wastewater Treatment Facility. Treatment of the waste source will reduce contributions to dose from radon and reduce the likelihood of migration of radionuclides.

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GLOSSARY OF TERMS

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Administrative Record (AR): Documents including correspondence, public comments, Records of Decision, and technical reports upon which the agencies base their remedial action selection. The Administrative Record is made available for public review so that community members have the opportunity to provide comments to the U.S. Department of Energy (DOE) on proposed cleanup activities at the FEMP site. The Administrative Record for the Fernald Environmental Management Project (FEMP) site is located at the Public Environmental Information Center (PEIC).

Amended Consent Agreement (ACA): The modified Consent Agreement was signed in September, 1991, which includes the renegotiation framework and schedules for developing, implementing, and monitoring appropriate response actions at the FEMP and to facilitate cooperation, exchange of information, and participation of the U.S. Environmental Protection Agency (EPA) and DOE in such actions.

Applicable or Relevant and Appropriate Requirements (ARARs): "Applicable" requirements mean those standards, criteria, or limitations promulgated under federal or state law that are required specific to a substance, pollutant, contaminant, action, location, or other circumstance at a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site. "Relevant and appropriate" requirements mean those standards, requirements, or limitations that address problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to that particular site.

By-product Material: (1) Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material, and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content [Section 11(e)(2) of the Atomic Energy Act (AEA)].

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): A federal law that provides a comprehensive framework to deal with the investigation and cleanup of hazardous substances released into the environment from a waste site.

Constituents of Concern (COCs): Contaminants detected at waste sites that present significant contributions to overall site risk. At the FEMP, these include:

- other radionuclides (besides uranium) including radium, thorium, and technetium;
- organic chemicals including trichloroethene and dichloroethane (degreasing solvents); and
- inorganic chemicals including arsenic, manganese, and cadmium.

Explanation of Significant Differences (ESD): A public record documenting a significant change to the remedy selected in the Record of Decision.

Feasibility Study (FS): Provides a full evaluation of cleanup alternatives based on information gathered during the remedial investigation.

Hazardous Waste: Those wastes that are designated hazardous by EPA under 40 Code of Federal Regulation (CFR) Part 261.

NOTE: Byproduct material as defined in Section 11(e)(2) of the AEA is specifically exempted from regulation as a hazardous waste in 40 CFR Part 261(a)(4). However, this material may exhibit a characteristic of hazardous waste that can pose a substantial or potential hazard to human health or the environment when improperly managed, thereby making certain hazardous waste provisions of the Resource Conservation and Recovery Act relevant and appropriate to the management of this material.

Low Specific Activity (LSA): Radioactive material that, by its nature, has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply.

National Priorities List (NPL): A formal listing of the nation's highest priority hazardous waste sites, as established by CERCLA, that have been identified for investigation and possible remediation. Sites are ranked by the EPA based on their potential impacts to human health and the environment.

Nevada Test Site (NTS): A DOE owned facility that currently accepts low-level radioactive material from DOE facilities. This sparsely populated area is located in a dry climate 88 kilometers (55 miles) north of Las Vegas, Nevada.

Operable Unit (OU): A term used to describe a logical grouping of environmental media or waste management facilities at a cleanup site.

Picocuries per liter (pCi/L) and picocuries per gram (pCi/g): Concentration terms expressing the total activity of radioactive constituent present within a given mass/volume (i.e., gram or liter) of a medium (i.e., soil or water). A picocurie is equivalent to the radioactivity present in one trillionth of one gram of radium.

Proposed Plan (PP): A document that summarizes DOE's preferred cleanup strategy, the rationale for the preference, and alternatives presented in the detailed analysis of the FS. The Proposed Plan solicits public review and comment on all alternatives under consideration.

Public Environmental Information Center (PEIC): An information repository located approximately 2.5 kilometer (1.5 miles) south of the FEMP site. In addition to the Administrative Record, the PEIC contains additional materials to help the public understand cleanup activities at the site, such as the Annual Environmental Report, news clippings,

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fact sheets, and textbooks. For additional information about the PEIC, call (513) 648-7480 during normal operating hours (See Section 10.0).

Radionuclide: Radioactive element characterized according to its atomic mass and atomic number which can be man-made or naturally occurring. Radioisotopes can have a long life as soil or water pollutants, and are believed to have potentially mutagenic effects on the human body.

Record of Decision (ROD): A public record documenting the final determination of the selected alternative. Records of Decision are legally binding documents that are developed in consideration of public comments and fulfill CERCLA requirements. FEMP CERCLA decisions are signed by representatives of EPA Region 5 and the DOE.

ROD-Amendment: A public record documenting a fundamental change to the remedy selected in the ROD.

Remedial Action (RA): The actual construction or implementation phase of an NPL site cleanup that follows remedial design.

Remedial Investigation (RI): Identifies the nature and extent of contamination at a site. Also provides an assessment of the potential risks associated with a site.

Removal Action: Cleanup actions taken to address a near-term environmental or public health concern due to the release or significant potential for release of hazardous substances. Removal actions are implemented at waste sites to address more immediate concerns while the RI/FS process is underway.

Resource Conservation and Recovery Act (RCRA): A 1976 act that enabled the EPA to issue regulations for a national hazardous waste management program. The regulations govern hazardous waste from the time it is created to the time of its disposal. RCRA requires strict "cradle to grave" control, documentation, and proper management of hazardous wastes.

Three Year Operating Period: A three year operating period was established to treat all the Silos 1 and 2 material as a common design basis for all alternatives evaluated in the FS. This assumption is documented in Appendix G of the FS.

To Be Considered (TBC) Criteria: Nonpromulgated advisories, criteria, or guidance developed by EPA, other federal agencies, or states that provide information necessary to develop CERCLA remedies.

Toxicity Characteristic Leaching Procedure (TCLP): Analytical test designed to determine the leachability of RCRA metals and organics under the conservative conditions of the waste form breaking down in an acidic medium similar to what might be expected in a sanitary landfill.

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