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2003

EPA Superfund
Record of Decision Amendment:

FEED MATERIALS PRODUCTION CENTER (USDOE)
EPA ID: OH6890008976
OU 04
FERNALD, OH
09/24/2003

Department of Energy

Ohio Field Office
Fernald Environmental Management Project
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OCT 08 2003

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Washington, DC 20460

DOE-0004-04

Dear Sir or Madam:

FINAL RECORD OF DECISION AMENDMENT FOR OPERABLE UNIT 4, SILO 3 REMEDIAL ACTIONS

Pursuant to the United States Environmental Protection Agency (USEPA) guidance, presented in Appendix D of "A Guide to Preparing Superfund Proposed Plans, Records of Decision (ROD), and Other Remedy Selection Decision Documents," (EPA 540-R-98-031, July 1999), please find enclosed an unbound hard copy of both the Revised Proposed Plan for Silo 3 Remedial Actions and the Record of Decision Amendment for Operable Unit 4 (OU4) Silo 3 Remedial Actions.

If you have any questions regarding this documentation, please contact John Sattler at (513) 648-3145.

Sincerely,

Glenn Griffiths

Glenn Griffiths
Acting Director

FCP:Sattler

Enclosures: As Stated

cc w/enclosures:

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FINAL

RECORD OF DECISION AMENDMENT FOR OPERABLE UNIT 4 SILO 3 REMEDIAL ACTIONS

AT THE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT
FERNALD OHIO

40430-RP-0026
Revision 0

August 2003

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DECLARATION STATEMENT

SITE NAME AND LOCATION

Fernald Closure Project -- Operable Unit 4 (OU4), Silo 3, Fernald, Hamilton County, Ohio.

STATEMENT OF BASIS AND PURPOSE

This Record of Decision Amendment for Remedial Actions at Silo 3 [hereinafter called the ROD Amendment] addresses the re-evaluation of the treatment component of the selected remedy for the remediation of the OU4 Silo 3 material at the Fernald Closure Project (FCP) in Fernald, Ohio. The remedial action identified in this ROD Amendment was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) Part 300].

The decision presented herein is based on the information available in the administrative record established and maintained for OU4 in accordance with CERCLA. This decision is also based on input received from the United States Environmental Protection Agency (EPA), the Ohio Environmental Protection Agency (OEPA), and the public during review of the Proposed Plan for Silo 3. The Department of Energy (DOE) has considered all comments received during the public comment period in the preparation of this ROD Amendment.

The State of Ohio concurs with the remedy and the applicable or relevant and appropriate requirements (ARARs) put forth in this ROD Amendment for the remediation of OU4 Silo 3 material.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from OU4, if not addressed by implementing the response action selected in this ROD Amendment, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

On the basis of the evaluation documented in the Proposed Plan for Silo 3, the selected remedy addressing Silo 3, a portion of OU4 at the Fernald Closure Project, has been modified to the following:

- Removal of material from Silo 3 by pneumatic and/or mechanical processes
- Treatment to the extent practical, by addition of a chemical stabilization reagent and a reagent to reduce dispersability
- If above treatment step is deemed unimplementable, a contingency backup would be implemented to double package the waste

In addition, the remedy for Silo 3 continues to include the following components, which were not reevaluated, and remain as documented in the original OU4 ROD, and subsequent Explanation of Significant Differences (ESD) for Silo 3:

- Maintain transportation risk less than $1x10^{-6}$
- Off-site disposal of Silo 3 material at the Nevada Test Site or a permitted commercial facility
- Removal of Silo 3 structure, remediation facilities, and associated systems and components.
- Cleanup of soil in Silo 3 area to meet final remediation levels in Operable Unit 5 ROD
- Appropriate treatment and disposal of all secondary wastes at the Nevada Test Site or an appropriately licensed off-site facility.
- Collection of perched water encountered during remedial activities for treatment at OU5 water treatment facilities.
- Continued access controls and maintenance and monitoring of the stored waste inventories.
- Institutional controls of the OU4 area such as deed and land-use restrictions.

A comparison of the revised Silo 3 remedy and the previous remedy specified in the Silo 3 ESD, using the nine criteria specified by the NCP in 40 Code of Federal Regulations (CFR) Part 300, is presented in Section 5 of this ROD Amendment. The selected remedy satisfies both of the threshold criteria specified by the NCP and represents the best balance between the alternatives with respect to the five primary balancing criteria. This remedy will achieve substantial risk reduction by removing the sources of contamination, treating the material that poses the highest risk, shipping the treated material off-site for disposal, and managing the remaining contaminated soils and debris consistent with the site-wide strategy for the Fernald Closure Project.

STATUTORY DETERMINATIONS

As documented in Section 6 of this ROD Amendment, the selected remedy satisfies all of the statutory requirements specified by the NCP [40 CFR Part 300.430(f)(5)(ii)]. The selected remedy is protective of human health and the environment, complies with all federal and state requirements that are legally applicable or relevant and appropriate to the remedial action. This remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, is cost effective, and adequately addresses the statutory preference for remedies which include treatment as a principal element.

The selected remedy includes treatment to reduce the dispersability and mobility of contaminants, and thereby satisfies the statutory preference for treatment as a principal element. The selected remedy also provides risk reduction proportional to the cost of the remedy. If the treatment step cannot be satisfactorily implemented due to overriding technical or short-term worker risk impediments, then the formal contingency action explained in Section 4 of this ROD Amendment (additional double packaging of materials in the protective shipping containers) is also deemed to provide an appropriate balance of risk reduction, effectiveness, and cost. The contingent remedy satisfies Section 121 requirements and preferences under the site-specific circumstances giving rise to the need for the contingency action.

The Silo 3 remedy defined in this ROD Amendment has costs proportional to its overall effectiveness, and therefore meets the statutory requirement for cost-effectiveness.

This remedy will result in contaminated debris and soil being dispositioned in accordance with the EPA-approved RODs for OU3 and OU5, respectively. This remedy may result in pollutants or contaminants, as defined by CERCLA, [i.e., contaminated soil and debris in the Onsite Disposal Facility (OSDF)] remaining on-site. Therefore, a review will be conducted every five years after commencement of remedial actions to ensure that the remedy continues to provide adequate protection of human health and the environment.

The change documented in the ROD Amendment is bounded by the alternatives evaluated in the original Feasibility Study/Proposed Plan/Environmental Impact Statement (FS/PP/EIS) and the subsequent Supplemental Analyses. Therefore, it is DOE's determination that potential National Environmental Policy Act (NEPA) issues associated with the change have been adequately evaluated and that no additional NEPA documentation or evaluation is necessary.

9/10/03

Robert Warther, Manager
United States Department of Energy – Ohio Field Office

Date

Wm. E. Muno

9/24/03

William E. Muno, Director
Superfund Division
United States Environmental Protection Agency – Region V

Date

1 INTRODUCTION

1.1 Background

This Record of Decision Amendment addresses a change to the remedy for Silo 3 at the Fernald Closure Project in Cincinnati, Ohio, as previously described in the 1994 OU4 ROD and the 1998 ESD document for Silo 3. Other components of the selected remedy for OU4 have not been reevaluated and remain as documented in the original OU4 ROD, and its subsequent modifications.

DOE and EPA are implementing the change outlined in this ROD Amendment for Silo 3 because a revised treatment alternative that is fully compliant with applicable regulatory requirements has become available since the 1998 issuance of the Silo 3 ESD. This revised treatment alternative provides reduced cost without any meaningful reductions in either short or long-term remedy effectiveness.

The Fernald Closure Project site is included on the National Priorities List (NPL) of the EPA. Inclusion on the NPL reflects the relative importance placed by the federal government on ensuring the expedient completion of cleanup operations at the Fernald Closure Project. DOE owns the facility and, as lead agency, is conducting cleanup activities at the site under its Environmental Restoration and Waste Management Program. The EPA and the OEPA support the DOE. Together, the three agencies actively promote local community and public involvement in the decision making process regarding the remediation of the site.

1.2 Original OU4 Record of Decision

The decision documented by the original OU4 ROD was based on the information available in the Administrative Record for OU4 and maintained in accordance with CERCLA. The major documents prepared through the CERCLA process include the OU4 Remedial Investigation (RI), the original OU4 FS, and the original Proposed Plan PP for OU4. The original selected remedy of vitrification was selected (after the original FS/PP-Draft EIS was issued) with consideration of input received from public hearings held on March 21, 1994, in Harrison, Ohio and on May 11, 1994, in Las Vegas, Nevada. In preparation of the original OU4 ROD, DOE considered the comments received both during the public comment period for the original FS/PP-Draft EIS and those following issuance of the final EIS. The original OU4 ROD was approved by DOE and EPA in December 1994.

In March 1998, DOE and EPA signed an ESD for Silo 3, which formally approved the shift from vitrification to chemical stabilization/solidification or polymer encapsulation for treating the Silo 3 residues to achieve disposal facility waste acceptance criteria and the associated quantitative Toxicity Characteristic Leachate Procedure (TCLP)-based performance standards adopted by the 1994 ROD.

1.3 Reason for Record of Decision Amendment

Since the Silo 3 ESD was issued in 1998, DOE and EPA have received new information concerning (1) the waste acceptance criteria for the Nevada Test Site disposal facility, and (2) the potential availability of other commercial facilities that can accept the Silo 3 residues for disposal as 11e.(2) regulated materials. This new information demonstrates that it is now permissible to permanently dispose of the Silo 3 residues in an untreated form at the Nevada Test Site, and that a commercial facility may also be able to accept the untreated Silo 3 material in the near future. As previously stated treatment will be applied to the degree reasonably implementable to address the dispersability and mobility of the heavy metals.

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

DOE is issuing this ROD Amendment as part of its public participation responsibilities under Section 117(a) of CERCLA, and 40 CFR 300.430(f)(2) of the NCP. The intent of this ROD Amendment is to inform the public on the revision of the previously approved remedy for Silo 3 material.

This ROD Amendment summarizes key information that can be found in greater detail in the *Revised Proposed Plan for Silo 3.* This ROD Amendment, along with the PP for Silo 3 and other supporting documentation, will become part of the Administrative Record pursuant to 40 CFR Part 300.825(a)(2). The addresses for the Administrative Record locations are as follows:

Public Environmental Information Center 7400 Willey Road Cincinnati, OH 45013-9402 513-648-7480 Tuesday and Thursday, 7:30 a.m. to 4:30 p.m.	U.S. EPA Region V, SRF-5J 77 W. Jackson Blvd. Chicago, IL 60604 312-886-0992

Key Documents From Administrative Record File

- 1993a, *Remedial Investigation Report for Operable Unit 4.* Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (AR Index Numbers Vol. I-III: U-006-304.15 – 17)
- 1994a. *Feasibility Study for Operable Unit 4.* Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (AR Index Numbers No. U-006-405.3)
- 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. (AR Index Numbers Vol. I-IV: No. U-006-404.13 – 16)
- 1994. *Record of Decision for Operable Unit 4.* EPA ID OH6890008976: ROD ID EPA/ROD/R05-65/287. (AR Index No. U-006-501.5) [abstract at hhtp://www.epa.gov/superfund/sites/rodsites/0504934.htm]
- 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. (AR Index No. U-006-503.11)

2 SITE BACKGROUND

The Fernald Closure Project, formerly known as the Fernald Environmental Management Project and the Feed Materials Production Center, is a 1050-acre DOE facility located approximately 18 miles northwest of Cincinnati. Fernald, Ohio is a small rural community located just south of the FCP. The FCP is a government-owned facility that operated from 1952 to 1989 providing in excess of 500 million pounds of high-purity uranium metal products in support of U.S. Defense initiatives. In 1992 the site was renamed the Fernald Environmental Management Project and the mission was formally changed to environmental restoration under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. Its current name, the Fernald Closure Project, was adopted in 2003 to reflect a continuing emphasis on the completion of restoration activities and achieving the final closure end state safely and efficiently.

To facilitate restoration, the CERCLA work scope for the 1,050-acre facility was divided into five operable units: the waste pits (Operable Unit 1); other waste units (Operable Unit 2); the production area facilities and legacy-waste inventories (Operable Unit 3); Silos 1&2 and Silo 3 (Operable Unit 4); and contaminated environmental media (Operable Unit 5).

The selected remedial actions documented in the RODs for the five operable units include: production facility decontamination and dismantlement (D&D); on-site disposal of the majority of contaminated soil and D&D debris; off-site disposal of the contents of the two K-65 silos (Silos 1&2), Silo 3, waste pit material, legacy waste inventories, and limited quantities of soil and D&D debris not meeting on-site waste acceptance criteria; and treatment of contaminated groundwater to restore the affected portions of the Great Miami Aquifer underlying the FCP. Ultimately, approximately 975 acres of the 1,050-acre property will be restored to beneficial use as an undeveloped park, and approximately 75 acres will be dedicated to the footprint of the On-site Disposal Facility. Contaminated portions of the aquifer will be restored to beneficial use as a drinking water supply, and long-term stewardship actions will be put in place consistent with the final designated land use.

2.1 Overview of Silo 3

Silo 3, located adjacent to the K-65 silos (Silos 1&2) on the western periphery of the site, is an unbermed concrete silo that contains 5,088 cubic yards of cold metal oxides, a by-product material generated during Fernald's uranium processing operations. The predominant radionuclide of concern identified within the material is thorium-230, which is produced from the natural decay of uranium-238. The overall objective of the Silo 3 remedial action is to safely retrieve the residues from the concrete silo and package and transport the materials for off-site disposal in a manner compliant with regulatory requirements.

The materials contained in Silo 3 consist of relatively dry, powder-like residues that were placed in the silo over the time period 1954 to 1957. The residues consist of the metallic and non-metallic impurities that remained following the extraction of uranium from ore and ore concentrates in Fernald's refinery operations during the mid-1950s. The residues were prepared for storage following a volume reduction and concentration step known as calcining, which is a roasting process in the presence of lime that serves to remove moisture and convert the impurities to their more stable (less leachable) oxide form. Following calcining, the dry residues were pneumatically conveyed to Silo 3 for longer-term interim storage as part of DOE's ongoing custodial responsibility for the materials.

Although both residues share similar uranium processing origins and the same regulatory status, the Silo 3 residues have different engineering properties and are radiologically different from the Silos 1&2 K-65 residues. As "cold" residues (a term of engineering convenience used to reflect the residual radium-bearing content of the residues), the Silo 3 materials have a much lower radium content than the K-65 materials, and therefore Silo 3 exhibits a much lower direct radiation field and has a substantially lower radon-222 emanation rate compared to Silos 1&2. The K-65 materials in Silos 1&2 are also moisture-rich, silty, and clay-like materials, whereas the Silo 3 materials are dry and powdery. Ambient moisture contents for the materials in Silo 3 range from 3 to 10 percent by weight, which reflect their dry condition.

On an activity basis, the predominant radiological constituent in the Silo 3 material is thorium-230. The thorium contaminated Silo 3 residues do not present the same level of direct radiation exposure potential as the radium-bearing Silos 1&2 residues, and exhibit significantly lower emissions of radon gas (which forms as a radium decay product). However, the residual thorium content and the relatively dry powdery condition of the Silo 3 residues together represent a dispersability hazard and an inhalation and ingestion hazard to workers and the public if proper control and containment measures are not in place during material handling and transportation steps.

DOE has designated the residues contained in Silo 3 and Silos 1&2 as Section 11e.(2) byproduct materials under the Atomic Energy Act of 1954, as amended (AEA). This regulatory classification acknowledges the origin of the materials and identifies that they consist of tailings and wastes that were produced by the extraction and concentration of uranium from ores that were processed primarily for their source material content. As 11e.(2) byproduct materials, the residues are statutorily excluded from the definition of solid and hazardous waste under the Resource Conservation and Recovery Act (RCRA) of 1976; this statutory exclusion is described in the RCRA regulations under 40 CFR 261.4(a)(4). Specific regulatory requirements for management of the byproduct materials are defined through the AEA regulations and accompanying policies and directives.

As a point of reference, although they are statutorily excluded from formal RCRA hazardous waste definitions and administrative requirements, the Silo 3 residues do contain sufficient quantities of four RCRA regulated metals (arsenic, cadmium, chromium, and selenium) such that they can exceed RCRA thresholds for leachability as measured through the RCRA TCLP) laboratory test. As explained further below, this condition was a consideration in establishing remedy-specific quantitative performance levels in the 1994 Operable Unit 4 ROD for rendering the Silo 3 residues suitable for off-site disposal through treatment.

2.2 Purpose and Need for Decision

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

The EPA has established a formalized risk assessment process to determine the necessity for implementation of cleanup actions. Under this process, several hypothetical scenarios that could expose members of the public to site contamination were examined. One of these scenarios assumed that site access was not controlled (i.e., unrestricted) and a member of the public could be exposed to the higher contamination areas. Results of the risk assessment performed for this hypothetical, unrestricted access scenario indicated that an individual establishing residence within the highly contaminated portions of the OU4 area, under existing conditions, would be subjected to an increased risk of incurring an adverse health effect. Risk assessment calculations performed for OU4 indicate the projected level of increased risk exceeds established federal regulatory guidelines. Based on the results of the baseline risk assessment, the DOE concluded in the RI that existing site conditions warrant remedial action.

2.3 Original Selected Remedy for Silo 3 Material

The major components of the selected remedy documented in the original OU4 ROD are:

- Removal of the contents of the Silos 1, 2, 3 and the decant sump tank sludge.
- Treatment of the Silos 1, 2, and 3 material and sludges removed from the silos and the decant sump tank by vitrification to meet disposal facility WAC.
- Off-site shipment of the vitrified contents of Silos 1, 2, 3 and the decant sump tank for disposal at the Nevada Test Site.
- Demolition of Silos 1, 2, 3 and 4 and decontamination, to the extent practicable, of the concrete rubble, piping, and other generated construction debris.
- Removal of the earthen berms and excavation of the contaminated soils within the boundary of OU4, to achieve remediation levels. Placement of clean backfill to original grade following excavation.

- Demolition of the remediation and support facilities after use. Decontamination or recycling of debris before disposition.
- On-property interim storage of excavated contaminated soils and contaminated debris in a manner consistent with the approved *Work Plan for FEMP Removal Action No. 17 - Improved Storage of Soil and Debr is* (DOE 1996)[1], pending final disposition of soil and debris in accordance with the RODs of OUs 5 and 3, respectively.
- Continued access controls and maintenance and monitoring of the stored waste inventories.
- Institutional controls of the OU4 area such as deed and land-use restrictions.
- Potential, additional treatment of stored OU4 soil and debris using OU5 and OU3 waste treatment systems.
- Pumping and treating, as required, of any contaminated perched groundwater encountered during remedial activities.
- Disposal of the OU4 contaminated debris and soils consistent with the RODs for OUs 3 and 5, respectively.

2.4 1998 Silo 3 ESD Modification to the 1994 ROD

In early 1998, an ESD was developed for Silo 3 to replace the vitrification technology with chemical stabilization/solidification or polymer encapsulation as the preferred treatment option for treating the Silo 3 wastes to achieve the TCLP-based waste acceptance limits for off-site disposal. This modification was adopted to address implementability concerns with vitrification that were revealed in pilot scale tests of the technology on surrogate materials chosen to emulate the salient engineering properties of the silos materials.

The Silo 3 ESD, which was signed by DOE and EPA in March 1998, acknowledged that the adoption of a chemical stabilization/solidification or polymer encapsulation alternative for Silo 3 (as a replacement for vitrification) would not be a fundamental change to the original remedy identified in the 1994 ROD, provided that the alternate process continued to meet all remedial objectives and performance standards of the approved ROD for a cost roughly equivalent to the original remedy, and that the remedy includes disposal at a protective, appropriately permitted off-site disposal facility.

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[1] This component of the selected remedy was documented in the original Operable Unit 4 record of Decision (ROD) in 1994. However, for purposes of this ROD Amendment the reference has been updated to the most recent revision.

The Silo 3 ESD also acknowledged that the waste treatment step could be implemented either off site or on site to achieve the intended TCLP-based waste acceptance criteria requirement. If the treatment step were to be conducted off site, on-site pretreatment would be conducted at the Fernald Closure Project as necessary to reduce the dispersability of the thorium-bearing particulates and render the material acceptable for transportation. The ESD required that on-site pretreatment, in combination with packaging in accordance with Department of Transportation (DOT) regulations, must reduce the dispersability of the thorium-bearing particulates and result in a transportation risk less than 1 x 10^{-6} Incremental Life-time Cancer Risk.

The modified Silo 3 remedy specified by the 1998 ESD consisted of:

- Removal of the wastes From Silo 3
- Treatment, either on site or off site using chemical stabilization/solidification or a polymer-based encapsulation process, to stabilize RCRA-regulated metals to meet RCRA TCLP limits and attain disposal facility waste acceptance criteria
- If off-site treatment is employed, off-site shipment must be preceded by on-site pretreatment and/or packaging such that the risk to the public from transportation of the material to the off-site facility is less than $1x10^{-6}$
- Off-site disposal at either the Nevada Test Site or a permitted commercial disposal facility
- Removal and disposal of the Silo 3 structure and the waste handling, packaging, and treatment systems
- Cleanup of the soil underlying the Silo 3 area to the final remediation levels defined in the Operable Unit 5 ROD.

2.5 Treatment Criteria for Silo 3 Material

At the time of the 1994 ROD, the Nevada Test Site was the only available disposal location that could accept the vitrified silo materials for permanent disposal. As part of its waste acceptance criteria, the Nevada Test Site required in 1994 that all treated or untreated waste accepted for disposal at the facility -- regardless of its statutory exempt or non-exempt status -- meet TCLP limits for toxicity-characteristic constituents regulated under RCRA. Based on this disposal-facility-specific requirement, the 1994 OU4 ROD adopted the TCLP limits as quantitative performance standards for treating (in this case vitrifying) the materials prior to off-site disposal.

In the 1994 ROD, the RCRA TCLP limits were adopted as performance requirements for waste treatment, due to the requirement that the material meet the Nevada Test Site's formal TCLP-based waste acceptance criteria (versus broader adoption as *applicable* requirements, since the materials continued to retain their statutorily exempt legal status). The Nevada Test Site TCLP limits therefore became the relevant and appropriate performance standard in the 1994 ROD for treating the Silo 3 wastes to achieve an acceptable disposal condition for the four RCRA metals of concern (arsenic, cadmium, chromium, and selenium) contained within the Silo 3 waste.

At the time of the 1998 ESD for Silo 3, the Nevada Test Site waste acceptance criteria limits continued to require that all treated and untreated waste accepted for disposal meet the TCLP limits for RCRA regulated constituents (again regardless of the waste's statutorily exempt or non-exempt RCRA status). The 1998 Silo 3 ESD therefore continued to adopt the facility-specific TCLP limits as a performance standard for designing a satisfactory treatment process to render the Silo 3 residues acceptable for off-site disposal.

3 BASIS FOR MODIFYING THE OU4 RECORD OF DECISION

Since the Silo 3 ESD was issued in 1998, DOE and EPA have received new information concerning (1) the waste acceptance criteria for the Nevada Test Site disposal facility, and (2) the potential availability of other commercial facilities that can accept the Silo 3 residues for disposal as 11e.(2) regulated materials.

3.1 Waste Acceptance Criteria for the Nevada Test Site

In February 2002, the Nevada Test Site, in conjunction with the state and federal regulatory agencies that oversee the facility's waste disposal operations, updated the waste acceptance criteria for the facility. As part of the February 2002 revision, the acceptance requirements for RCRA-regulated materials were clarified. In essence, the revision requires TCLP-based acceptance levels only for those wastes that are statutorily regulated under RCRA. Statutorily exempt materials, such as 11e.(2) materials, no longer need to meet TCLP-based acceptance criteria, provided the waste is otherwise disposed of in a manner that is protective of human health and environment. As part of an eligibility evaluation, a waste profile for each statutorily exempt waste must be reviewed individually to ensure that protective requirements are met for the constituents that would otherwise be regulated under RCRA.

During May 2002, Nevada Test Site regulatory personnel completed a draft waste profile review for the statutorily exempt Silo 3 material, and deemed the material to be acceptable for disposal at the facility without the need for further treatment. A letter indicating the eligibility of the untreated Silo 3 material for disposal at the Nevada Test Site was formally issued by the facility in June 2002, a copy of which is included in the technical supplement to the Proposed Plan.

3.2 Emergence of Potential Commercial Disposal Options for DOE 11e.(2) Materials

Also since the time that the 1998 Silo 3 ESD was prepared, potential commercial disposal options have been identified for disposal of untreated Silo 3 material. Similar to the revised waste acceptance criteria requirements at the Nevada Test Site, a commercial facility would be able to accept Silo 3 material in an untreated state provided the material is deemed eligible for disposal by the regulatory agency, a waste-specific profile review is conducted, and all other waste acceptance criteria requirements that are applicable to the waste are met. For purposes of comparison of alternatives in the Proposed Plan, the Envirocare facility, in Clive, Utah was assumed as a representative permitted commercial disposal facility.

This new development may result in additional off-site disposal site options for DOE and EPA to consider in evaluating disposal at a protective, appropriately permitted off-site disposal facility as allowed by the 1998 ESD. The actual disposal facility will be selected as part of the design process and may include the Nevada Test Site, an appropriately permitted commercial facility that can accept the materials, or a combination of both. In the Proposed Plan, one option (the Nevada Test Site) was utilized to illustrate the costs and logistics of off-site disposal, and permit a fair comparison of the proposed revised remedy with the 1998 Silo 3 ESD remedy (previous remedy).

3.3 Rationale for Proposed Change

The new information summarized above demonstrates that it is now permissible to permanently dispose of the Silo 3 residues in an untreated form at the Nevada Test Site, and that a commercial facility may also be able to accept the untreated Silo 3 materials in the near future. DOE and EPA conclude based on this new information that the TCLP-based waste treatment performance standard, adopted in both the 1994 ROD and the 1998 Silo 3 ESD as a facility-specific criterion for treatment, is no longer necessary for the purposes of maintaining regulatory compliance with disposal facility waste acceptance requirements. DOE and EPA are removing the quantitative TCLP performance standard as a criterion for execution of the Silo 3 remedy.

As a result of this new development, members of the public have expressed a concern that if the primary requirement for treatment (to satisfy waste acceptance criteria obligations) is removed through the proposed ROD Amendment, other secondary benefits of waste treatment -- such as the further incremental control of the dispersability of the Silo 3 material, in the unlikely event of a severe transportation accident that subsequently damages the protective shipping containers during transit -- could be overlooked. DOE and EPA have taken these comments into consideration in the development of the modification to the Silo 3 remedy that is proposed in this document. Similarly, DOE and EPA recognize that, irrespective of the recent waste acceptance criteria revision, any new modifications to the remedy must continue to meet the 1×10^{-6} ILCR transportation risk threshold for the remedy adopted by the 1998 Silo 3 ESD.

4 DESCRIPTION OF SIGNIFICANT DIFFERENCES OR NEW ALTERNATIVES

This section describes the revised Silo 3 remedy, and provides a side-by-side comparison with the components of the previous 1998 ESD remedy for Silo 3. The following section then evaluates the revised remedy against the nine criteria specified in the National Contingency Plan. The focus of the description in this section, and the evaluation in the following section, is on that component of the plan that is proposed to be changed, specifically the treatment portion of the remedy. The previous and the revised remedies are summarized below, and compared in detail in the following sections.

Previous 1998 ESD Remedy

- Removal of the wastes From Silo 3
- Treatment, either on site or off site using chemical stabilization/solidification or a polymer-based encapsulation process, to stabilize RCRA-regulated metals to meet RCRA TCLP limits and attain disposal facility waste acceptance criteria

- If off-site treatment is employed, off-site shipment must be preceded by on-site pretreatment and/or packaging such that the risk to the public from transportation of the material to the off-site facility is less than $1x10^{-6}$

- Off-site disposal at either the Nevada Test Site or a permitted commercial disposal facility

- Removal and disposal of the Silo 3 structure and the waste handling, packaging, and treatment systems

- Cleanup of the soil underlying the Silo 3 area to the final remediation levels defined in the Operable Unit 5 ROD.

Revised Remedy

- Removal of the wastes from Silo 3 *(this element remains unchanged from the previous plan)*

- Treatment, to the degree reasonably implementable, to address material dispersability and metals mobility. Potential implementability and worker exposure concerns with this treatment are discussed under “Contingency Backup Actions in the next section *(change from the previous plan).*

- Double packaging of the untreated waste, as a contingency backup, in the event the selected treatment approach is deemed unimplementable as a result of operational difficulties which cannot be practically overcome *(change from the previous plan)*

- Requirement to maintain the transportation risk to the public of less than $1x10^{-6}$ Incremental Life-time Cancer Risk [ILCR] *(this element remains unchanged from the previous plan)*

- Off-site disposal at either the Nevada Test Site or a permitted commercial disposal facility *(this element remains unchanged from the previous plan)*
- Removal and disposal of the Silo 3 structure and the waste handling, packaging, and treatment systems *(this element remains unchanged from the previous plan)*
- Cleanup of the soil underlying the Silo 3 area to the final remediation levels defined in the Operable Unit 5 ROD *(this element remains unchanged from the previous plan).*

4.1 Detailed Description of the Revised Remedy

Waste Removal. Under the revised remedy the waste will be removed from Silo 3 employing both pneumatic and mechanical systems. These waste retrieval systems remain unchanged from the previous remedy. As a result of the relatively high concentration of thorium-230 (an alpha emitter) and the dry powdery consistency of the waste, special attention will be necessary during design to ensure the construction of waste handling systems, which would minimize the release of particulates from the waste material to the work area or the environment. This same design consideration would be necessary for either the previous or the revised remedy.

To address this concern, containment structures and high efficiency air filtration systems will be employed during waste retrieval. A strict radiological control program will be implemented during all Silo 3 operations to reduce worker exposures to As Low As Reasonably Achievable (ALARA) levels.

This control program will include engineering controls such as the filtration and containment systems, administrative controls such as project specific training and detailed operational procedures for workers, and personnel protective equipment such as protective clothing and air-supplied respirators. A thorough personnel and environmental monitoring program will also be implemented to assess the effectiveness of the controls.

Waste Treatment. As was the case with the previous remedy, the material will be removed from the silo in its dry form. The previous remedy would require the construction and operation of a chemical stabilization/solidification processing system, which includes the wetting of the material and addition of one or several chemical reagents. With the previous plan, the chemical stabilization/solidification step would involve the addition of sufficient chemical reagents and post-treatment testing to ensure the treated waste form no longer exceeded TCLP limits for the four RCRA-regulated metals (cadmium, arsenic, chromium, and selenium) that are of concern with the Silo 3 materials. Under the revised remedy, this chemical processing system will not be constructed; in its place a system will be installed to add a liquid solution to the Silo 3 material as it enters the package, in order to raise the waste's moisture content and reduce its dispersability and mobility.

As previously discussed, the acceptance criteria of the Nevada Test Site have been modified to permit receipt of the Silo 3 waste material in an untreated form. The basis for the modified WAC is recognition of the classification of the material as 11e.(2) byproduct material coupled with the material-specific waste profile review and protectiveness evaluation conducted by the Nevada Test Site regulatory personnel. Full compliance with the DOT transportation requirements, Nevada Test Site waste acceptance criteria, and 1998 Silo 3 ESD requirements pertaining to the risk during routine transportation (i.e., less than 1 x 10^{-6} ILCR) can be attained by the direct load out, transport, and disposal of the untreated waste material. Bench scale testing applied to Silo 3 materials has identified a potentially cost-effective and implementable approach to providing a beneficial level of treatment to the waste material prior to off-site transport. These tests yielded encouraging results indicating that a liquid solution could be successfully added to the waste as it was loaded into the packages. The results indicate that a meaningful reduction in the dispersability of the waste can be gained through the addition of the liquid to the waste as it is packaged. Considering these results, it is also anticipated that the addition of a chemical stabilization reagent to this same solution could offer some companion benefits of further reducing the mobility of radioactive and non-radioactive RCRA-regulated metals in the waste.

As a result of the test data, the DOE has committed to install the necessary process equipment to add a liquid solution to the waste materials as it is delivered into the final packages. This solution is envisioned to include both a liquid reagent to aid in reducing the dispersablity of the waste material (a material crusting agent, which also raises the moisture content of the material) in the event of an unforeseen severe accident during transport, and a second component (a chemical stabilization agent) to yield a beneficial reduction in the mobility of some, if not all, of the metals present in the Silo 3 residues.

The addition of the additives to treat the waste for dispersability and for metals mobility is being implemented to address concerns expressed by involved stakeholders, and is not a necessary prerequisite to comply with legal ARAR-driven requirements or DOT-driven transportation requirements. As such, the DOE remains committed to applying a “best management practice” effort to ensure the successful addition of the liquid additives to the waste material.

The criteria for addition of liquid additives will consist of operational criteria applied in a best management approach (utilizing the final equipment and operational configuration to apply the specified additive formulation). Given the absence of any regulatory requirement, no analytical criteria (e.g., treated waste metals analyses) are necessary as part of the best management approach to demonstrate the degree of treatment.

Contingency Backup Actions. As previously stated, the DOE has committed to a best effort to successfully implement the addition of the treatment solution to the waste material on the basis of best-available information gleaned from laboratory-scale studies. As such, significant questions remain on the ability to apply this system in a practical and reliable manner to the full-scale waste packaging system. It is believed that the mock up test program will provide more objective data on the viability of such a treatment system and may provide useful information on the means and methods to overcome any or most operational difficulties created by the addition of the liquid solution. Operability concerns associated with the liquid delivery system which have been identified to date include: (1) plugging of the liquid delivery spray nozzles and/or waste delivery chute; (2) inability to get the treated waste product to effectively fill the packages; (3) pull back of moisture laden air into the screw conveyor causing plugging; (4) difficulties created by the mixture of the two chemical additives into a single solution for delivery to the packaging system; and (5) moisture related caking or binding of filters in the air handling equipment.

In the event one or all of these concerns were to materialize during full-scale operations the on-line efficiency, capacity and cost of the remedy would be impacted. For example the plugging of the spray nozzles or the plugging of the conveyor screws would require the shutdown of operations and the performance of intrusive maintenance. Maintenance workers would be required to don fully encapsulating protective clothing and supplied air respirators and then come in direct contact with the waste material. These actions would delay operations and subject workers to potential exposures to thorium bearing material, with resultant schedule and cost increases.

DOE will interact with EPA, OEPA, and the involved stakeholders during the future mock up efforts to implement this treatment system. In the event that one or both of the waste additives cannot be practically applied, DOE will consult with the regulatory agencies and involved stakeholders on the details of the operational difficulties. The results of mock up testing, startup, and initial operations will be made available to EPA, OEPA, and other stakeholders, as will adequate opportunity for input to any decision to alter the scope of treatment or to pursue the contingency plan. Regulatory approval will be obtained prior to finalizing such a decision.

Under the conditions where the costs and/or projected worker exposures associated with the application of one or both of the additives become disproportionate with the potential benefits gained, DOE will cease efforts to apply that portion of the liquid solution to the waste that is causing the operational impediments. If the operational impediments result in the decision to discontinue all steps of the liquid treatment process, then a contingency backup action will be implemented. This contingency action will involve the use of a double packaging system as a backup means to further reduce the potential dispersability of waste material released under a hypothetical severe accident involving material transit. The contingency plan will meet all Remedial Action Objectives, ARARs, and other criteria specified for the Revised Remedy. Upon completion of the previously discussed interaction with the EPA, OEPA, and the public, and receipt of regulatory agency approval, the basis and rationale for the contingency-action decisions will be documented in a formal post-decision memorandum, and will be documented for the public in a Remedial Design Fact Sheet.

Waste Packaging and Shipping. Once the waste is retrieved from the silo it will be transferred by screw conveyor to a load hopper for direct delivery into the selected packaging configuration. The previously described chemical solution will be added as the waste enters the package.

The packaging and mode of transportation utilized remain unchanged from the previous remedy. To represent the range of available configurations, the evaluation documented in the PP assumed that soft-sided containers will be placed into steel Sea/Land containers and placed on trucks for off-site transport. Other packaging configurations and modes of transportation, including direct load onto rail flatbed cars with rail transport to a truck offloading station closer to the disposal facility (intermodal transport) or direct rail transport from the Fernald Closure Project to the disposal facility, are available that would meet transportation risk criteria and DOT regulations. The Nevada Test Site can only receive waste containers by truck, therefore only direct truck transport or intermodal transport with offloading from rail to truck is acceptable for disposal at this location. In the event rail transport were to be implemented as the mode of transportation, dedicated unit trains would be used to the maximum extent practical.

Waste Disposal This component of the remedy remains unchanged from the 1998 Silo 3 ESD remedy. Although the remedy will continue to allow disposal at either the Nevada Test Site or an appropriately permitted commercial disposal facility, a representative waste transportation mode (truck transport) and disposal location (Nevada Test Site) was utilized as the representative option for comparison and costing in the Proposed Plan.

During the design and implementation of the Silo 3 remedy, DOE will select the transportation mode(s) and compliant disposal location(s) that provide the best overall balance of reduced transportation risk and cost effectiveness. Only disposal facilities that meet the regulatory compliance requirements of the CERCLA off-site rule (40 CFR 300.440) will be considered.

Silo Demolition and Soil Cleanup. This component of the remedy remains unchanged from the 1998 Silo 3 ESD remedy. This Silo 3 structure will be demolished with the debris properly disposed of in the On-site Disposal Facility or off site at the Nevada Test Site or an appropriately permitted commercial disposal facility. Contaminated soil underlying the facility will be cleaned up to achieve the final remediation levels in the Operable Unit 5 ROD.

The excavated soil will be disposed of in the On-site Disposal Facility (or off site, as appropriate) depending on whether the On-site Disposal Facility waste acceptance criteria levels for the contaminated soil are met.

5 EVALUATION OF ALTERNATIVES

Comparative evaluations of the revised Silo 3 remedy and the Silo 3 ESD remedy (previous remedy) were conducted employing the nine evaluation criteria defined in the National Contingency Plan as the framework for identifying technical and administrative differences between the alternate plans.

The first two evaluation criteria -- overall protection of human health and the environment and compliance with ARARs -- are considered threshold criteria that must be attained by the selected remedial action. The next five criteria include short-term protectiveness, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, implementability, and cost.

These criteria are considered primary balancing criteria, which are looked at collectively to arrive at the best overall solution that offers the best balance of tradeoffs among the criteria. The final two criteria -- state acceptance and community acceptance -- are evaluated following receipt of comments on the Proposed Plan, and are incorporated, as appropriate, into the final remedy selection in the ROD Amendment.

The OU4 FS, PP, ROD, and Silo 3 ESD documented a detailed evaluation of a full range of alternatives against these same criteria to arrive at the selected previous remedy contained in the 1998 Silo 3 ESD. The discussion in this section therefore focuses on a specific comparative analysis for the two alternative Silo 3 remedies, aimed at those components that are different.

In addition to the nine criteria comparative analysis, Section 121 of CERCLA and the NCP (40 CFR 300.430) require that the remedy selection process consider and address a statutory preference for remedies that employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of hazardous constituents as a principal element.

The DOE and EPA are required to reach a finding in the proposed amendment to the ROD documenting whether the selected remedy satisfactorily fulfills this statutory preference. This statutory preference is addressed in Section 6 of this ROD Amendment.

As part of the original RI/FS for OU4, formal remedial action objectives were identified to guide the overall remedial action alternative development and evaluation process. The original remedial action objectives for the cleanup of the Silo 3 residues as defined in the OU4 FS Report are:

- Prevent direct contact with or ingestion of Silo 3 material
- Prevent release or migration of waste materials to soil, groundwater, surface water or sediment
- Prevent exposures to Silo 3 material that may cause an individual to exceed applicable dose limits.

These original remedial objectives remained unchanged in the 1998 Silo 3 ESD and are again being maintained as the basis for the revised remedy. The revised remedy was developed fully considering these formal remedial action objectives.

5.1 Threshold Criterion No. 1: Overall Protection of Human Health and the Environment

Both the previous and the revised remedies provide for the protection of human health and the environment by removing the high concentration waste residues from the site and properly disposing of them at the Nevada Test Site or a permitted commercial disposal facility. Off-site disposal will be conducted in accordance with the waste acceptance criteria for the receiving facility. The representative disposal facility selected for purposes of evaluating the alternate remedies is the Nevada Test Site. The Nevada Test Site incorporates engineering and institutional controls into the facility design and is situated in a climatic, demographic, and hydrogeologic setting that minimizes the potential for exposures to human or environmental receptors. The licensing process for a permitted commercial disposal facility ensures a similar level of protectiveness to the Nevada Test Site through the location, design, and acceptance criteria of the disposal facility.

The Nevada Test Site waste acceptance criteria establishes a set of requirements that must be fulfilled to permit acceptance of a waste stream for safe, protective disposal. DOE submitted a draft profile to the Nevada Test Site describing the untreated Silo 3 residues and has gained approval of the waste steam for disposal at the facility. This approval by the Nevada Test Site was in part based upon a review of the characteristics of the Silo 3 waste and a determination that the disposal of the material untreated would provide a compliant, protective, and permanent disposal solution. A final waste profile must be submitted to the Nevada Test Site prior to shipping the Silo 3 waste. A copy of the general acceptance letter from the Nevada Test Site is provided in the supplement to the Proposed Plan.

Both remedies specify that all surrounding soil will be excavated to meet the final remediation levels in the Operable Unit 5 ROD. The residual risk that will remain at the site following completion of the remedial action is consistent with that described in the original Operable Unit 4 Feasibility Study and would remain unchanged by the implementation of the revised remedy. This residual risk would be expected to be in the range of 10^{-6} to the undeveloped park user as described in the Operable Unit 5 Feasibility Study and ROD.

5.2 Threshold Criterion No. 2: Compliance with ARARs

Both the previous and the revised remedies will attain compliance with ARARs. The ARARs identified in the Operable Unit 4 Feasibility Study and 1994 ROD, and were not changed by the 1998 ESD for Silo 3, and have been maintained as the criteria for the evaluation documented in this ROD Amendment. One requirement has been revised since issuance of the Silo 3 ESD -- the selection of the RCRA TCLP limits as a quantitative performance requirement for treatment of the Silo 3 waste. As described earlier, as a result of a change in the waste acceptance criteria for the Nevada Test Site, the RCRA-regulated metals in the waste no longer need to be treated to attain TCLP levels as a necessary condition for waste acceptance. As a result of this changed condition, the application of this former requirement is no longer considered a relevant criteria for the Silo 3 remedy. With this change, the revised remedy will attain all identified ARARs, and performance criteria. A detailed compilation of the ARARs for the revised Silo 3 remedy is provided in Appendix A of this ROD Amendment.

5.3 Balancing Criterion No. 1: Long-term Effectiveness and Permanence

The previous remedy and the revised remedy both provide a remedy that is effective in the long term and a permanent solution for the Silo 3 wastes. Both alternatives provide for the removal of the Silo 3 waste from the site and the cleanup of any contaminated soil from the silo area. The waste will be shipped from the site and disposed of at an off-site facility in full compliance with the waste acceptance criteria and any relevant licensing restrictions for the receiving facility. The design of these facilities, in concert with their waste acceptance criteria and regional climatic, demographic, and hydrogeologic setting provide a waste disposal solution that is both effective in the long term and permanent.

The previous remedy provides an incremental increase in long-term effectiveness by including treatment to the TCLP levels as a performance requirement of the remedy. The revised remedy includes the application of a binding agent and a stabilizing reagent to the waste, which is expected to provide a meaningful level of reduction in both the dispersability of the packaged waste and the leachability of the metals. It is not anticipated or expected that the application of this treatment approach will fully reduce the leachability of the four RCRA regulated metals of concern within the Silo 3 waste (arsenic, selenium, chromium, and cadmium) to below TCLP levels in all cases. The additional incremental reduction in metals leachability provided by the previous remedy over and above that anticipated by the proposed approach is not considered significant since the mobility of contaminants in the incoming waste is already a consideration in development of acceptance criteria for the receiving disposal facilities. For both the previous remedy and the revised remedy, disposal in accordance with approved disposal facility waste acceptance criteria will assure that disposal of Silo 3 material will be protective of human health and the environment. The Silo 3 waste will be disposed in the off-site facilities with other byproduct or low level radioactive wastes shipped by other generators with similar characteristics to those exhibited by the treated or untreated cold metal oxides in the silo. Adherence to the waste acceptance requirements of the receiving disposal facility ensures full compliance with prevailing state and federal environmental and health protection regulations governing the long-term performance of these waste disposal systems.

As previously discussed, any identified contaminated soil in the area of Silo 3 will be cleaned up to attain the final remediation levels in the Operable Unit 5 ROD, consistent with other areas of the Fernald site. These cleanup levels were developed to help ensure the long-term protectiveness and permanence of the Fernald cleanup. These cleanup levels were set following a consensus building process that involved the DOE, regulatory agencies, and the community. These cleanup levels have been designed to provide a site-wide remedy that will reduce the residual risk following cleanup to the range of 10^{-6} to the undeveloped park user. The detailed exposure assumptions underlying this risk analysis can be found in the Operable Unit 5 Feasibility Study and ROD.

5.4 Balancing Criterion No. 2: Reduction of Toxicity, Mobility, or Volume Through Treatment

Both the previous and the proposed remedies provide for treatment of the waste materials prior to disposal at the Nevada Test Site or a permitted commercial disposal location. The previous plan would provide some incremental decrease in the mobility of the waste over that provided by the revised remedy.

This incremental additional decrease is not considered significant for health or environmental reasons and is not required to comply with the acceptance criteria of the receiving facility. The chemical stabilization approach envisioned under the previous plan would provide for an increase (approximately 50 percent) in volume over the revised plan due to the type and quantity of waste additives necessary to ensure attainment of the TCLP limits imposed under the previous remedy. The revised plan contemplates the addition of waste additives to the degree attainable in a practical and implementable manner. Bench scale studies demonstrated that a dilute lignosulfonate solution could be effectively added to the waste as it enters the packages to reduce the dispersability of the material. These tests were aimed at adding the lignosulfonate solution to the waste such that the moisture content of the waste was increased by up to 20 percent. These bench tests proved successful and DOE has committed to applying this system in the revised remedy. A second chemical reagent, aimed at reducing the leachability of the nonradioactive metals, is also planned to be applied to the waste through the same delivery system. The operability of such a waste additive and liquid delivery system at full scale is not yet proven. As previously discussed, the DOE will make a best effort to ensure the success of the process. In the event the process cannot be applied at full scale, DOE will first attempt to modify or, if need be, eliminate one or both of the additives in the liquid delivery system, if that is the source of the interference. As the next step, in the event the liquid delivery system cannot be successfully operated at all (with or without additives), the contingency action will be implemented following the regulatory and stakeholder consultation process previously described. Under the contingency action, a backup double packaging requirement will be imposed as a tradeoff for elimination of the liquid delivery step.

5.5 Balancing Criterion No. 3: Short-term Effectiveness

The National Contingency Plan identifies the considerations for which the short-term effectiveness criterion should be evaluated as risks to the community during implementation of the alternative, potential impacts to workers during remedial actions, potential environmental impacts during implementation, and time until protection is achieved. Overall, this criterion favors the revised remedy due to its advantages in worker risk and implementation schedule.

Due to the dispersible nature and high thorium-230 content of the Silo 3 material, a primary short-term effectiveness issue is the potential for worker exposures due to Silo 3 material becoming airborne during retrieval, processing, and packaging. Equipment and operational controls, such as ventilation through dust collection equipment, dust control measures during bulk retrieval, and contamination control practices, must be implemented at each unit operation to minimize the risk of worker exposure to airborne Silo 3 material. These considerations would be designed into the waste handling systems of both the current and revised remedies.

A key consideration in the analysis of the short-term effectiveness of the two remedies is the risks attributable to the transportation of the packaged materials to the off-site disposal facility.

A detailed transportation risk analysis was completed evaluating the potential risks associated with routine (no accidents) waste transportation and to hypothetical accident scenarios for both the previous and the revised remedies. The following table presents the results of the transportation risk analysis.

RESULTS OF THE TRANSPORTATION RISK ANALYSIS

	Previous Remedy Routine Transport ILCR	**Revised Remedy Routine Transport ILCR**
Truck To NTS	8.3 x 10^{-10}	1.8 x 10^{-9}
Rail to Envirocare	2.9 x 10^{-10}	4.4 x 10^{-10}
	Previous Remedy Accident Scenario ILCR	**Revised Remedy Accident Scenario ILCR**
Truck to NTS	3.1 x 10^{-11}	4.4 x 10^{-8}
Rail to Envirocare	1.6 x 10 $^{-10}$	2.3 x 10^{-7}

Additional details concerning the assumptions, methodology, and results of the analysis are documented in the Silo 3 Proposed Plan.

These risk estimates compare favorably to the criteria of being below a risk of 1 x 10^{-6} ILCR for routine transportation established by the 1998 Silo 3 ESD. The calculated risk attributable to the revised remedy is slightly higher than the previous remedy due to the increased waste loading in the shipping containers resulting in higher direct radiation levels on the outside of the package.

Operation and maintenance of the additional equipment required for chemical stabilization of leachable metals to meet TCLP levels under the current plan results in increased non-radiological risk (worker injury), and the potential for increased radiological exposures to workers. In addition, operation of the chemical stabilization process results in an incremental increase in short-term environmental impacts attributable to increased generation of secondary waste (e.g. wastewater and solid waste) derived from increased material handling and processing steps.

As will be discussed under the implementability criterion, the chemical stabilization operation in addition to the retrieval and packaging, transportation and disposal operations, increases the operational complexity of the previous remedy over and above the liquid additive system contemplated by the revised remedy. This increased complexity results in increased uncertainty in the schedule for completion of Silo 3 remediation.

5.6 Balancing Criterion No. 4: Implementability

This criterion favors the revised remedy due to less complex operations and a resulting greater confidence in its ability to be successfully implemented.

The equipment and operations required to retrieve the Silo 3 material from the silo, and package the treated or untreated material for transportation to the disposal facility are common to both cleanup alternatives. Chemical stabilization of the leachable metals for the previous remedy requires additional equipment and unit operations over and above those envisioned to support the proposed remedy. In addition, assuring that the process accomplishes adequate chemical stabilization to meet the TCLP limits requires additional sampling and process controls to monitor the characteristics of the feed stream and control the stabilization recipe. Additional product sampling to verify attainment of TCLP limits, and the ability to reprocess treated waste failing to meet the limits is also required.

As documented in the 1998 Silo 3 ESD, a primary factor in the selection of the previous remedy for Silo 3 was the significant implementability issues associated with treatment of the material due to its unique physical, chemical and radiological characteristics. The dispersible nature of the Silo 3 material, in combination with its thorium-230 content, results in dust control and contamination concerns. The need to mitigate these concerns in the design of equipment such as the material handling and mixing equipment associated with the chemical stabilization process included in the ESD remedy, further increases the complexity of the design, operation, process control, and maintenance aspects of the remedy.

This additional equipment and greater number of unit operations increases the operational and maintenance complexity and risk of operational upsets, and thereby results in a greater implementability risk for the current plan, than those that would be expected by the revised remedy. Some operational challenges are expected during the implementation of the liquid addition system for the revised remedy. As previously stated, DOE expects that these will be overcome during the mock up testing.

The administrative feasibility associated with obtaining the necessary approvals for acceptance at the Nevada Test Site is equivalent for either remedy. The licensing process for the acceptance of the treated waste material at the representative commercial facility (Envirocare) is considered to be more complex.

The schedule for implementation of the previous remedy including design, construction, operations and post-treatment system cleanout and demolition has been estimated at 43 months. The schedule duration to implement the same scope for the revised remedy is estimated at 35 months. The differences are attributable to the added design engineering for the more complex treatment process, and to the added schedule duration to execute the operations and shipping program associated with previous remedy.

5.7 Balancing Criterion No. 5: Cost

A detailed cost evaluation of the previous and revised remedies is documented in the Proposed Plan for Silo 3 and detailed in the Supplement to the Proposed Plan. The accuracy of both estimates is considered +50/-30 percent, consistent with CERCLA guidance. For purposes of comparative analysis, treated waste is assumed to be shipped by truck to the Nevada Test Site for each alternative. The following summarizes the major cost elements for the previous plan and the revised remedy alternatives. Costs associated with the D&D of the Silo 3 structure have not been included. Similarly, the costs for addressing any contaminated soil in the Silo 3 area have been excluded from both options.

Summary Cost Data ($ Million)

Alternative	**Previous Cleanup Plan**	**Revised Cleanup Plan**
Capital Cost	20.0	14.0
Engineering, Proj. Mgmt., Const. Mgmt. and Startup Cost	15.0	15.0
Operation and Maintenance Cost	7.0	4.0
Transportation and Disposal Cost	11.0	7.0
D&D Cost	2.0	2.0
Total Cost	**55.0**	**42.0**

Due to the incremental life-cycle costs of providing treatment to stabilize arsenic, cadmium, chromium, and selenium to achieve TCLP limits, the estimated cost for the previous remedy is estimated at $13 million greater than the revised plan. These incremental costs include additional capital costs to support the installation of the chemical stabilization system, increased operational costs attributable to additional staff and analytical demand, and increased shipping costs due to the almost 50 percent increase in volume to be shipped under the previous remedy.

It should be noted that the difference between the two alternatives ($13 million) is within the errors expected from estimating (plus 50 percent, minus 30 percent), and therefore should not be heavily relied upon in decision making. While a more precise estimate of the cost differences between the two alternate remedies cannot be made without the benefit of more detailed engineering, it can be reasonably expected that the cost to implement the previous remedy will be higher than that to implement the revised plan. These added costs would be attributable to the added design, construction, operation and demolition scope associated with the more complex treatment approach dictated by the previous remedy.

5.8 Modifying Criterion No. 1: State Acceptance

The OEPA has had an opportunity to review and participate in the revision of the Silo 3 remedy and concurs with the revised remedy.

5.9 Modifying Criterion No. 2: Community Acceptance

DOE’s recommendation to implement the revised remedy for Silo 3 was documented in the Proposed Plan for Silo 3, which was made available for public comment from April 30, 2003 through May 30, 2003. A public hearing was held in the vicinity of the Fernald Closure Project on May 13, 2003. DOE and EPA have considered comments provided by the community in making the final alternative selection documented in this ROD Amendment. Comments received during the public comment period are addressed in the Responsiveness Summary, contained in Appendix B of this ROD Amendment.

6 STATUTORY DETERMINATIONS

The NCP [40 CFR Section 300.430(f)(5)(ii)] specifies that a ROD shall describe the following statutory requirements as they relate to the scope and objectives of the action:

- How the selected remedy is protective of human health and the environment;
- How the remedy will comply with all ARARs established under federal and state environmental laws (or justify a waiver);
- How the remedy is cost-effective (i.e., provides overall effectiveness proportional to its costs);
- How the remedy will use permanent solutions and alternative technologies or recovery technologies to the maximum extent practicable; and
- How the remedy will satisfy the statutory preference for remedies that employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants as a principle element, or if it is not satisfied, explain why a remedy providing reductions in toxicity, mobility, or volume was not selected.

In addition, CERCLA requires five year reviews to determine if adequate protection of human health and the environment is being maintained where RAs result in hazardous substances remaining on-site. A discussion is provided below of how the revised remedy for Silo 3 satisfies these statutory requirements.

6.1 Protection of Human Health and the Environment

The revised remedy achieves the requirement of being protective of human health and the environment by: (1) removing the sources of contamination, (2) treating, to the extent reasonably technically feasible, the materials giving rise to the principle threats from Silo 3 (3) disposing of treated materials at an off-site location that provides the appropriate level of protectiveness; and (4) remediating contaminated soils and debris to protective levels. The contents of Silo will be removed, treated to the extent reasonably implementable to reduce the dispersability and mobility of contaminants, and transported in a protective manner to an offsite facility for disposal. The location, design, and waste acceptance criteria of the offsite disposal facility will assure that the disposal of the Silo 3 material provides long-term protection of human health and the environment. Concrete from the Silo 3 structure and the associated remediation facilities will be removed from OU4 and disposed of in a manner consistent with the approved OU3 ROD. Contaminated soil will also be removed and disposed in a manner consistent with the approved OU5 ROD.

Baseline cancer risks from current conditions exceed the 10^{-4} to 10^{-6} acceptable risk range. Under the future land use scenario of continued federal ownership, the residual cancer risk from Silo 3 will be reduced to less than 1×10^{-6}. There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

6.2 Compliance with ARARs

The revised remedy for Silo 3 will comply with all ARARs. As described earlier, as a result of a change in the waste acceptance criteria for the Nevada Test Site, the RCRA-regulated metals in the waste no longer need to be treated to attain TCLP levels as a necessary condition for waste acceptance. As a result of this changed condition, the application of this former requirement is no longer considered a relevant criteria for the Silo 3 remedy. With this change, the revised remedy will attain all ARARs and performance criteria identified for the Silo 3 remedy. A detailed compilation of the ARARs for the revised Silo 3 remedy is provided in Appendix A of this ROD Amendment.

6.3 Cost Effectiveness

DOE has determined that the revised remedy for Silo 3 has costs that are proportional to the overall effectiveness of the remedy. Therefore, the revised remedy meets the statutory requirement for cost effectiveness, as defined by the NCP [40 CFR 300.430(f)(1)(ii)(D)].

6.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

DOE has determined, with the concurrence of the EPA and the OEPA, that the revised remedy for Silo 3 represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner. Of the alternatives that are protective of human health and the environment and comply with ARARs, DOE has determined that this selected remedy provides the best balance of tradeoffs among the alternatives in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost. As documented in the next section, the revised remedy also meets the statutory preference for treatment as a principle element.

6.5 Preference for Treatment as a Principal Element

Under Section 121 of CERCLA, DOE and EPA are required to reach a finding that the selected remedial alternative satisfies a statutory preference for remedies that employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of hazardous constituents as a principal element. The finding is to be made through the detailed comparison of the two alternatives, considering site-specific factors and the five primary balancing criteria specified by the NCP (40 CFR 300.430).

On the basis of the detailed comparisons described above, DOE and EPA conclude that the modified Silo 3 treatment process satisfactorily achieves the statutory preference for treatment as a principal element and provides sufficient additional risk reduction in relation to cost. If the treatment step cannot be satisfactorily implemented due to overriding technical or short-term worker risk impediments, then the formal contingency action (additional double packaging of materials in the protective shipping containers) is also deemed to provide an appropriate balance of risk reduction, effectiveness, and cost to satisfy Section 121 requirements and preferences under the site-specific circumstances giving rise to the need for the contingency action.

6.6 National Environmental Policy Act

In the original ROD for OU4 DOE chose to complete an integrated CERCLA/NEPA process. This decision was based on the longstanding interest on the part of local stakeholders to prepare an Environmental Impact Statement (EIS) on the restoration activities at the FEMP and on the recognition that the draft document was issued and public comments received. Therefore, the document served as DOE's ROD for OU4 under both CERCLA and NEPA; however, it is not the intent of the DOE to make a statement on the legal applicability of NEPA to CERCLA actions.

Four Supplemental Analyses have been prepared evaluating changes to the original OU4 FS/PP EIS:

- January 9, 1996, evaluating shipping material for disposal via truck as opposed to the combination of rail/truck evaluated in the OU4 FS/PP-EIS.
- August 20, 1996 evaluating the Silo 3 remediation alternatives, including on-site treatment with disposal at the NTS or a PCDF, and transportation of untreated Silo 3 material to an off-site facility.
- March 3, 1998 evaluating Accelerated Waste Retrieval of the Silos 1 and 2 material.
- March 13, 2000 considering of alternatives for the remediation of the Silos 1 and 2 material.

No additional impacts were identified as a result of these reevaluations, and in each case, DOE determined that no additional NEPA evaluation or documentation was required.

The change documented in the ROD Amendment is bounded by the alternatives evaluated in the original FS/PP/EIS and the subsequent Supplemental Analyses. Therefore, it is DOE's determination that potential NEPA issues associated with the change have been adequately evaluated and that no additional NEPA documentation or evaluation is necessary.

7 COMMUNITY PARTICIPATION

Compliance with the public participation requirements specified by the NCP (40 CFR 300.435(c)(2)) for revision of the Silo 3 remedy have been met through the following actions:

- The Proposed Plan, and information supporting DOE's selection of the revised remedy for Silo 3 has been made available at two Administrative Record locations: the Public Environmental Information Center at the Fernald Closure Project, and at the EPA offices in Chicago, Illinois.
- The Fernald Citizens Advisory Board, the Fernald Residents for Environmental Safety and Health, OEPA, and other stakeholders have been informed during the evaluation and development of the revised remedy through periodic briefings and communications.
- DOE's recommendation for the revised Silo 3 remedy and the supporting rationale were documented in a Proposed Plan, which was placed into the Administrative Record on April 29, 2003.
- A thirty-day public comment period was established from April 30, 2003 through May 30, 2003. A public hearing was held in the vicinity of the Fernald Closure Project on May 13, 2003. The availability of the Proposed Plan, and the schedule for the comment period and hearing were advertised in local newspapers on April 30, 2003.
- No oral nor written comments were received at the public hearing on May 13, 2003. A transcript of the public hearing is contained in the Responsiveness Summary (Appendix B). All comments received during the public comment period, as well as DOE's response to each comment, are documented in the Responsiveness Summary.

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

AND TO BE CONSIDERED REQUIREMENTS

FOR SILO 3 REMEDIAL ACTION

TABLE A-1
ARARS FOR SILO 3 REMEDIAL ACTION
CHEMICAL-SPECIFIC

Medium	Clean Air Act (CAA)	Requirement	ARAR/TBC	Rationale for Implementation
Air	Radionuclide Emissions (Except Airborne Radon-222), 40 CFR Part 61 Subpart H.	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that might cause any member of the public to receive, in any year, an effective dose equivalent (EDE) of 10 mrem or greater per year. Monitoring is required at release points having potential to discharge radionuclides that could cause an EDE in excess of 1% of the standard (0.1 mrem/yr) to any member of the public.	Applicable	Radioactive materials within Silo 3 could contribute to the dose received by members of the public from the air pathway during implementation of Silo 3 remedial actions.
Air	Radon-222 Emissions, 40 CFR Part 61 Subpart Q.	No source at a DOE facility shall emit more than 20 $pCi/m^2.s$ of radon-222 as an average for the entire source during periods of storage and disposal.	Applicable	A ‘source’ is defined by NESHAP Subpart Q as ‘any building, structure, pile, or impoundment used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit radon-222 in excess of this standard prior to remedial action.” Temporary staging of Silo 3 material during the process of packaging and transportation to the disposal facility does not constitute a ‘source’ for the purposes of this standard. This standard is applicable to the facility used for disposal of the Silo 3 material.

TABLE A-1 (Continued)

<table>
<tr><th>Medium</th><th>DOE</th><th>Requirement</th><th>ARAR/TBC</th><th>Rationale for Implementation</th></tr>
<tr>
<td>Air</td>
<td>Radiation Protection of the Public and the Environment, Proposed 10 CFR Part 834.</td>
<td>Residual concentrations of radionuclides in the air within uncontrolled areas are limited to those listed below (for known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding limit must not exceed 1.0.).
Derived Concentration Guide
(µCi/mL)
<table>
<tr><th>Isotope</th><th>D[a]</th><th>W</th><th>Y</th></tr>
<tr><td>Actinium-227</td><td>2×10^{-15}</td><td>7×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Lead-210</td><td>9×10^{-13}</td><td>-----[b]</td><td>-----</td></tr>
<tr><td>Polonium-210</td><td>1×10^{-12}</td><td>1×10^{-12}</td><td>-----</td></tr>
<tr><td>Protactinium-231</td><td>-----</td><td>9×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Radium-224</td><td>-----</td><td>4×10^{-12}</td><td>-----</td></tr>
<tr><td>Radium-226</td><td>-----</td><td>1×10^{-12}</td><td>-----</td></tr>
<tr><td>Radium-228</td><td>-----</td><td>3×10^{-12}</td><td>-----</td></tr>
<tr><td>Technetium-99</td><td>1×10^{-8}</td><td>2×10^{-9}</td><td>-----</td></tr>
<tr><td>Strontium-90[c]</td><td>5×10^{-11}</td><td>-----</td><td>9×10^{-12}</td></tr>
<tr><td>Thorium-228</td><td>-----</td><td>5×10^{-14}</td><td>4×10^{-14}</td></tr>
<tr><td>Thorium-230</td><td>-----</td><td>4×10^{-14}</td><td>5×10^{-14}</td></tr>
<tr><td>Thorium-232</td><td>-----</td><td>7×10^{-15}</td><td>1×10^{-14}</td></tr>
<tr><td>Uranium-234</td><td>4×10^{-12}</td><td>2×10^{-12}</td><td>9×10^{-14}</td></tr>
<tr><td>Uranium-235</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-13}</td></tr>
<tr><td>Uranium-236</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-13}</td></tr>
<tr><td>Uranium-238</td><td>5×10^{-12}</td><td>2×10^{-12}</td><td>1×10^{-14}</td></tr>
</table>
[a] D, W, and Y (days, weeks, years) represent lung retention classes; removal halftimes assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 8,400 m^3 of air per year (based on an exposure over 24 hours per day, 365 days/ year).
[b] A dashed line means that no limit has been established.
[c] The value shown for daily derived concentration guide (DCG) is for strontium radionuclides with a f_1 value of 3×10^{-1}. The value shown for yearly DCG is for strontium radionuclides for a f_1 value of 1×10^{-2}.</td>
<td>To be considered</td>
<td>Remediation of the Silo 3 material has the potential to release radionuclides.</td>
</tr>
</table>

TABLE A-1 (Continued)

Medium	DOE (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Air	Residual Radioactive Material, DOE Order 5400.5 Chap. IV, 6.b (proposed 10 CFR Part 834).	Interim Storage The above-background concentration of radon-222 in air above an interim storage facility must not exceed: 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 0.5 pCi/L above background or above any location outside the site.	To be considered	Management of radium and thorium bearing waste might result in the release of radon gas to the environment.
Water	Radiation Protection of the Public and the Environment, Proposed 10 CFR Part 834.	Residual concentrations of radionuclides in water that may be ingested are listed below. These DCGs for the COCs are based on a committed EDE of 100 mrem/yr, assuming ingestion of 2 liters/day. Note that these DCGs apply only if ingestion is the single pathway of exposure. Ingested Water DCGs Isotope (µCi/mL) Actinium-227 1x10^{-8} Lead-210 3x10^{-8} Polonium-210 8x10^{-8} Protactinium-231 1x10^{-8} Radium-224 4x10^{-7} Radium-226 1x10^{-7} Radium-228 1x10^{-7} Technetium-99 1x10^{-4} Strontium-90 1x10^{-6} Thorium-228 4x10^{-7} Thorium-230 3x10^{-7} Thorium-232 5x10^{-8} Uranium-234 5x10^{-7} Uranium-235 6x10^{-7} Uranium-236 5x10^{-7} Uranium-238 6x10^{-7}	To be considered	Remediation of the Silo 3 material has the potential to release radionuclides.

TABLE A-1 (Continued)

<table>
<tr><th>Medium</th><th>CWA</th><th>Requirement</th><th>ARAR/TBC</th><th>Rationale for Implementation</th></tr>
<tr><td>Water</td><td>Ohio Water Quality Standards, Ohio Administrative Code (OAC) 3745-1-04.</td><td>“Five Freedoms” for surface water:

Surface waters of the state shall be free from:
• objectionable suspended solids;
• floating debris, oil and scum;
• materials that create a nuisance;
• toxic, harmful or lethal substances; and
• nutrients that create nuisance growth.</td><td>Relevant and Appropriate</td><td>Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.</td></tr>
<tr><td>Water</td><td>Ohio Water Quality Standards, OAC 3745-1-07.</td><td><u>Use Designations and Criteria</u>

All pollutants or combinations of pollutants shall not exceed, outside the mixing zone, the Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designations listed in Tables 7-1 through 7-15 of this rule.

The following constituents of concern (COCs) for Operable Unit 4 have warm water habitat criteria concentrations outside the mixing zone as follows:
<table>
<tr><th>30-day Criteria Constituent</th><th>average conc.[a] (ug/l)</th><th>conc. (ug/l)</th></tr>
<tr><td>antimony</td><td>650</td><td>190</td></tr>
<tr><td>arsenic</td><td>360</td><td>190</td></tr>
<tr><td>beryllium</td><td>Tab. 7-10[b] Tab. 7-11[c]</td><td></td></tr>
<tr><td>cadmium</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>chromium Tab. 7-10</td><td>Tab. 7-11</td><td></td></tr>
<tr><td>copper</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>cyanide</td><td>46</td><td>12</td></tr>
<tr><td>lead</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>mercury</td><td>1.1</td><td>0.20</td></tr>
<tr><td>nickel</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>selenium</td><td>20</td><td>5.0</td></tr>
<tr><td>silver</td><td>Tab. 7-10 1.3</td><td></td></tr>
<tr><td>thallium</td><td>71</td><td>16</td></tr>
</table>
</td><td>Relevant and Appropriate</td><td>Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.</td></tr>
</table>

TABLE A-1 (Continued)

<table>
<tr>
<td>Water</td>
<td>Ohio Water Quality Standards, OAC 3745-1-07 (continued).</td>
<td>
<table>
<tr><td>30-day Criteria
Constituent</td><td>average conc.[a]
(ug/l)</td><td>conc.
(ug/l)</td></tr>
<tr><td>zinc</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>30-day Criteria
Constituent</td><td>average conc.[a]
(ug/l)</td><td>conc.
(ug/l)</td></tr>
<tr><td>2-butanone160000</td><td>7100</td><td></td></tr>
<tr><td>4-nitrophenol</td><td>790</td><td>35</td></tr>
<tr><td>acentone</td><td>550000</td><td>78000</td></tr>
<tr><td>aldrin</td><td>----</td><td>0.01</td></tr>
<tr><td>bis(2-ethylhexyl) phthalate1100</td><td>8.4</td><td></td></tr>
<tr><td>carbon tetrachloride1800</td><td></td><td>280</td></tr>
<tr><td>DDT</td><td>----</td><td>0.001</td></tr>
<tr><td>Dieldrin</td><td>----</td><td>0.005</td></tr>
<tr><td>di-n-butyl-phthalate350</td><td>190</td><td></td></tr>
<tr><td>diethylphthalate</td><td>2600</td><td>120</td></tr>
<tr><td>dimethylphthalate</td><td>1700</td><td>73</td></tr>
<tr><td>enosulfan[d]</td><td>----</td><td>0.003</td></tr>
<tr><td>endrin</td><td>----</td><td>0.002</td></tr>
<tr><td>fluoranthene</td><td>200</td><td>8.9</td></tr>
<tr><td>methylene chloride</td><td>9700</td><td>430</td></tr>
<tr><td>PCBs</td><td>----</td><td>0.001</td></tr>
<tr><td>phenol</td><td>5300</td><td>370</td></tr>
<tr><td>tetrachloroethene</td><td>540</td><td>73</td></tr>
<tr><td>toluene</td><td>2400</td><td>1700</td></tr>
</table>
[a] Criteria concentration shall be met outside mixing zone.
[b] Criteria concentration based on hardness of water. See Table 7-10 for calculation to determine maximum concentration outside the mixing zone.
[c] 30-day average criteria based on hardness of water. See Table 7-11 for calculation to determine allowable 30-day average concentration outside the mixing zone.
[d] No designation was made as to whether endosulfan referred to endosulfan I or endosulfan II or the sum total of each.

The remaining COCs for OU4 will have criteria concentration levels based on calculated acute aquatic criteria or chronic aquatic criteria.
</td>
<td></td>
<td></td>
<td></td>
</tr>
</table>

TABLE A-2
ARARS FOR SILO 3
REMEDIAL ACTION, LOCATION-SPECIFIC

NEPA/EPA	Requirement	ARAR/TBC	Rationale for Implementation
Endangered Species Protection, 50 CFR Part 402 (ORC 1518, 1513.25 and OAC 1501-18-1-01).	Federal agencies must not jeopardize the continued existence of any endangered or threatened species, or destroy or adversely modify critical habitat of such species.	Applicable	The FEMP is located within the range of the Indiana bat, a federally listed endangered species, which has been sighted at the FEMP. Therefore, this requirement is applicable. Any potential impacts of the remedial actions on this species must be evaluated and appropriate action taken.
NEPA/DOE	Requirement	ARAR/TBC	Rationale for Implementation
Compliance with Floodplain/Wetlands Environmental Review Requirements, 10 CFR Part 1022 (Executive Order 11990).	DOE actions in a wetland must first evaluate the potential adverse effects that those actions might have on the wetland and consider the natural and beneficial values served by the wetlands.	Applicable	This requirement is applicable because the FEMP is a DOE facility. Several alternatives might result in destruction or modification of wetland areas.

TABLE A-3

ARARS FOR SILO 3
REMEDIAL ACTION, ACTION–SPECIFIC

AEA/DOE	Requirement	ARAR/TBC	Rationale for Implementation
10 CFR Part 1021.2	DOE actions must be subjected to NEPA evaluation as outlined by the Council on Environmental Quality regulations in 40 CFR Part 1500-1508.	Applicable	This requirement is applicable because the FEMP is a DOE facility, and this requirement requires NEPA evaluation for specific actions at DOE facilities.
CWA	Requirement	ARAR/TBC	Rationale for Implementation
Nationwide Permit Program, 33 CFR Part 330.	The U.S. Corps of Engineers can issue a Nationwide Permit (NWP) as a general permit for certain classes of actions that involve dredge or fill activities in wetlands or navigable waters. Discharges of dredged or fill material into wetlands may require a wetland delineation.	Applicable	Remediation activities may require construction of access roads and utility lines resulting in minor wetland disturbances. Dredge and fill activities related to construction of these access roads and utility lines will be conducted in accordance with the substantive terms and conditions of NWP 14 (Road Crossing), and NWP 12 (Utility Line Backfill and Bedding). OEPA has been granted Section 401 State Water Quality Certification for NWPs 12 and 14.
Discharge of Stormwater Runoff, 40 CFR Part 122.26 (OAC 3745-38).	Stormwater runoff from landfills, construction sites, and industrial activities must be monitored and controlled. A Stormwater Pollution Prevention Plan is required for construction activities that result in a total land disturbance of five or more acres.	Applicable	Required of industrial waste sites and construction sites of greater than five acres that discharge stormwater runoff to the waters of the U.S. Some remedial alternatives evaluated might disturb more than five acres of land.

TABLE A-3 (Continued)

CWA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Discharge of Treatment System Effluent, 40 CFR Part 125.100. 40 CFR Part 125.104.	Best Management Practices (BMPs) Development and implementation of a BMP program to prevent the release of toxic or hazardous pollutants to waters of the U.S. Development and implementation of a sitewide BMP Program is also required as a condition of the FEMP National Pollution Discharge Elimination System (NPDES) Permit. The BMP program must: • Establish specific objectives for the control of toxic and hazardous pollutants, and • Include a prediction of direction, rate of flow, and total quantity of toxic and hazardous pollutants where experience indicates a reasonable potential for equipment failure.	Relevant and Appropriate	All of the proposed actions have the potential for releases and runoff from this operable unit (OU).
Safe Drinking Water Act (SDWA)	Requirement	ARAR/TBC	Rationale for Implementation
Ohio Water Well Standards, OAC 3745-9-10.	Abandonment of Test Holes and Wells Upon completion of testing, a test hole or well shall be either completely filled with grout or such material as will prevent contaminants from entering groundwater.	Applicable	Test borings and wells might be installed and/or closed as part of these remedial alternatives.

TABLE A-3 (Continued)

UMTRCA	Requirement	ARAR/TBC	Rationale for Implementation
Implementation of Health and Environmental Protection Standards for Uranium Mill Tailings, 40 CFR Part 192 Subpart C.	This subpart contains guidance, criteria, and supplemental standards for compliance with Subparts A and B of 40 CFR Part 192.	Relevant and Appropriate	Radioactive materials in this OU 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.
RCRA Subtitle C	Requirement	ARAR/TBC	Rationale for Implementation
Hazardous Waste Determinations, 40 CFR Part 262.11 (OAC 3745-52-11).	Any generator of waste must determine whether or not the waste is hazardous. The procedures for determination include: • Identification of whether a particular material of concern is a "solid waste"; • Identification of whether a particular exclusion applies to the material eliminating it from definition as a "solid waste"; • Identification of whether a particular solid waste might be classified as a hazardous waste; and • Determination of whether a material otherwise classified as a "hazardous waste" might be excluded from RCRA regulation.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes (e.g., secondary waste) that exhibit a hazardous characteristic.)	These procedures are established to determine whether wastes are subject to the requirements of RCRA. The materials in Silo 3 are specifically exempt from the applicability of RCRA requirements. However, certain specific RCRA requirements, as identified in the remainder of this table, have been identified as relevant and appropriate to the onsite management (storage, transportation) of Silo 3 material. Hazardous waste determination requirements of 40CFR 262.11 are relevant and appropriate to determine whether wastes generated during remediation of Silo 3 material, such as debris generated during decontamination (e.g., concrete scabbling) or other secondary waste must be treated, stored, and disposed in accordance with RCRA.
Hazardous Waste Exclusions, 40 CFR Part 261.4(a)(4) and 40 CFR 261(b)(7) (OAC 3745-51-4)	Materials which are not solid waste include: • Source, special nuclear or by-product material as defined by the Atomic Energy Act of 1954 as amended Solid wastes which are not hazardous wastes include: • Solid waste from the extraction, beneficiation and processing of ores and minerals.	Applicable	The materials in Silo 3 were generated from the extraction/beneficiation of uranium from its ore and have been classified as by-product consistent with Section 11(e)2 of the AEA.

TABLE A-3(Continued)

RCRA Subtitle C	Requirement	ARAR/TBC	Rationale for Implementation
Empty Containers, 40 CFR Part 261.7 (OAC 3745-51-7).	Containers that have held hazardous wastes are “empty” and exempt from further RCRA regulations if one or more of the following are met: • No more than 2.5 cm (1 inch) of residue remains on the bottom of their inner liner; • Less than 3% by weight of total capacity remains (less than or equal to 110 gallon container); and • Less than 0.3% by weight of total capacity remains (greater than 110 gallon container). Containers that have held acutely hazardous (“P” listed) wastes are “empty” and exempt from further RCRA regulation if: • They or their inner liners have been triple rinsed with an adequate solvent or the inner liner has been removed from the container.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Containers used to treat or store secondary waste generated consequential to implementing remedial actions to address the silo 3 residues may exhibit hazardous waste characteristics which must be removed before the containers might be reused or disposed.
Generators Who Transport Hazardous Waste for Off-site Treatment, Storage, or Disposal; 40 CFR Parts 262.20 - 33 and 263.20 - 31 (OAC 3745-52-20 through 33 and OAC 3745-53-20 through 31).	Any generator who transports hazardous waste for off-site treatment, storage or disposal must originate and follow-up the manifest for off-site shipments.	Applicable	Any secondary wastes generated consequential to the implementation of remedial actions to address the silo 3 residues which are determined to be RCRA hazardous waste would be subject to the manifest requirements to facilitate offsite treatment or disposal.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Standards; 40 CFR Part 264 Subpart B (OAC 3745-54-13 through 16).	General Standards • Waste Analysis - OAC 3745-54-13: Operators of a facility must obtain a detailed chemical and physical analysis of a representative sample of each hazardous waste to be treated, stored, or disposed of at the facility prior to treatment, storage, or disposal. • Security - OAC 3745-54-14: Operators of a facility must prevent the unknowing or unauthorized entry of persons or livestock into the active portions of the facility, maintain a 24-hour surveillance system, or surround the facility with a controlled access barrier and maintain appropriate warning signs at facility approaches. • Inspections - OAC 3745-54-15: Operators of a facility must: (1) develop a schedule and regularly inspect monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment that are important to preventing, detecting or responding to environmental or human health hazards; (2) promptly or immediately remedy defects; and (3) maintain an inspection log. • Training - OAC 3745-54-16: Operators must train personnel, within six months of their assumption of duties at a facility, in hazardous waste management procedures relevant to their positions, including emergency response training.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Secondary wastes generated during the implementation of remedial actions to address the silo 3 residues might be required to be treated, stored, and disposed in accordance with TSD facility standards.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Preparedness and Prevention; 40 CFR Part 264 Subpart C and 40 CFR Part 264.31 (OAC 3745-54-31).	Treatment, storage, and disposal facility (TSDF) operators must design, construct, maintain and operate facilities to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of hazardous waste to air, soil, or surface water which might threaten human health or the environment.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Secondary wastes generated during the implementation of remedial actions to address Silo 3 might be required to be treated, stored, and disposed in accordance with TSD facility standards.
40 CFR Part 264.32 (OAC 3745-54-32).	Facilities must be equipped with an internal communication or alarm system, a telephone, or a two-way radio for calling outside to emergency assistance, fire control, and spill control. Decontamination equipment and water must be at an adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems.		
40 CFR Part 264.33 (OAC 3745-54-33).	Fire protection, spill-control and decontamination equipment, and communication and alarm systems must be tested and maintained, as necessary, to ensure proper emergency operation.		
40 CFR Part 264.34 (OAC 3745-54-34).	Personnel must have immediate access to emergency communication or alarm systems whenever hazardous waste is being handled at the facility.		
40 CFR Part 264.35 (OAC 3745-54-35).	Aisle space must be sufficient to allow unobstructed movement of personnel, fire and spill control, and decontamination equipment.		
40 CFR Part 264.37 (OAC 3745-54-37).	Operators must attempt to make arrangements, appropriate to the waste handled, for emergency response by local and state fire, police and medical personnel.		

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Contingency Plan and Emergency Procedures; 40 CFR Part 264 Subpart D and 40 Part CFR 264.51 (OAC 3745-54-51).	Each facility operator must have a contingency plan designed to minimize hazards to human health or the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to the air, soil, or surface/groundwater.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Secondary wastes generated during the implementation of remedial actions to address Silo 3 might be required to be treated, stored, and disposed in accordance with TSD facility standards.
40 CFR Part 264.52 (OAC 3745-54-52).	Contingency plans should address procedures to implement a response to incidents involving hazardous waste, and provide for: internal and external communications, arrangements with local emergency authorities, an emergency coordinator list, a facility emergency equipment list indicating equipment descriptions and locations, and a facility personnel evacuation plan.		
40 CFR Part 264.55, .56 (OAC 3745-54-55 through 56).	Each facility must have an emergency coordinator who: (1) has responsibility for coordinating emergency response measures; (2) is on the premises or on call at all times; (3) is thoroughly familiar with all aspects of the contingency plan, facility operations, location and characteristics of waste handled, location of pertinent records, and facility layout; and (4) has the authority to commit the resources necessary to implement the contingency plan in the event of an emergency.		

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
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).	An operator must close facilities in a manner that: • Minimizes the need for further maintenance; • Minimizes post-closure escape of hazardous constituents; and • Complies with specific, unit-type closure requirements. Contaminated equipment, structures and soils must be properly disposed or decontaminated. Following closure, a survey plot showing the location of hazardous waste disposal units, with respect to surveyed benchmarks, must be filed with the legal total zoning authority.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Secondary wastes generated during the implementation of remedial actions to address Silo 3 might be required to be treated, stored, and disposed in accordance with TSD facility standards.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Container Storage, 40 CFR Part 264 Subpart I 40 CFR Part 264.171-178 (OAC 3745-55-71 through -78).	Containers of RCRA hazardous waste must be: • Maintained in good condition; • Compatible with hazardous waste to be stored; • Close during storage (except to add or remove waste); and • Managed in a manner that will not cause the container to rupture or leak. Storage areas must be inspected weekly for leaking and deteriorated containers and containment systems. Containers must be placed on a sloped, crack-free base, and protected from contact with accumulated liquid. A containment system with a capacity of 10 percent of the volume of the largest container of free liquids must be provided. Spilled or leaked waste must be removed in a timely manner to prevent overflow of the containment system. Incompatible materials must be separated. Incompatible materials stored near each other must be separated by a dike or other barrier. At closure, hazardous waste and residue from the containment system must be removed, and containers, liners, bases, and soils must be removed or decontaminated.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Secondary wastes generated during the implementation of remedial actions to address Silo 3 might be required to be treated, stored, and disposed in accordance with TSD facility standards.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Tank Systems, 40 CFR Part 264 Subpart J (OAC 3745-55-91 through 96).	Design, operating standards, and inspection requirements for tank units within which hazardous waste is stored or treated. Includes the following: • Tank design must be compatible with the material being stored. • Tank must be designed and have sufficient strength to store or treat waste in order to ensure that it will not rupture or collapse. • Tank must have secondary containment that is capable of detecting and collecting releases to prevent migration of wastes or accumulated liquids to the environment.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Design criteria, operating standards, and inspections for tank treatment units might be relevant and appropriate for alternatives utilizing treatment or storage in a tank prior to disposal.
Closure Requirements for Tanks, 40 CFR Part 264.197 (OAC 3745-55-97).	At closure, the facility owner must do the following: • Remove waste residues; • Remove or decontaminate tank system components; • Remove or decontaminate contaminated soils and structures; • Manage all of the above as hazardous wastes; and • If all contaminated soils cannot be removed, meet the landfill requirements of 40 CFR Part 264.310.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	These standards will pertain to closure of any tanks and appurtenances used to provide treatment or storage of non-excluded wastes associated with the implementation of remedial actions for silo 3.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Miscellaneous Units, 40 CFR Part 264 Subpart X (40 CFR 264.601, .602 and OAC 3745-57-91 and 92).	Environmental performance standard, monitoring, inspection, and post-closure care for treatment in miscellaneous units as defined in 40 CFR Part 260.10.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Miscellaneous units might be utilized under various alternatives to remediate waste that is sufficiently similar to hazardous wastes.
Corrective Action for Solid Waste Management Units (SWMUs), 40 CFR Part 264 Subpart S and 40 CFR Part 264.552, .553.	Corrective action management units (CAMUs) might be designated at the site as areas where remediation wastes (solid, hazardous, or contaminated media and debris) might be placed during the process of remediation. Temporary units consisting of tanks and container storage units might be used to store and treat hazardous waste during the process of corrective action.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	During the process of remediation, waste materials might require temporary management in containment buildings, temporary units, stockpiles, or other land based units for the purpose of staging, treating or disposing the material. Materials generated from remediation of the Silo 3 material are considered remediation wastes. Some of the waste material might exhibit a RCRA characteristic, or otherwise be sufficiently similar to hazardous waste to make this requirement relevant and appropriate.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Containment Buildings, 40 CFR Part 264 Subpart DD and 40 CFR Part 264.1101, .1102.	Hazardous waste and debris might be placed into units known as containment buildings for the purpose of interim storage or treatment. Containment buildings must be fully enclosed to prevent exposure to the elements and ensure containment of managed wastes. Floor and containment walls must be designed and constructed of materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit. Surfaces coming in contact with hazardous waste must be chemically compatible with waste. Primary barriers must be constructed to prevent migration of hazardous constituents into barrier. Secondary containment systems including secondary barriers and leak detection systems must also be constructed for containment buildings used to manage wastes containing free liquids. Controls must be implemented to ensure: the primary barrier is free of significant cracks, corrosion, or other deterioration that may allow release of hazardous waste; the level of hazardous waste does not exceed height of containment walls and is otherwise maintained within containment walls; tracking of waste out of unit by personnel or equipment used in handling waste is prevented; and fugitive dust emissions are controlled at the level of no visible emissions.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	During the process of remediation, waste materials might require temporary management for the purpose of staging or treating the material. Some of the waste material might exhibit a RCRA characteristic, or otherwise be sufficiently similar to hazardous waste to make this requirement relevant and appropriate.

TABLE A-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Radiation Dose Limit (All Pathways), Proposed 10 CFR Part 834.	The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an EDE greater than 100 mrem from all exposure pathways.	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.
CAA	Requirement	ARAR/TBC	Rationale for Implementation
Control of Fugitive Dust, OAC 3745-17-08.	Visible emissions of fugitive dust generated during grading, loading, or construction operations and other practices that emit fugitive dust shall be minimized or eliminated.	Relevant and Appropriate	The implementation of remedial action alternatives will require the movement of dirt and other material likely to result in fugitive dust emissions. This requirement is relevant and appropriate because the FEMP is not located in an area subject to this regulation.
Prevention of Air Pollution Nuisance, ORC 3704.01-.05 and OAC 3745-15-07.	Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared a public nuisance and is prohibited.	Applicable	During the remediation process, some potential exists for emissions of radionuclides and toxic chemicals to the air.

TABLE A-3 (Continued)

CAA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Control of Visible Particulate Emissions from Stationary Sources, OAC 3745-17-07.	Discharge of particulate emissions of a shade or density greater than 20 percent opacity into ambient air from any stack is prohibited. Transient limits are included in this regulation.	Applicable	Treatment operations for various alternatives might result in the release of particulate material.
Permit to Install, OAC 3745-31-05(A)(3).	The director shall issue a permit to install if he/she determines that the installation or modification and operation of the air contaminant source will employ the best available technology.	Relevant and Appropriate	Although an administrative permit to install is not required for alternatives involving treatment, the substantive requirements of this section must be met by employing Best Available Technology (BAT) for treating particulate and other off-gas emissions.

TABLE A-3 (Continued)

CAA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Restrictions on Particulate Emissions from Industrial Processes, OAC 3745-17-11.	This requirement establishes numerical emission release limits for particulate material from industrial sources. Any source (operation, process, or activity) shall be operated so that particulate emissions do not exceed allowable emission rates specified in this regulation [based on processing weights (Table 1) or uncontrolled mass rate of emissions (Figure II) of OAC 3745-17-11]. A source complies with Table 1 requirements if its rate of particulate emission is always equal to or less than the allowable rate of particulate emission based on the maximum capacity of the source: Process Rate at Maximum Capacity (lb/hr) — Allowable Rate of Particulate Emission (lb/hr)[1] 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58 [1] Excerpted from Table 1 of OAC 3745-17-11.	Applicable	Treatment operations for various alternatives might result in release of particulate material that might exceed these standards.

TABLE A-4

OTHER REQUIREMENTS FOR SILO 3 REMEDIAL ACTION ALTERNATIVES

Title	Requirement	Rationale for Implementation
OSHA Worker Protection Requirements, 29 CFR Parts 1904 and 1910.	Establishes requirements to protect workers who could be exposed to radiation, noise, hazardous wastes, or other contaminants or hazards at the remediation site.	This OU is a remediation site under CERCLA. Compliance with 29 CFR Part 1910.120 is required for sites undergoing remediation by 40 CFR Part 300.150.
DOT Requirements for Transportation of Hazardous Materials, 49 CFR Parts 171-173, 177, 178.	Hazardous materials may not be transported on public highways except in accordance with these regulations: • Part 171, General Requirements. • Part 172, this part establishes shipping papers, marking, labeling, placarding, and emergency response information requirements. • Part 173, this part establishes packaging and other shipping requirements for hazardous materials, including radioactive materials. • Part 177, Requirements of the Transporter. • Part 178, Specifications for Shipping Containers.	Applicable to those alternatives which involve transportation of the waste materials off-site. Radioactive materials and materials sufficiently similar to hazardous wastes might be shipped off-site.
Highway Improvement Act of 1982, 23 USC 127.	Establishes vehicle weight limits for interstate highways.	Applicable to those alternatives which involve transportation of the waste materials off-site.
Hazardous Materials Transportation Act, 49 USC 1801-1812.	Establishes requirements for minimizing environmental impacts of spills or releases of hazardous materials.	Applicable to those alternatives which involve transportation of the waste materials off-site. Radioactive materials and materials sufficiently similar to hazardous wastes might be shipped off-site.

TABLE A-4 (Continued)

Title	Requirement	Rationale for Implementation
NTS Waste Acceptance Criteria.	Establishes which wastes may be disposed at the Nevada Test Site.	The NTS waste acceptance criteria would be applicable to disposals at the NTS. NTS operates under DOE Order 435.1, "Radioactive Waste Management."
National Historic Preservation Act, 16 USC 470 et seq.	Protects sites listed or eligible for listing in the National Register of Historic Places.	Required by law for the alternatives affected.
Archaeological and Historic Preservation Act, 16 USC 469.	Preserves artifacts and data associated with archaeological finds.	Required by law for the alternatives affected.
American Indian Religious Freedom Act, 42 USC 1996.	Provides for tribal access by native peoples to grave sites and sites of cultural, symbolic, or religious significance.	Required by law for the alternatives affected.
Native American Graves Protection and Repatriation Act, 25 USC 3001.	Provides for return of human remains and cultural objects from Native American graves to affiliated tribes.	Required by law for the alternatives affected.
Protection and Enhancement of Cultural Environment, Executive Order 11593.	Requires inventory of site for potential historic places for eligibility in the National Register of Historic Places.	Required by law for the alternatives affected.
Fish and Wildlife Coordination Act, 16 USC 66 et seq.	Requires consultation with other state agencies on activities that might affect any body of water for the conservation of fish and wildlife resources.	Required by law for the alternatives affected.

TABLE A-4 (Continued)

Title	Requirement	Rationale for Implementation
Archaeological Resources Protection Act, 16 USC 470 (a).	Requires permit for removal of any archaeological resources from federal lands.	Required by law for the alternatives affected.
Antiquities Act and Historic Sites Act, 16 USC 431-433 and 16 USC 461-467.	Requires identification and preservation of cultural resources on federal lands; includes natural landmarks.	Required by law for the alternatives affected.
Farmland Protection Policy Act, 7 USC 4201 et. Seq.	Requires protection and maintenance of farmland for its beneficial use as a national resource.	Required by law for the alternatives affected.
Occupational Radiation Protection, 10 CFR Part 835	Provides standards for occupational radiation protection of workers at DOE facilities.	Required by law for safety and worker protection at DOE facilities (replaces former DOE Order 5480.11).
DOE Order	Title	Rationale for Implementation
5400.3	Hazardous and Mixed Waste Program	Contractual obligation for activities at DOE facilities.
5400.5	Radiation Protection of the Public and the Environment	Contractual obligation for activities at DOE facilities.
451.1A	NEPA Compliance Program	Contractual obligation for activities at DOE facilities.
5480.1B	Environmental, Safety, and Health Program for DOE Operations	Contractual obligation for activities at DOE facilities.
460.1A	Packaging and Transportation Safety	Contractual obligation for activities at DOE facilities.
460.2	Departmental Materials Transportation and Packaging Management	Contractual obligation for activities at DOE facilities.

TABLE A-4 (Continued)

DOE Order	Title	Rationale for Implementation
5480.4	Environmental Protection, Safety, and Health Protection Standards	Contractual obligation for activities at DOE facilities.
440.1A	Worker Protection for DOE Federal and Contractor Employees	Contractual obligation for activities at DOE facilities.
435.1	Radioactive Waste Management	Contractual obligation for activities at DOE facilities.
414.1	Quality Assurance	Contractual obligation for activities at DOE facilities.
430.1A	Life Cycle Asset Management	Contractual obligation for activities at DOE facilities.

APPENDIX B

RESPONSIVENESS SUMMARY

B Responsiveness Summary

B.1 Purpose

As stated in the U. S. Environmental Protection Agency (EPA) Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, the responsiveness summary serves three important purposes. First it provides the DOE with information about community preferences regarding both the proposed remedial alternative and general concerns about the site. Second, it demonstrates how public and support agency comments were integrated into the decision-making process. Third, it allows DOE to formally respond to public comments.

This Responsiveness Summary has been prepared to meet the requirements of Sections 113(k)(2)(B)(iv) and 117(b) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA). As the lead agency at the FCP, DOE is required to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on the Revised Proposed Plan for Remedial Action at Silo3.

B.2 Community Participation For Silo 3

DOE is responsible for conducting the community relations for the FCP. A community relations program was established for the FEMP in 1985 to provide information about the site regarding updates and progress of the clean-up activities.

In November 1993, DOE implemented a public participation program at Fernald to involve community members and other interested parties in the decision-making process at the site. This Fernald Community Advisory Board (FCAB), formerly known as the Fernald Citizens Task Force, was chartered to provide DOE, EPA, and Ohio Environmental Protection Agency (OEPA) with recommendations about cleanup solutions and future courses of action at the FEMP. These efforts, along with the community relations activities required by CERCLA, reflect DOE's intent to fully involve the community in the decision-making process.

More recently, DOE has encouraged public involvement and informal comment throughout reevaluation of the remedy for Silo 3. Stakeholder input was a key factor in development of the revised remedy formally recommended in the PP issued for formal review. This approach has provided a genuine opportunity for stakeholders to identify issues, voice their concerns, and learn about the proposed clean-up plan. The informal opportunity for the public to provide input enabled DOE to address stakeholder questions and concerns in advance of the formal public comment period.

Two Administrative Records, located at the Public Environmental Information Center at the FCP and EPA Region V offices in Chicago, Illinois have been established to provide an information repository on the decision-making process for interested members of the public.

B.2.1 Public Comment Period

The DOE recently held a public comment period from April 30 through May 30, 2003, for interested parties to comment on the modified selected remedy for the Silo 3 material. The public comment period was held in accordance with Section 117 of CERCLA. A public hearing was held in the vicinity of the FCP on May 13, 2003 to provide the public with a forum to submit oral comments on the proposed revised remedy. No written or oral comments were received by DOE at the Public Hearing. A transcript of the hearing is included in the attachment to this Responsiveness Summary.

The availability of the Final PP and supporting documentation, the schedule for the comment period, and the location and schedule for the public hearing, were announced in local newspapers on April 30, 2003. In addition, this information was announced on the Fernald Closure Project web site (www.fernald.gov), and communicated by direct mail to stakeholders on the FCP Public Affairs mailing list.

B.2.1.1 Responses to Public Comments

Comments were received from only one stakeholder during the public comment period. These comments, and DOE's response to each comment, are documented below.

<u>Comment 1: from Robert Vogel</u>

"As the initial justification for the use of soft sided shipping containers for Silo 3 material was that it would be in a treated form and therefore resistant to dispersion, the Proposed Plan should explain why untreated Silo 3 material will not disperse. On page 3-6 the airborne release fraction of 0.01 is referenced as the "bounding value" without any attempt to connect this number to the specific characteristics of Silo 3 material. Due to the two different materials which Silo 3 contains (refer to M:SP:2001-0082) the number 0.01 can only be correct to use for one of these materials. Anyone familiar with Silo 3 material of rotary calciner origin would find it difficult to believe that 0.01 is reflective of this extremely dispersible material. It is probably reasonable to use this number for material produced by the spray calciner, but it is clearly inappropriate to use this number for both materials."

Response: The primary issue raised in this comment is whether or not the airborne release fraction (ARF) utilized in the transportation risk evaluation adequately represents the behavior of the material, given the known variability in the sources and physical characteristics of the material. The ARF is one of three interdependent parameters affecting potential inhalation exposure, and represents the fraction of any material released from a container that becomes airborne. The other two are the Fraction Released (fraction of material in a container that is released during an accident) and the Respirable Fraction (fraction of the airborne material that becomes respirable). The fraction released is scaled to the various accident severity categories with 100 percent assumed for the most severe accident. For the Silo 3 transportation risk evaluation, the Respirable Fraction was assumed to be 36 percent based on the most conservative empirical data from tests on Silo 3 material.

A significant literature search was conducted prior to the conducting the RADTRAN modeling runs for the risk evaluation in order to derive a best and supportable ARF. The American Society of Mechanical Engineers performed an independent peer review of the DOE reference guide on ARFs (DOE-HDBK-3010, *Airborne Release Fraction/Rates And Respirable Fractions for Nonreactor Nuclear Facilities*. The ASME recommended a bounding ARF of 0.01 for powders. ASME deemed this to be conservative value and this ARF was adopted for use in the RADTRAN modeling runs performed for the Silo 3 risk analysis. The earlier RADTRAN runs referenced in the comment used an ARF of 0.0001 based upon the DOE reference guide (DOE-HDBK-3010). The current ARFs used for the risk analyses supporting the Silo 3 Proposed Plan are more conservative by a factor of 100.

As discussed in the Proposed Plan, the treatment step included as part of the revised remedy will result in a substantial reduction in ARF compared to the untreated material, However, in order to provide additional conservatism, the transportation risk evaluation took no credit for the any reduction in dispersability resulting from the treatment step.

It is recognized, as stated in this comment, the materials within Silo 3 are not homogeneous and likely have a span of ARFs because of the large range of particle sizes. It is recognized that variability in the physical characteristics of Silo 3 material will impact its dispersability and ARF. However, based upon both the conservatism incorporated into the RADTRAN modeling assumptions and independent evaluation of the ARF basis, the ARF of 0.01 is sufficiently conservative to represent the range of characteristics present in Silo 3 material, including material produced by the rotary calciner. Therefore, the evaluation documented in the Proposed Plan adequately characterizes the transportation risk associated with the proposed remedy.

Comment 2: from Robert Vogel

"Page 3-17, 2nd paragraph, second sentence - "inhalation" is stated to be calculated but there are no data to quantify inhalation so that the reviewer cannot determine if the amount assumed to be inhaled is reasonable. If the purpose of this document is to be informative to the public, it should focus on the elements of this project that are most important; no aspect should be made more clear to the reader than that of inhalation since "cloudshine" and "groundshine" are trivial in comparison. The Proposed Plan does not clarify this issue. This is especially questionable given the inappropriate use of the release fraction mentioned above.

Secondly, the amount of material assumed to be inhaled would be helpful to know as the ILCR data stated in the Proposed Plan is not significantly different from RADTRAN data generated in 2002 which was solely based on external dose. As the external dose potential for Silo 3 is minor compared to potential internal exposure, the inclusion of inhalation dose should be reflected in the ILCR data. To be believable, inhalation data should be quantified in the Proposed Plan."

Response: This comment raises two primary issues: 1) Are the assumptions made in the risk evaluation regarding the amount of silo 3 material assumed to be inhaled in an accident scenario reasonable; and 2) to what extent is the resulting inhalation dose considered in calculating the dose and resulting Incremental Lifetime Cancer Risk (ILCR).

The radiological risks to the public and workers during transportation of Silo 3 material were evaluated using the RADTRAN5 computer model and code developed by Sandia National Laboratories. The dose conversion factors and other input parameters used in the evaluation of Silo 3 material are documented in Tables 2 through 5 in the Transportation Risk Evaluation (Attachment 3 in the Technical Supplement to the Silo 3 Proposed Plan). The final section of the Transportation Risk Evaluation also provides references to the documents providing the methodology and technical basis for the risk evaluation.

In response to the first issue raised in the comment, the amount of airborne material assumed to be inhaled (the Respirable Fraction (RF)) utilized in the risk evaluation was a conservative estimate based upon available data on Silo 3 material. It is generally accepted that respirable particles are those less than 10 µm in diameter. The most conservative and supportable test results for Silo 3 material yielded an average fraction of 36 percent of the material that was less than 10 µm in diameter. Other tests suggested as low as 0.99 percent of the particles were less than 10 µm. The current RADTRAN runs assumed 36 percent of the airborne material was respirable.

Second, the population dose and risk for routine (non-accident) transport is based solely on external radiation dose. For the accident scenarios the external and internal doses are summed. The doses are reported as the sum of inhalation, ground shine, and cloud shine. Since, as recognized in the comment, dose from “cloudshine” and “groundshine” is trivial (approximately 1%) in comparison to dose from inhalation, the reported accident scenario doses and resulting ILCR attribute 99% of the dose to inhalation following an accident..

An important factor in calculating the inhalation dose is the Dose Conversion Factor (DCF) or the dose per quantity of activity inhaled. In preparation for the current RADTRAN runs, the characteristics of the Silo 3 radionuclide forms were evaluated to assure use of the most appropriate solubility class DCF assignment. Processing of the Silo 3 material with the rotary calciner was more likely to have produced insoluble material (termed Class Y material), which in most cased results in DCFs which are considerably higher than more soluble material and deliver more dose per unit activity inhaled. Sometimes this dose is one to two orders of magnitude higher. The less effective spray calciner would have tended to produce insoluble material, but may also have produced some materials with higher solubility (lower DCF) than those yielded from the rotary calciner. The modeling conducted to support the Silo 3 risk evaluation conservatively assumed an insoluble form for the Silo 3 materials and utilized the higher DCF’s (Class Y) for dose calculation purposes.

One exception to the above discussion should be noted, that being for Thorium-230, one of the predominant radiological constituents present in the Silo 3 materials. Thorium-230 has a soluble DCF that is 24 percent higher than its insoluble form. Although thorium compounds, including those associated with Silo 3 material, are considered to be insoluble, the DCF used in the Silo 3 risk analysis was the average between the soluble and insoluble forms as a conservative bounding value.

Following estimation of dose for a given routine or accident based transportation scenario, the RADTRAN model is then used to yield an estimate of the risk to an exposed individual or population. The model estimates risk by multiplying the calculated dose by a single fatal cancer risk coefficient of 5 x10^{-4} per rem. This includes both internal and external radiation dose equivalents. This risk coefficient is utilized in the Silo 3 risk evaluation and is consistent with the recommendations and methods in *Health Effects of Exposure to Low Levels of Ionizing Radiation,* BEIR V, National Academy of Sciences (1990) and ICRP 60, *Recommendations of the International Commission on Radiological Protection*, International Commission of Radiological Protection (1991). The resultant risk totals were quite low and no other specific organ dose assessment was necessary.

The information summarized above demonstrates that the assumptions underlying the risk evaluation are reasonable given the known variations in the physical properties of the Silo 3 residues and provide an appropriate basis for decision making.

Comment 3: from Robert Vogel

"Much of the data used in the development of the current plan derives from testing done by Jenike and Johanson on Silo 3 material. Unfortunately, this material was from Small Scale Retrieval origin with its extremely different characteristics from the remaining two thirds of the silo material. For the expertise of Jenike and Johanson to fully benefit the project and provide the basis for design decisions, they should have been provided with Silo 3 material of rotary calciner origin."

Response: The primary concern raised in this comment is the degree to which the testing done by Jenike & Johanson (J&J) was based upon sufficiently representative characterization of the physical properties of Silo 3 material. Due to their expertise in the field of bulk solids storage, transfer, and flow, J&J was utilized to perform physical property studies to support evaluation of retrieval, material handling, and treatment alternatives for Silo 3 material. As noted in the comment, these studies were performed utilizing actual Silo 3 material as well as flyash which has similar dusting properties. The Silo 3 material used in these studies was, as indicated in the comment, from the Small-Scale Waste Retrieval Project, obtained in the lower portion of the silo, where it would be expected to be of spray calciner origin.

In addition to their evaluation of the actual Silo 3 material, J&J also utilized a significant body of historical data on the characteristics of Silo 3 material, which included copies of historical silo 3 information (reference M:SP:2001-0082) and videos of the vibracore sampling that was performed from the top of the silo. Design decisions were also based on information from past processing facilities, sampling results from several sampling efforts, studies from multiple consultants, and objectives for final disposal.

Physical tests performed by Jenike and Johanson were performed at different moisture levels to determine the affect on flowability due to hygroscopic nature of the material, and modeling was done for different scenarios to allow for variability in material properties.

Jenike and Johanson studies provided design information consistent with dry, fine powdery material as opposed to free-flowing material such as plastic pellets or coarse sand. The report validates material handling observations made during the various sampling and testing efforts performed on Silo 3, and the original pneumatic conveyance approach used to transfer the material from the old production area to the storage silo. The various reports support the current proposed design approach, which uses: batch process with limited overnight storage in bins; steep sided bins for mass flow; screw conveyors; densification table added to packaging system to de-aerate material after it becomes fluidized; and weigh table for package filling due to density differences and also because packaging will be volume not weight limited; and spray nozzle assembly. Modeling also provides various scenarios for pneumatic retrieval and mechanical retrieval, both methods selected due to anticipated variation in compaction of material.

The combination of physical testing of actual Silo 3 material, utilization of a variety of modeling scenario to account for variability in material characteristics, and the use of historical data to support and supplement the studies, provides a sound technical basis for the evaluation of retrieval, material handling, and treatment alternatives for Silo 3 material.

ATTACHMENT B-1

TRANSCRIPT OF MAY 13, 2003 PUBLIC HEARING

FERNALD PUBLIC HEARING

SILO 3 PROPOSED PLAN

PUBLIC COMMENTS

Tuesday, May 13, 2003
6:30 p.m.
Crosby Township Senior Center
8910 Willey Road
Harrison, Ohio

- - -

MR. STEGNER: At this time we'll open the formal public hearing portion of the meeting. Again, there are comment cards you can use if you do not want to speak tonight. You can hand them to me at the end of the hearing or you can send them via e-mail to me.

So with that, does anybody have anything they would like to say during the public comment period this evening?

MS. SCHROER: The person that usually does all our talking is sick.

MR. STEGNER: Yeah, she called me and said she wasn't going to be able to make it. But, again, you have until May 30th to get your comments in to me.

With that, going once, twice. Thank you all very much for coming tonight.

\- - -

PUBLIC HEARING CONCLUDED

\- - -

CERTIFICATE

I, LOIS A. ROELL, RMR, the undersigned, a notary public-court reporter, do hereby certify that at the time and place stated herein, I recorded in stenotypy and thereafter had transcribed with computer-aided transcription the within (2) two pages, and that the foregoing transcript of proceedings is a complete and accurate report of my said stenotypy notes.

Lois A. Roell

MY COMMISSION EXPIRES: LOIS A. ROELL, RMR
SEPTEMBER 7, 2003. NOTARY PUBLIC-STATE OF
KENTUCKY

FERNALD
Closure Project

DOE and EPA Propose an Amendment to the Cleanup Plan for Silo 3 at the Fernald Closure Project

PUBLIC COMMENT PERIOD – APRIL 30 TO MAY 30, 2003

INTRODUCTION

This Proposed Plan summarizes a proposed amendment to the Record of Decision (ROD) for Silo 3 at the Fernald Closure Project in Cincinnati, Ohio. It explains the Department of Energy's (DOE's) and U.S. Environmental Protection Agency's (EPA's) recommended change to the Silo 3 cleanup plan as previously described in the 1994 Operable Unit 4 ROD and the 1998 Explanation of Significant Differences (ESD) document for Silo 3. DOE and EPA will adopt a final plan for Silo 3 after all pubic comments and information submitted during the comment period have been reviewed and considered.

DOE and EPA are considering a change for Silo 3 because a new treatment alternative that is fully compliant with applicable regulatory requirements has become available since the 1998 issuance of the Silo 3 ESD. This new treatment alternative provides reduced cost without any meaningful reductions in either short or long-term remedy effectiveness.

This Proposed Plan is intended to be a short summary of DOE and EPA's reasons for advocating a change to the Silo 3 cleanup plan. For those members of the public who wish to evaluate this proposal in more detail, they are encouraged to consult the documents found in the information repositories listed on the last page of this Proposed Plan. The repositories also hold copies of the original ROD, Feasibility Study, and Remedial Investigation for Operable Unit 4, of which Silo 3 is a part.

A supplement to this Proposed Plan has also been prepared that includes the key technical or regulatory information that factored into the decision. The supplement is available on request and includes backup detail for four areas:

- Letter from DOE'S Nevada Test Site confirming the eligibility of Silo 3 materials for disposal at the Nevada Test Site
- A detailed compilation of applicable or relevant and appropriate regulatory requirements (ARARs) for the Silo 3 Proposed Plan
- Technical backup for the transportation risk assessment
- Cost estimate backup information.

Public input on the proposed changes and the information that supports the changes is an important contribution to the cleanup plan selection process. Both DOE and EPA encourage the public to review and comment on the proposed changes in the Silo 3 cleanup plan as presented in this Proposed Plan. Opportunities to comment include a public meeting (see side bar) and a prepaid comment form at the back of this document.

Inside This Plan

Public Meeting

May 13, 2003

6:30 to 8:00 p.m.

at

the Crosby Senior Center

Crosby Township, OH

40430-RP-0014

Rev. 0, Final

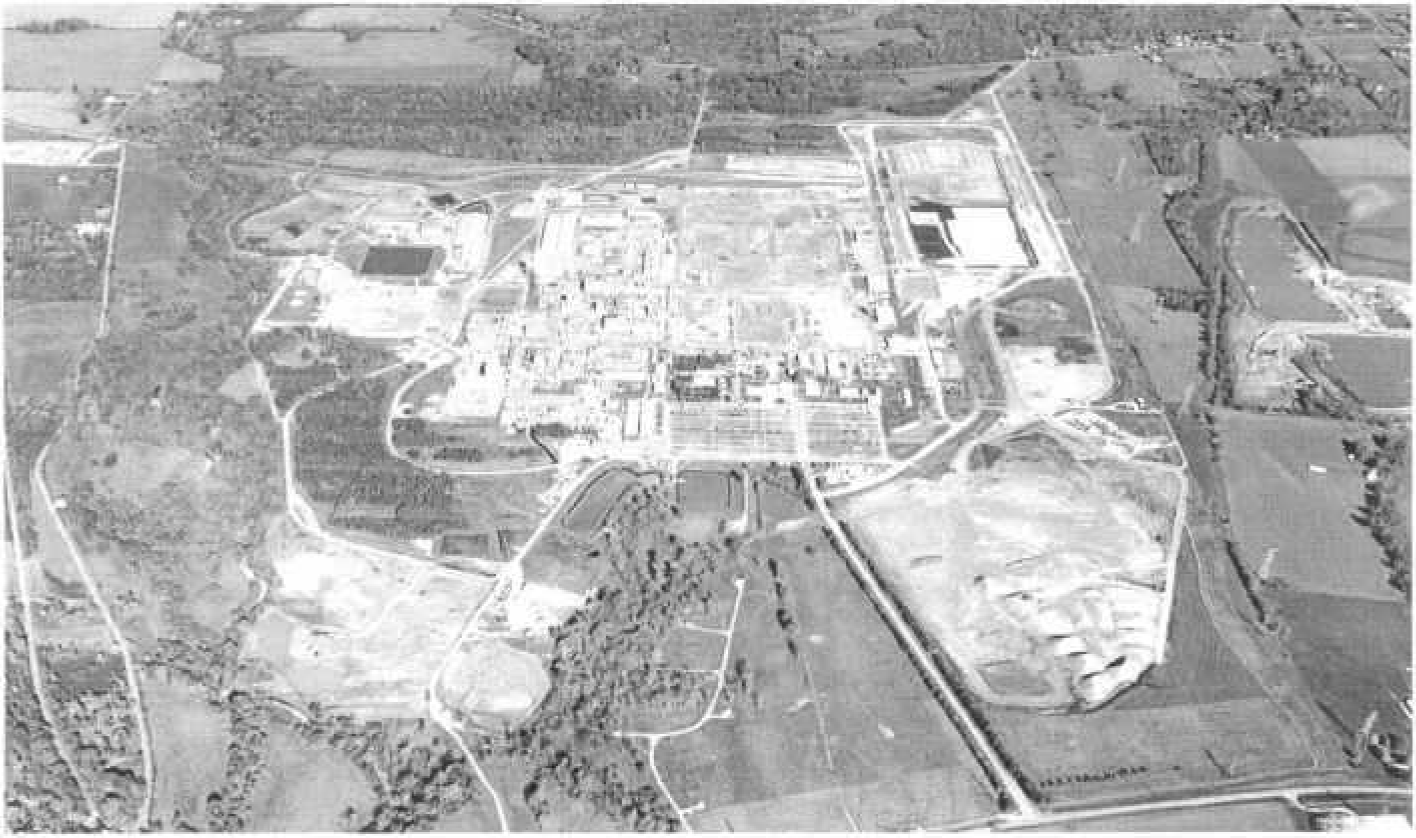
SITE BACKGROUND

The Fernald Closure Project is a 1050-acre DOE former uranium production facility located at approximately 18 miles northwest of Cincinnati. Fernald, Ohio is a small rural community located just south of the site. The government-owned facility operated from 1952 to 1989 providing in excess of 500 million pounds of high-purity uranium metal products in support of U.S. Defense initiatives. In 1992 the site was renamed the Fernald Environmental Management Project and the mission was formally changed to environmental restoration under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. Its current name, the Fernald Closure Project, was adopted in 2003 to reflect a continuing emphasis on the completion of restoration activities and achieving the final closure end state safely and efficiently.

To facilitate restoration, the CERCLA work scope for the 1,050-acre facility was divided into five operable units: the waste pits (Operable Unit 1); other waste units (Operable Unit 2); the production area facilities and legacy-waste inventories (Operable Unit 3); Silos 1&2 and Silo 3 (Operable Unit 4); and contaminated environmental media (Operable Unit 5).

Since 1992, Superfund remedial investigations and feasibility studies have been completed for each of the operable units, and final RODs to establish cleanup levels and document the cleanup plans have been signed for each by DOE and EPA.

The selected remedial actions documented in the RODs for the five operable units include: production facility decontamination and dismantlement (D&D); on-site disposal of the majority of contaminated soil and D&D debris; off-site disposal of the contents of the two K-65 silos (Silos 1&2), Silo 3, waste pit material, legacy waste inventories, and limited quantities of soil and D&D debris not meeting on-site waste acceptance criteria; and treatment of contaminated groundwater to restore the affected portions of the Great Miami Aquifer underlying the site. Ultimately, approximately 975 acres of the 1,050-acre property will be restored to beneficial use as an undeveloped park, and approximately 75 acres will be dedicated to the footprint of the On-site Disposal Facility. Contaminated portions of the aquifer will be restored to achieve Safe Drinking Water Act standards, and long-term stewardship actions will be put in place consistent with the final designated land use.



CERCLA cleanup actions are well underway at the 1,050-acre Fernald site.

Overview of Silo 3 and the 1994 ROD

Silo 3, located adjacent to the K-65 silos (Silos 1&2) on the western periphery of the site, is an unbermed concrete silo that contains 5,088 cubic yards of cold metal oxides, a by-product material generated during Fernald's uranium processing operations. The predominant radionuclide of concern identified within the material is thorium-230, which is produced from the natural decay of uranium-238. The overall objective of the Silo 3 remedial action is to safely retrieve the residues from the concrete silo and package and transport the materials for off-site disposal in a manner compliant with regulatory requirements.

The materials contained in Silo 3 consist of relatively dry, powder-like residues that were placed in the silo over the time period 1954 to 1957. The residues consist of metallic and non-metallic impurities that remained following the extraction of uranium from ore and ore concentrates in Fernald's refinery operations during the mid-1950s. The residues were prepared for storage following a volume reduction and concentration step known as calcining, which is a roasting process in the presence of lime that serves to remove moisture and convert the impurities to their more stable (less leachable) oxide form. Following calcining, the dry residues were pneumatically conveyed to Silo 3 for longer-term interim storage as part of DOE's ongoing custodial responsibility for the materials.

Although both residues share similar uranium processing origins and the same regulatory status, the Silo 3 residues have different engineering properties and are radiologically different from the Silos 1&2 K-65 residues. As "cold"residues (a term of engineering convenience used to reflect the residual radium-bearing content of the residues), the Silo 3 materials have a much lower radium content than the K-65 materials, and therefore Silo 3 exhibits a much lower direct radiation field and has a substantially lower radon-222 emanation rate compared to Silos 1&2. The K-65 materials in Silos 1&2 are also moisture-rich, silty, and clay-like materials, whereas the Silo 3 materials are dry and powdery. Ambient moisture contents for the materials in Silo 3 range from 3 to 10 percent by weight, which reflect their dry condition.

The Silos 1&2 and Silo 3 project area

Silo 3 contains 5,088 cubic yards of uranium processing residues

On an activity basis, the predominant radiological constituent in the Silo 3 material is thorium-230. The thorium contaminated Silo 3 residues do not present the same level of direct radiation exposure potential as the radium-bearing Silos 1&2 residues, and exhibit significantly lower emissions of radon gas (which forms as a radium decay product). However, the residual thorium content and the relatively dry powdery condition of the Silo 3 residues together represent a dispersability hazard and an inhalation and ingestion hazard to workers and the public if proper control and containment measures are not in place during subsequent material handling and transportation steps.

The residues contained in Silo 3 and Silos 1&2 are designated as Section 11e.(2) byproduct materials under the Atomic Energy Act, which is a regulatory classification that acknowledges the origin of the materials and identifies that they consist of tailings and wastes that were produced by the extraction and concentration of uranium from ores that were processed primarily for their source material content. As 11e.(2) byproduct materials, the residues are statutorily excluded from the definition of solid and hazardous waste under the Resource Conservation and Recovery Act (RCRA) of 1976; this statutory exclusion is described in the RCRA regulations under 40 CFR 261.4(a)(4). Specific regulatory requirements for management of the byproduct materials are defined through the Atomic Energy Act regulations and accompanying policies and directives.

As a point of reference, although they are statutorily excluded from formal RCRA hazardous waste definitions and administrative requirements, the Silo 3 residues do contain sufficient quantities of four RCRA regulated metals (arsenic, cadmium, chromium, and selenium) such that they can exceed RCRA thresholds for leachability as measured through the RCRA toxicity characteristic leaching procedure (TCLP) laboratory test. As explained further below, this condition was a consideration in establishing remedy-specific quantitative performance levels in the 1994 Operable Unit 4 ROD for rendering the Silo 3 and Silos 1&2 residues suitable for off-site disposal through treatment.

In the 1994 Operable Unit 4 ROD, on-site vitrification and off-site disposal of both the Silo 3 and the Silos 1&2 materials was selected as the preferred remedy for the Operable Unit 4 materials as a whole. Vitrification is a treatment process that heats the materials to such temperatures that the materials fuse to a glass-like state, which in turn binds up the radioactive and non-radioactive metals in the waste to a low leachability condition. At the time of the 1994 ROD, the Nevada Test Site was the only available disposal location that could accept the vitrified silo materials for permanent disposal. As part of its waste acceptance criteria, the Nevada Test Site required in 1994 that all treated or untreated waste accepted for disposal at the facility -- regardless of its statutory exempt or non-exempt status -- meet TCLP limits for toxicity-characteristic constituents regulated under RCRA. Based on this disposal-facility-specific requirement, the 1994 Operable Unit 4 ROD adopted the TCLP limits as quantitative performance standards for treating (in this case vitrifying) the materials prior to off-site disposal.

In the 1994 ROD, the RCRA TCLP limits were adopted as *relevant and appropriate* regulatory performance requirements for waste treatment, due to the requirement that the material meet the Nevada Test Site's formal TCLP-based waste acceptance criteria (versus broader adoption as *applicable* requirements, since the materials continued to retain their statutorily exempt legal status). The Nevada Test Site TCLP limits therefore became the relevant and appropriate performance standard in the 1994 ROD for treating the Silo 3 wastes to achieve an acceptable disposal condition for the four RCRA metals of concern (arsenic, cadmium, chromium, and selenium) contained within the Silo 3 waste.

1998 Silo 3 ESD Modification to the 1994 ROD

In early 1998, an ESD was developed for Silo 3 to replace the vitrification technology with chemical stabilization/solidification or polymer encapsulation as the preferred treatment option for treating the Silo 3 wastes to achieve the TCLP-based waste acceptance limits for off-site disposal. This modification was adopted to address implementability concerns with vitrification that were revealed in pilot scale tests of the technology on surrogate materials chosen to emulate the salient engineering properties of the silos materials. In the pilot scale tests, it was found that the high sulfate content of the Silo 3 residues would result in significant technical and operational difficulties and an unacceptable degree of uncertainty in the technology's ability to reliably produce a consistent vitrified material on a full-scale, continuous basis.

The ESD acknowledged that the adoption of a chemical stabilization/solidification or polymer encapsulation alternative for Silo 3 as a vitrification replacement would not be a fundamental change to the original remedy identified in the 1994 ROD, provided that the alternate process continued to meet all remedial objectives and performance standards of the approved ROD and for a cost roughly equivalent to the original remedy, and that the remedy includes disposal at a protective, appropriately permitted off-site disposal facility.

At the time of the 1998 ESD for Silo 3, the Nevada Test Site waste acceptance criteria limits continued to require that all treated and untreated waste accepted for disposal meet the TCLP limits for RCRA regulated constituents (again regardless of the waste's statutorily exempt or non-exempt RCRA status). The 1998 Silo 3 ESD therefore continued to adopt the facility-specific TCLP limits as a relevant and appropriate regulatory performance standard for designing a satisfactory treatment process to render the Silo 3 residues acceptable for off-site disposal.

The 1998 Silo 3 ESD also acknowledged that the waste treatment step could be implemented either off site or on site to achieve the intended TCLP-based waste acceptance criteria requirement. If the treatment step were to be conducted off site, on-site pretreatment would be conducted at the Fernald site as necessary to reduce the dispersability of the thorium-bearing particulates and render the material acceptable for transportation. The ESD required that on-site pretreatment, in combination with packaging in accordance with Department of Transportation (DOT) regulations, must reduce the dispersability of the thorium-bearing particulates and result in a transportation risk less than 1 x 10^{-6}.

March 1998, DOE and EPA signed the ESD for Silo 3, which formally approved the shift from vitrification to chemical stabilization/solidification or polymer encapsulation for treating the Silo 3 residues to achieve the quantitative TCLP-based performance standards adopted by the 1994 ROD. A policy decision was also made in the ESD to implement the Silo 3 remedy separately from the treatment of the Silos 1&2 material.

NEW INFORMATION AND REASONS FOR PROPOSED CHANGE

Since the Silo 3 ESD was issued in 1998, DOE and EPA have received new information concerning 1) the waste acceptance criteria for the Nevada Test Site disposal facility, and 2) the availability of other commercial facilities that can accept the Silo 3 residues for disposal as 11e.(2) regulated materials.

Waste Acceptance Criteria for the Nevada Test Site

In February 2002, the Nevada Test Site, in conjunction with the state and federal regulatory agencies that oversee the facility's waste disposal operations, updated the waste acceptance criteria for the facility. As part of the February 2002 revision, the acceptance requirements for RCRA-regulated materials were clarified. In essence, the revision requires TCLP-based acceptance levels only for those wastes that are statutorily regulated under RCRA. Statutorily exempt materials, such as 11e.(2) materials, no longer need to meet TCLP-based acceptance criteria, provided the waste is otherwise disposed of in a manner that is protective of human health and environment. As part of an eligibility evaluation, a waste profile for each statutory exempt waste must be reviewed individually to ensure that protective requirements are met for the constituents that would otherwise be regulated under RCRA.

During May 2002, Nevada Test Site regulatory personnel completed a draft waste profile review for the statutorily exempt Silo 3 materials, and deemed them to be acceptable for disposal at the facility without the need for further treatment. A letter indicating the eligibility of the untreated Silo 3 materials for disposal at the Nevada Test Site was formally issued by the facility in June 2002, a copy of which is included in the technical supplement to this Proposed Plan.

Emergence of a Commercial Disposal Facility to Accept DOE 11e.(2) Materials

Also since the time that the 1998 Silo 3 ESD was prepared, potential commercial disposal options have been identified for disposal of untreated Silo 3 material. Similar to the revised waste acceptance criteria requirements at the Nevada Test Site, a commercial facility would be able to accept Silo 3 material in an untreated state provided the material is deemed eligible for disposal by the regulatory agency, a waste-specific profile review is conducted, and all other waste acceptance criteria requirements that are applicable to the waste are met. For purposes of this Proposed Plan, the Envirocare facility, in Clive, Utah is identified as a representative permitted commercial disposal facility. The Envirocare facility is currently in the process of working with their regulatory agency to gain approval for accepting the Silo 3 materials untreated into their 11e.(2) disposal cell.

This new development may result in additional off-site disposal site options for DOE and EPA to consider in executing the requirement contained in the 1998 ESD that the Silo 3 remedy include disposal at a protective, appropriately permitted off-site disposal facility. The actual disposal facility will be selected as part of the design process and may include the Nevada Test Site, an appropriately permitted commercial facility that can accept the materials, or a combination of both. In this Proposed Plan, one option (the Nevada Test Site) will be selected as the representative disposal facility option to illustrate the costs and logistics of off-site disposal, and permit a fair comparison of the modified remedial action with the 1998 Silo 3 ESD remedial action.

Rationale For Proposed Change

The new information summarized above demonstrates that it is now permissible to permanently dispose of the Silo 3 residues in an untreated form at the Nevada Test Site, and that a commercial facility may also be able to accept the untreated Silo 3 materials in the near future. DOE and EPA conclude based on this new information that the TCLP-based waste treatment performance standard, adopted in both the 1994 ROD and the 1998 Silo 3 ESD as a facility-specific relevant and appropriate requirement for treatment, is no longer necessary to maintain long-term protectiveness and regulatory compliance with disposal facility waste acceptance requirements. DOE and EPA are therefore proposing to remove the quantitative TCLP performance standard as a relevant and appropriate regulatory requirement for execution of the Silo 3 remedy. This change will be formally documented in the ROD Amendment, following the completion of the public participation process.

As a result of this new development, members of the public have expressed a concern that if the primary requirement for treatment (to satisfy waste acceptance criteria obligations) is removed through the proposed ROD Amendment, other secondary benefits of waste treatment -- such as the further incremental control of the dispersability of the Silo 3 material, in the unlikely event of a severe transportation accident that subsequently damages the protective shipping containers during transit -- could be overlooked. DOE and EPA have taken these comments into consideration in the development of the modification to the Silo 3 cleanup plan that is proposed in this document. Similarly, DOE and EPA recognize that, irrespective of the recent waste acceptance criteria revision, any new modifications to the cleanup plan must continue to meet the 1×10^{-6} transportation risk threshold for the remedy adopted by the 1998 Silo 3 ESD.

ALTERNATIVE CLEANUP PLAN BEING EVALUATED

This section describes the proposed revised Silo 3 cleanup plan, and provides a side-by-side comparison with the components of the currently approved 1998 ESD remedy for Silo 3. The following section then evaluates the revised cleanup plan against the nine criteria specified in the National Contingency Plan. The focus of the description in this section, and the evaluation in the following section, is on that component of the plan that is proposed to be changed, specifically the treatment portion of the remedy.

For purposes of describing and evaluating the two cleanup alternatives, a representative waste transportation mode (truck transport) and disposal location (Nevada Test Site) has been adopted for both alternative cleanup plans. During the design and implementation of the Silo 3 remedy, DOE will select the transportation mode(s) and compliant disposal location(s) that provide the best overall balance of reduced transportation risk and cost effectiveness. Only disposal facilities that meet the regulatory compliance requirements of the CERCLA off-site rule (40 CFR 300.440) will be considered.

The currently approved and the proposed revised cleanup plans are described in the following sections, and a side by-side comparison summary is provided in the Remedy Comparison Summary below.

Currently Approved 1998 ESD Cleanup Plan

- Removal of the wastes From Silo 3
- Treatment, either on site or off site using chemical stabilization/solidification or a polymer-based encapsulation process, to stabilize RCRA-regulated metals to meet RCRA TCLP limits and attain disposal facility waste acceptance criteria
- If off-site treatment is employed, off-site shipment must be preceded by on-site pretreatment and/or packaging such that the risk to the public from transportation of the material to the off-site facility is less than 1×10^{-6}
- Off-site disposal at either the Nevada Test Site or a permitted commercial disposal facility
- Removal and disposal of the Silo 3 structure and the waste handling, packaging, and treatment systems
- Cleanup of the soil underlying the Silo 3 area to the final remediation levels defined in the Operable Unit 5 ROD.

Remedy Comparison Summary

Existing Cleanup Plan	Proposed Revised Cleanup Plan
• Removal of waste from Silo by both pneumatic and mechanical processes • Treatment using chemical stabilization or polymer encapsulation to meet TCLP limits • If off-site treatment adopted, pretreatment or packaging to reduce transportation risk to less than 1×10^{-6} • Off-site disposal at the Nevada Test Site or permitted commercial facility • Removal of Silo 3 structure and waste hauling/treatment systems • Cleanup of soil in Silo 3 area to meet final remediation levels in Operable Unit 5 ROD	• Removal of waste from Silo by both pneumatic and mechanical processes • Treatment to the extent practical, by addition of a chemical stabilization reagent and a reagent to reduce dispersability • If above treatment step is deemed unimplementable, a contingency backup would be implemented to double package the waste • Maintain transportation risk less than 1×10^{-6} • Off-site disposal at the Nevada Test Site or a permitted commercial facility • Removal of Silo 3 structure and waste hauling/treatment systems • Cleanup of soil in Silo 3 area to meet final remediation levels in Operable Unit 5 ROD
Cost ($ Millions) Capital Cost 20.0 Engineering, Construction, Startup 15.0 Operation and Maintenance 7.0 Transportation and Disposal 11.0 Facility D&D 2.0 ***Total Estimated Cost* 55.0***	***Cost ($ Millions)*** Capital Cost 14.0 Engineering, Construction, Startup 15.0 Operation and Maintenance 4.0 Transportation and Disposal 7.0 Facility D&D 2.0 ***Total Estimated Cost* 42.0***

Proposed Revised Cleanup Plan

- Removal of the wastes from Silo 3 (*this element remains unchanged from the currently approved plan*)
- Treatment, to the degree reasonably implementable, to address material dispersability and metals mobility. Potential implementability and worker exposure concerns with this treatment are discussed under "Contingency Backup Actions in the next section (*change from the currently approved plan*).
- Double packaging of the untreated waste, as a contingency backup, in the event the selected treatment approach is deemed unimplementable as a result of operational difficulties which cannot be practically overcome (*change from the currently approved plan*)
- Requirement to maintain the transportation risk to the public of less than $1x10^{-6}$ Incremental Life-time Cancer Risk [ILCR] (*this element remains unchanged from the currently approved plan*)
- Off-site disposal at either the Nevada Test Site or a permitted commercial disposal facility (*this element remains unchanged from the currently approved plan*)
- Removal and disposal of the Silo 3 structure and the waste handling, packaging, and treatment systems (*this element remains unchanged from the currently approved plan*)
- Cleanup of the soil underlying the Silo 3 area to the final remediation levels defined in the Operable Unit 5 ROD (*this element remains unchanged from the currently approved plan*).

Detailed Description of the Proposed Revised Cleanup Plan

Waste Removal. Under the proposed revised cleanup plan the waste would be removed from Silo 3 employing both pneumatic and mechanical systems. These waste retrieval systems remain unchanged from the currently approved cleanup plan. As a result of the relatively high concentration of thorium-230 (an alpha emitter) and the dry powdery consistency of the waste, special attention would be necessary during design to ensure the construction of waste handling systems, which would minimize the release of particulates from the waste material to the work area or the environment. This same design consideration would be necessary for either the currently approved or the proposed revised cleanup plan.

To address this concern, containment structures and high efficiency air filtration systems would be employed during waste retrieval. A strict radiological control program would be implemented during all Silo 3 operations to reduce worker exposures to As Low As Reasonably Achievable (ALARA) levels. This control program will include engineering controls such as the filtration and containment systems, administrative controls such as project specific training and detailed operational procedures for workers, and personnel protective equipment such as protective clothing and air-supplied respirators. A thorough personnel and environmental monitoring program would also be implemented to assess the effectiveness of the controls.

Waste Treatment. Under the proposed revised cleanup plan, a differing treatment approach would be implemented. Under both plans, the material would be removed from the silo in its dry form. The currently approved 1998 ESD cleanup plan envisions the construction and operation of a chemical stabilization/solidification processing system, which includes the wetting of the material and addition of one or several chemical reagents. With the currently approved plan, the chemical stabilization/solidification step would involve the addition of sufficient chemical reagents and post-treatment testing to ensure the treated waste form no longer exceeds TCLP limits for the four RCRA-regulated metals (cadmium, arsenic, chromium, and selenium) that are of concern with the Silo 3 materials. Under the proposed revised cleanup plan, this chemical processing system would not be constructed; in its place a system would be designed and installed to add a liquid solution to the dry waste material as it enters the package, in order to reduce the waste's dispersability and mobility.

As previously discussed, the acceptance criteria of the Nevada Test Site has been modified to permit receipt of the Silo 3 waste material in an untreated form. The basis for the modified WAC is recognition of the classification of the material as 11e.(2) byproduct material coupled with the material-specific waste profile review and protectiveness evaluation conducted by the Nevada Test Site regulatory personnel. Full compliance with the DOT transportation requirements, Nevada Test Site waste acceptance criteria, and 1998 Silo 3 ESD requirements pertaining to the risk during routine transportation (i.e., less than 1×10^{-6}) can be attained by the direct load out, transport, and disposal of the untreated waste material. Bench scale testing applied to Silo 3 materials has identified a potentially cost-effective and implementable approach to providing a beneficial level of treatment to the waste material prior to off-site transport. These tests yielded encouraging results indicating that a liquid solution could be successfully added to the waste as it was loaded into the packages. The results indicate that a meaningful reduction in the dispersability of the waste can be gained through the addition of the liquid to the waste as it is packaged. Considering these results, it is also anticipated that the addition of a chemical stabilization reagent to this same solution could offer some companion benefits of further reducing the mobility of radioactive and non-radioactive RCRA-regulated metals in the waste.

As a result of the test data, the DOE has committed to install the necessary process equipment to add a liquid solution to the waste materials as it is delivered into the final packages. The final makeup of this solution has not as yet been selected but is envisioned to include both a liquid reagent to aid in reducing the dispersablity of the waste material (a material crusting agent, which also raises the moisture content of the material) in the event of an unforeseen severe accident during transport, and a second component (a chemical stabilization agent) to yield a beneficial reduction in the mobility of some, if not all, of the metals present in the Silo 3 residues.

During the limited bench testing a dilute lignosulfonate solution (which serves as a material crusting agent) was added to the waste materials resulting in a meaningful reduction in the dispersability of the packaged materials. The addition of a dilute lignosulfonate solution was selected to represent the range of available waste additives aimed at raising the moisture content and reducing the dispersability of powdered material.

As part of earlier technology demonstration studies and proof of principle evaluations conducted on Silo 3 materials, laboratory evaluations were performed to evaluate the effectiveness of various stabilization additives aimed at reducing the mobility of the metals present in the materials. Similarly, various other stabilization-additive studies have been conducted by DOE on other waste streams at the Fernald site (primarily on lead contaminated soils from the firing range) and by EPA at other CERCLA sites under the Superfund Innovative Technology Evaluation (SITE) program. These studies attest to the beneficial reduction in mobility of various metals afforded by differing waste stabilization additives. Representative examples of these stabilization additives include ferrous sulfate and triple phosphate, which each target different metals for mobility reduction. On the basis of these studies, there is a clear expectation that the addition of a chemical stabilization reagent to the waste materials will result in some beneficial reduction in the mobility of some or all of the metals present in the waste.

The addition of the additives to treat the waste for dispersability and for metals mobility is being implemented to address concerns expressed by involved stakeholders, and is not a necessary prerequisite to comply with legal ARAR-driven requirements or DOT-driven transportation requirements. As such, the DOE remains committed to applying a "best management practice" effort to ensure the successful addition of the liquid additives to the waste materials.

As part of this best management approach, a mock up of the Silo 3 waste packaging system will be conducted. The purpose of the mock up is to mimic full scale operating conditions in order to provide operability and maintainability data to the design process. The liquid additive delivery system will be included in this mock up testing program. Information obtained from this mock up test will be factored, to the extent practical, into the final as-built configuration of the liquid delivery system. A final formulation for the additive solutions is being developed, in consultation with industry experts, in preparation for the mock up test. The mock up test will be used to demonstrate the effect of adding the liquid solution on the design and operation of the packaging system and, potentially, to identify physical or operating modifications to improve operability of the final configuration.

The criteria for addition of liquid additives will consist of operational criteria applied in a best management approach (utilizing the final equipment and operational configuration to apply the specified additive formulation). As part of the best management approach, no analytical criteria (e.g., treated waste metals analyses) will be applied to final waste form to demonstrate the degree of treatment.

Contingency Backup Actions. As previously stated, the DOE has committed to a best effort to successfully implement the addition of the treatment solutions to the waste materials on the basis of best-available information gleaned from laboratory-scale studies. As such, significant questions remain on the ability to apply this system in a practical and reliable manner to the full-scale waste packaging system. It is believed that the mock up test program will provide more objective data on the viability of such a treatment system and may provide useful information on the means and methods to overcome any or most operational difficulties created by the addition of liquid solution. Operability concerns associated with the liquid delivery system which have been identified to date include: (1) plugging of the liquid delivery spray nozzles and/or waste delivery chute; (2) inability to get the treated waste product to effectively fill the packages; (3) pull back of moisture laden air into the screw conveyor causing plugging; (4) difficulties created by the mixture of the two chemical additives into a single solution for delivery to the packaging system; and (5) moisture related caking or binding of filters in the air handling equipment.

In the event one or all of these concerns were to materialize during full-scale operations the on-line efficiency, capacity and cost of the remedy would be impacted. For example the plugging of the spray nozzles or the plugging of the conveyor screws would require the shutdown of operations and the performance of intrusive maintenance. Maintenance workers would be required to don fully encapsulating protective clothing and supplied air respirators and then come in direct contact with the waste materials. These actions would delay operations and subject workers to potential exposures to thorium bearing material, with resultant schedule and cost increases.

DOE will interact with EPA, Ohio EPA, and the involved stakeholders during the future mock up efforts to implement this treatment system. In the event that one or both of the waste additives cannot be practically applied, DOE will consult with the regulatory agencies and involved stakeholders on the details of the operational difficulties. The results of mock up testing, startup, and initial operations will be made available to EPA, Ohio EPA, and other stakeholders, as will adequate opportunity for input to any decision to alter the scope of treatment or to pursue the contingency plan. Regulatory approval will be obtained prior to finalizing such a decision.

Under the conditions where the costs and/or projected worker exposures associated with the application of one or both of the additives become disproportionate with the potential benefits gained, DOE will cease efforts to apply that portion of the liquid solution to the waste that is causing the operational impediments. If the operational impediments result in the decision to discontinue all steps of the liquid treatment process, then a contingency backup action will be implemented. This contingency action will involve the use of a double packaging system as a backup means to further reduce the potential dispersability of waste material released under a hypothetical severe accident involving material transit. The contingency plan will meet all Remedial Action Objectives, ARARs, and other criteria specified for the proposed revised cleanup plan. Upon completion of the previously discussed interaction with the EPA, Ohio EPA, and the public, and receipt of regulatory agency approval, the basis and rationale for the contingency-action decisions will be documented in a formal post-decision memorandum, and will be documented for the public in a Remedial Design Fact Sheet.

Waste Packaging and Shipping. Once the waste is retrieved from the silo it would be transferred by screw conveyor to a load hopper for direct delivery into the selected packaging configuration. The previously described chemical solution would be added as the waste enters the package.

Representative DOT LSA-II lined, soft-sided container

For purposes of evaluating the alternative, a lined soft-sided container meeting DOT-LSA-II requirements was selected to represent the range of available packaging configurations.

The packaging and mode of transportation remains unchanged from the currently approved cleanup plan. These soft-sided containers would be placed into steel Sea/Land containers and placed on trucks for off-site transport. Other modes of transportation are available for this same packaging configuration, including direct load onto rail flatbed cars with rail transport to a truck offloading station closer to the disposal facility or direct rail transport to the disposal facility. The Nevada Test Site can only receive waste containers by truck, therefore only direct truck transport or intermodal transport with offloading from rail to truck is acceptable for disposal at this location. In the event rail transport were to be implemented as the mode of transportation, dedicated unit trains would be used to the maximum extent practical.

Steel Sea/Land cargo containers to transport DOT LSA-II soft-sided containers

Waste Disposal. This component of the remedy remains unchanged from the 1998 Silo 3 ESD remedy. The Nevada Test Site is selected as the representative option for comparison and costing in this Proposed Plan.

Silo Demolition and Soil Cleanup. This component of the remedy remains unchanged from the 1998 Silo 3 ESD remedy. This Silo 3 structure will be demolished with the debris properly disposed of in the On-site Disposal Facility or off site at the Nevada Test Site or an appropriately permitted commercial disposal facility. Contaminated soil underlying the facility will be cleaned up to achieve the final remediation levels in the Operable Unit 5 ROD.

The excavated soil will be disposed of in the On-site Disposal Facility (or off site, as appropriate) depending on whether the On-site Disposal Facility waste acceptance criteria levels for the contaminated soil are met.

COMPARISON OF THE REVISED SILO 3 REMEDY WITH THE 1998 ESD REMEDY

Comparative evaluations of the proposed revised Silo 3 remedy and the currently approved Silo 3 ESD remedy were conducted employing the nine evaluation criteria defined in the National Contingency Plan as the framework for identifying technical and administrative differences between the alternate plans.

The first two evaluation criteria -- overall protection of human health and the environment and compliance with ARARs -- are considered threshold criteria that must be attained by the selected remedial action. The next five criteria include short-term protectiveness, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, implementability, and cost.

Explanation of the CERCLA Nine Criteria

DOE and EPA use the following nine criteria from the National Contingency Plan to compare and evaluate the cleanup alternatives. The nine criteria are categorized into three groups: *Threshold Criteria*, which must be met by each alternative in order to be eligible for selection; *Primary Balancing Criteria*, which are balanced against each other to achieve the best overall solution; and *Modifying Criteria*, which are evaluated following receipt of comments on the Proposed Plan.

Threshold Criteria	Primary Balancing Criteria	Modifying Criteria
1. **Overall Protection of Human Health and the Environment.** Assessment of the degree to which the cleanup alternative eliminates, reduces, or controls threats to public health and the environment. 2. **Compliance with Applicable or Relevant and Appropriate Requirements.** An evaluation of whether or not the alternative attains applicable or relevant and appropriate requirements (ARARs) under federal environmental laws or state environmental or facility siting laws.	**1. Long-Term Effectiveness and Permanence.** The cleanup alternative is evaluated in terms of its ability to maintain reliable protection of human health and the environment over time. **2. Reduction of Toxicity, Mobility, or Volume Through Treatment.** An evaluation of how well a cleanup alternative reduces the harmful nature of the contamination at the site; the ability of the contamination to move from the site into the surrounding area; and the amount of contaminated material remaining following implementation of the remedy. **3. Short-Term Effectiveness.** The length of time needed to implement a cleanup alternative is considered. DOE and EPA also assess the risks and adverse impacts that carrying out the cleanup alternative may pose to workers and nearby residents. **4. Implementability.** An assessment of how difficult the cleanup alternative will be to construct and operate, and whether the technology is readily available. **5. Cost.** A comparison of the costs of each alternative. Includes capital, operation, and maintenance costs. CERCLA and the National Contingency Plan require that a selected remedy be cost effective, which is defined as a remedy that has costs that are proportionate to overall effectiveness.	1. **State Acceptance.** DOE and EPA take into account whether or not the state agrees with the recommended change, and considers state comments in the development of the Proposed Plan and the ROD Amendment. 2. **Community Acceptance.** DOE and EPA will consider the comments of local and other affected residents on the recommended alternative presented in this Proposed Plan. Responses to the comments raised during the public comment period will be provided in a document called a Responsiveness Summary, which will be attached to the ROD Amendment.

These criteria are considered primary balancing criteria, which are looked at collectively to arrive at the best overall solution that offers the best balance of tradeoffs among the criteria. The final two criteria -- state acceptance and community acceptance -- are evaluated following receipt of comments on the Proposed Plan, and are incorporated, as appropriate, into the final remedy selection in the ROD Amendment.

The Operable Unit 4 Feasibility Study, Proposed Plan, ROD and Silo 3 ESD documented a detailed evaluation of a full range of alternatives against these same criteria to arrive at the selected current cleanup plan contained in the 1998 Silo 3 ESD. The discussion in this section therefore focuses on a specific comparative analysis for the two alternative Silo 3 cleanup plans, aimed at those components that are different.

In addition to the nine criteria comparative analysis, Section 121 of CERCLA and the National Contingency Plan (40 CFR 300.430) requires that the remedy selection process consider and address a statutory preference for remedies that employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of hazardous constituents as a principal element.

The DOE and EPA are required to reach a finding in the proposed amendment to the ROD documenting whether the selected remedy satisfactorily fulfills this statutory preference. A brief discussion is presented later in this section addressing this statutory preference.

As part of the original RI/FS for Operable Unit 4, formal remedial action objectives were identified to guide the overall remedial action alternative development and evaluation process. The original remedial action objectives for the cleanup of the Silo 3 residues as defined in the Operable Unit 4 Feasibility Study Report are:

- Prevent direct contact with or ingestion of Silo 3 material
- Prevent release or migration of waste materials to soil, groundwater, surface water or sediment
- Prevent exposures to Silo 3 material that may cause an individual to exceed applicable dose limits.

These original remedial objectives remained unchanged in the 1998 Silo 3 ESD and are again being maintained as the basis for the revised cleanup plan being recommended in this Proposed Plan. The proposed revised cleanup plan was developed fully considering these formal remedial action objectives.

Threshold Criterion No. 1: Overall Protection of Human Health and the Environment

Both the currently approved and the proposed revised cleanup plans provide for the protection of human health and the environment by removing the high concentration waste residues from the site and properly disposing of them at the Nevada Test Site or a permitted commercial disposal facility. Off-site disposal will be conducted in accordance with the waste acceptance criteria for the receiving facility. The representative disposal facility selected for purposes of evaluating the alternate cleanup plans is the Nevada Test Site. The Nevada Test Site incorporates engineering and institutional controls into the facility design and is situated in a climatic, demographic, and hydrogeologic setting that minimizes the potential for exposures to human or environmental receptors. The licensing process for a permitted commercial disposal facility ensures a similar level of protectiveness to the Nevada Test Site through the location, design, and acceptance criteria of the disposal facility.

The Nevada Test Site waste acceptance criteria establishes a set of requirements that must be fulfilled to permit acceptance of a waste stream for safe, protective disposal. The Nevada Test Site does not outline specific concentration based waste acceptance criteria for individual radiological or nonradiological hazardous constituents. The Nevada Test Site requires the waste generator to submit a waste profile for approval that fully describes the physical, radiological, and chemical characteristics of the waste. DOE submitted a draft profile to the Nevada Test Site describing the untreated Silo 3 residues and has gained approval of the waste steam for disposal at the facility. This approval by the Nevada Test Site was in part based upon a review of the characteristics of the Silo 3 waste and a determination that the disposal of the material untreated would provide a compliant, protective, and permanent disposal solution. A final waste profile must be submitted to the Nevada Test Site prior to shipping the Silo 3 waste. A copy of the general acceptance letter from the Nevada Test Site is provided in the supplement to this Proposed Plan.

Other waste acceptance criteria for the Nevada Test Site include the requirement for the packaging configuration to fully comply with DOT regulations for shipping. In order to be received at the Nevada Test Site the waste must have as little free liquid as is reasonably achievable and in no case greater than 1percent free liquid by volume. The packaged waste will comply with these requirements under both the currently approved or proposed revised cleanup plans, even with the additional moisture that is planned to be added to the waste for dispersability control under the revised cleanup plan.

Both cleanup plans specify that all surrounding soil will be excavated to meet the final remediation levels in the Operable Unit 5 ROD. The residual risk that will remain at the site following completion of the remedial action is consistent with that described in the original Operable Unit 4 Feasibility Study and would remain unchanged by the implementation of the proposed revised cleanup plan. This residual risk would be expected to be in the range of 10^{-6} to the undeveloped park user as described in the Operable Unit 5 Feasibility Study and ROD.

Threshold Criterion No. 2: Compliance with ARARs

Both the currently approved and the proposed revised cleanup plans will attain compliance with ARARs. The ARARs were identified in the Operable Unit 4 Feasibility Study and 1994 ROD, and were not changed by the 1998 ESD for Silo 3. One requirement has been revised since issuance of the Silo 3 ESD -- the selection of the RCRA TCLP limits as a relevant and appropriate performance requirement for treatment of the Silo 3 waste. As described earlier, as a result of a change in the waste acceptance criteria for the Nevada Test Site, the RCRA-regulated metals in the waste no longer need to be treated to attain TCLP levels as a necessary condition for waste acceptance. As a result of this changed condition, the application of this former requirement is no longer considered a relevant and appropriate requirement for the Silo 3 cleanup plan. With this change, the proposed revised cleanup plan will attain all identified ARARs, which are unchanged from the 1998 Silo 3 ESD and the 1994 Operable Unit 4 ROD. A detailed compilation of the ARARs for the revised Silo 3 remedy is provided in the supplement to this Proposed Plan.

Balancing Criterion No. 1 : Long-term Effectiveness and Permanence

The currently approved cleanup plan and the proposed revised cleanup plan both provide a remedy that is effective in the long term and a permanent solution for the Silo 3 wastes. Both alternatives provide for the removal of the Silo 3 waste from the site and the cleanup of any contaminated soil from the silo area. The waste will be shipped from the site and disposed of at an off-site facility in full compliance with the waste acceptance criteria and any relevant licensing restrictions for the receiving facility. The design of these facilities, in concert with their waste acceptance criteria and regional climatic, demographic, and hydrogeologic setting provide a waste disposal solution that is both effective in the long term and permanent.

The currently approved cleanup plan provides an incremental increase in long-term effectiveness by including treatment to the TCLP levels as a performance requirement of the remedy. The proposed revised cleanup plan includes the application of a stabilizing reagent to the waste, which is expected to provide a meaningful level of reduction in both the dispersability of the packaged waste and the leachability of the metals. It is not anticipated or expected that the application of this treatment approach will fully reduce the leachability of the four RCRA regulated metals of concern within the Silo 3 waste (arsenic, selenium, chromium, and cadmium) to below TCLP levels in all cases. The additional incremental reduction in metals leachability provided by the currently approved remedy over and above that anticipated by the proposed approach is not considered significant relative to health-based thresholds, in that the mobility of nonradioactive metals in the incoming waste is already a consideration in the siting, design, and health-protective acceptance criteria for the receiving disposal facilities. The Silo 3 waste will be disposed in the off-site facilities with other byproduct or low level radioactive wastes shipped by other generators with similar characteristics to those exhibited by the treated or untreated cold metal oxides in the silo. Adherence to the waste acceptance requirements of the receiving disposal facility ensures full compliance with prevailing state and federal environmental and health protection regulations governing the long-term performance of these waste disposal systems.

As previously discussed, any identified contaminated soil in the area of Silo 3 will be cleaned up to attain the final remediation levels in the Operable Unit 5 ROD, consistent with other areas of the Fernald site. These cleanup levels were developed to help ensure the long-term protectiveness and permanence of the Fernald cleanup. These cleanup levels were set following a consensus building process that involved the DOE, regulatory agencies, and the community. These cleanup levels have been designed to provide a site-wide remedy that will reduce the residual risk following cleanup to the range of 10^{-6} to the undeveloped park user. The detailed exposure assumptions underlying this risk analysis can be found in the Operable Unit 5 Feasibility Study and ROD.

Balancing Criterion No. 2: Reduction of Toxicity, Mobility, or Volume Through Treatment

Both the currently approved and the proposed cleanup plans provide for treatment of the waste materials prior to disposal at the Nevada Test Site or a permitted commercial disposal location. The currently approved plan would provide some incremental decrease in the mobility of the waste over that provided by the proposed revised cleanup plan.

This incremental additional decrease is not considered significant for health or environmental reasons and is not required to comply with the acceptance criteria of the receiving facility. The chemical stabilization approach envisioned under the currently approved plan would provide for an increase (approximately 50 percent) in volume over the proposed revised plan due to the type and quantity of waste additives necessary to ensure attainment of the TCLP limits imposed under the currently approved remedy. The overall increase from the in-situ volume associated with the currently approved remedy is estimated to be 63 percent, with 52 percent attributable to waste additives and 11 percent to air entrainment during waste retrieval.

The proposed revised plan contemplates the addition of waste additives to the degree attainable in a practical and implementable manner. Bench scale studies demonstrated that a dilute lignosulfonate solution could be effectively added to the waste as it enters the packages to reduce the dispersability of the material. These tests were aimed at adding the lignosulfonate solution to the waste such that the moisture content of the waste was increased up to 20 percent. These bench tests proved successful and DOE has committed to applying this system in the proposed revised cleanup plan. A second chemical reagent, aimed at reducing the leachability of the nonradioactive metals, is also planned to be applied to the waste through the same delivery system. The operability of such a waste additive and liquid delivery system at full scale is not yet proven. As previously discussed, the DOE will make a best effort to ensure the success of the process. In the event the process cannot be applied at full scale, DOE will first attempt to modify or, if need be, eliminate one or both of the additives in the liquid delivery system, if that is the source of the interference. As the next step, in the event the liquid delivery system cannot be successfully operated at all (with or without additives), the contingency action will be implemented following the regulatory and stakeholder consultation process previously described. Under the contingency action, a backup double packaging requirement will be imposed as a tradeoff for elimination of the liquid delivery step.

The volume of waste under the proposed revised cleanup plan is expected to increase by approximately 11 percent from the condition of the in-situ material due primarily to the entrainment of air during retrieval, but also including volume changes attributable to the addition of the waste treatment solution. There is an expectation that the actual increase may be less, due to the effect of introducing the liquids to waste material as it enters the package.

Balancing Criterion No. 3: Short-term Effectiveness

The National Contingency Plan identifies the considerations for which the short-term effectiveness criterion should be evaluated as risks to the community during implementation of the alternative, potential impacts to workers during remedial actions, potential environmental impacts during implementation, and time until protection is achieved. Overall, this criterion favors the proposed revised remedy due to its advantages in worker risk and implementation schedule.

Due to the dispersible nature and high thorium-230 content of the Silo 3 material, a primary short-term effectiveness issue is the potential for worker exposures due to Silo 3 material becoming airborne during retrieval, processing, and packaging. Equipment and operational controls, such as ventilation through dust collection equipment, dust control measures during bulk retrieval, and contamination control practices, must be implemented at each unit operation to minimize the risk of worker exposure to airborne Silo 3 material. These considerations must be designed into the waste handling systems of both the current and proposed revised cleanup plans.

Operation and maintenance of the additional equipment required for chemical stabilization of leachable metals to meet TCLP levels under the current plan results in increased non-radiological risk (worker injury), and the potential for increased radiological exposures to workers. In addition, operation of the chemical stabilization process results in an incremental increase in short-term environmental impacts attributable to increased generation of secondary waste (wastewater, and solid waste) derived from increased material handling and processing steps.

As will be discussed under the implementability criterion, the chemical stabilization operation in addition to the retrieval and packaging, transportation and disposal operations, increases the operational complexity of the current cleanup plan over and above the liquid additive system contemplated by the proposed revised cleanup plan. This increased complexity results in increased uncertainty in the schedule for completion of Silo 3 remediation.

A key consideration in the analysis of the two cleanup plans is the risks attributable to the transportation of the packaged materials to the off-site disposal facility. The potential risks associated with routine (no accidents) waste transportation and to hypothetical accident scenarios have been estimated for both the currently approved and the proposed revised cleanup plans.

The transportation risk analysis was completed through the use of an analytical model called RADTRAN 5. RADTRAN 5 was developed by Sandia National Lab and is used nationwide for transportation risk analysis involving radioactive materials. A more detailed discussion of the modeling input and output appears in Attachment 3 in the supplement to this Proposed Plan.

For both the current cleanup plan and the proposed revised cleanup plan, transportation risks have been evaluated for truck transport to the Nevada Test Site and the Envirocare facility in Utah (the representative commercial facility), intermodal (combined rail and truck) transport to the Nevada Test Site, and rail transport to Envirocare. For each of these modes of transport both the routine (i.e., accident free) and the accident-based risks have been estimated.

For the current cleanup plan, the chemically stabilized waste is assumed to be laced into lined, soft-sided packages and loaded into steel Sea/Land containers. For truck and intermodal (combined rail and truck) transport, 7 soft-sided packages are assumed to be loaded into each Sea/Land with one Sea/Land placed on each truck (four Sea/Lands are assumed to be placed on each flatcar). For direct rail transport, 9 soft-sided packages are assumed to be in each Sea/Land before loading onto the flat cars in recognition of the added weight that can be accommodated by rail over truck transport. For the currently approved remedy it has been estimated that 2810 soft-sided packages will be necessary to complete the project. This quantity includes some consideration for non-optimal packaging and a 47.9 percent waste loading rate. The 47.9 weight-percent waste loading rate is based upon the addition of the water, ferrous sulfate, lime, and portland cement treatment formulation developed during treatability testing.

For the truck shipment option, 402 Sea/Land containers (402 shipments) have been estimated as being necessary to convey the packaged waste by direct truck to the Nevada Test Site. For direct rail shipment, 313 Sea/Land containers and 79 shipments have been estimated to be necessary to transport the packaged waste to the representative commercial facility, Envirocare of Utah. For intermodal transport to the Nevada Test Site, 101 rail shipments would be required from the Fernald site to the intermodal facility, and 402 truck shipments from the intermodal facility to the Nevada Test Site.

For the proposed revised cleanup plan, the previously listed assumptions regarding the quantities of packages per conveyance were also applied to this option. Under this alternative, it has been estimated that 1910 soft-sided containers would be necessary to complete the project again taking some non-optimal packaging into consideration, and assuming a 79 weight-percent waste loading rate. The assumed waste loading rate is based upon the addition of a ferrous sulfate solution and lignosulfonate binder to optimize moisture content at 20 percent

It has been estimated that 273 Sea/Land containers would be required to convey the material to the Nevada Test Site under the proposed revised remedy. For intermodal transport to the Nevada Test Site, 69 rail shipments would be required from the Fernald site to the intermodal facility, and 273 truck shipments from the intermodal facility to the Nevada Test Site. For the direct rail option to Envirocare of Utah, it has been estimated that 213 Sea/Land containers and 54 railcar shipments will be required.

To analyze the risks associated with the routine transportation of the waste across the road or over the rails, it was assumed that no accidents occurred that lead to loss of containment of the inner lined packages. As a result, the risk during routine transportation is limited to direct radiation from the packages the general population. The general population exposed includes those individuals living along the route, those individuals sharing the route, and those individuals that may be encountered at rest stops.

Risks to the general population were estimated for hypothetical accident scenarios for both truck and rail transport. The risks were estimated based upon the assumption that accidents of increasing severity occurred. The model utilizes available actuarial statistics to predict the frequency of an accident of a certain severity, with those of higher severity occurring at a significantly lower frequency. As the severity of the accident increases, the RADTRAN 5 model assumes an increasing quantity of the packaged material becoming released to the environment due to a breach of the outer Sea/Land and the inner liners and packages. To ensure conservatism, for the current cleanup plan the waste was assumed to be in a monolithic form in the lined, soft-sided container with minor quantities of released materials available for resuspension by wind or fire. For the proposed revised cleanup plan, no credit is taken in the model for the planned treatment of the waste to reduce dispersability. Under these assumptions, essentially 100 percent of the waste materials are assumed to be released and available for resuspension as a result of the most severe hypothetical accident.

It should be noted that while the model is estimating the consequences of hypothetical, loss of containment accidents, the probability of such accidents actually occurring are remote. The probability of a maximum severity truck accident occurring such that all the soft-sided containers in the Sea/Land are breached during transport to the Nevada Test Site under the proposed revised remedy has been estimated at approximately 3 x 10^{-5} in a rural area, 3 x 10^{-7} in a suburban area, and approximately 9 x 10^{-9} in a urban area.

The probability of such a severe rail incident occurring during transport to Envirocare is estimated at approximately 9 x 10^{-7} in a rural area, 1 x 10^{-7} in a suburban area, and 7 x 10^{-8} in an urban area. The probability of the events occurring in rural areas are calculated to be higher due the duration of time the rail or truck is in these areas and the higher speeds typically attained by both modes of transportation in rural areas. The improbability of these events occurring is supported by Fernald experience to date. Since 1985 Fernald has shipped over 16,700 individual shipments to Portsmouth and the Nevada Test Site. In all these shipments, Fernald has never had a loss of containment accident. Similarly, Fernald has shipped 72 unit trains to date and has never experienced any accident that has released or even disturbed the waste load.

The following table presents the results of the transportation risk analysis. The table presents the increased probability of experiencing a cancer event in the lifetime (termed incremental lifetime cancer risk or ILCR) of the reasonably maximum exposed individual given both routine transportation of the material and an accident-based scenario for truck transport to the Nevada Test Site and rail shipment to Envirocare.

Results of the Transportation Risk Analysis

	Current Remedy Routine Transport ILCR	Proposed Revised Remedy Routine Transport ILCR
Truck to NTS	8.3 x 10^{-10}	1.8 x 10^{-9}
Rail to Ecare	2.9 x 10^{-10}	4.4 x 10^{-10}
	Current Remedy Accident Scenario ILCR	**Proposed Revised Remedy Accident Scenario ILCR**
Truck to NTS	3.1 x 10^{-11}	4.4 x 10^{-8}
Rail to Ecare	1.6 x 10^{-10}	2.3 x 10^{-7}

A more thorough description of the reasonable maximum exposed individual and the results of the risk analysis for the other modes of transportation to these disposal locations can be found in the supplement to this Proposed Plan. As can be seen from this data, for the currently approved remedy the incremental lifetime cancer risk during routine transportation (no accident condition) is estimated to be approximately 8.3 x 10^{-10} for truck transport to the Nevada Test Site and 2.9 x 10^{-10} for rail transport to Envirocare. For the proposed revised cleanup plan, the risk attributable to truck transportation to the Nevada Test Site is estimated at 1.8 x 10^{-9} and 4.4 x 10^{-10} for rail transport to Envirocare.

These risk estimates compare favorably to the criteria of being below a risk of 1 x 10^{-6} for routine transportation established by the 1998 Silo 3 ESD. The calculated risk attributable to the proposed revised cleanup plan is slightly higher than the current remedy due to the increased waste loading in the shipping containers resulting in higher direct radiation levels on the outside of the package.

For the hypothetical accident scenario, the highest incremental lifetime cancer risk (ILCR) to the reasonably maximum exposed individual is estimated to be 3.1 x 10^{-11} as a result of a Severity Category 8 accident in both suburban and rural areas during truck transport to the Nevada Test Site and 1.6 x 10^{-10} as a result of a Severity Category 8 accident in a suburban area during rail transport to Envirocare for the currently approved remedy. The ILCR for the maximum exposed individual is estimated to be 4.4 x 10^{-8} and 2.3 x 10^{-7} as a result of a Severity Category 8 accident in both rural and suburban areas for truck to the Nevada Test Site and in a suburban area for rail to Envirocare, respectively for the proposed revised cleanup plan. As previously stated, no consideration was given in the risk analysis for any reduction in dispersability afforded by the treatment contemplated by the proposed revised cleanup plan. As with the routine transport, the risk estimates for the hypothetical accident scenarios compare favorably to the criteria of being below a risk of 1 x 10^{-6} established by the 1998 Silo 3 ESD.

To minimize the potential risks associated with the hypothetical accident scenario, the Fernald site employs certain controls as part of every truck and rail shipment from the site. It is envisioned that these or similar measures would be used on the shipments of Silo 3 waste materials.

For truck shipments to the Nevada Test Site, the controls that Fernald applies to each shipment include: (1) a rigorous quality control and assurance program to ensure the quality of the packages and the conveyances and their compliance with DOT and Nevada Test Site requirements; (2) affixing a global positioning system transponder to each conveyance to track the progress of each vehicle and/or ensuring each driver has a working cellular phone or two-way radio; (3) employing screening criteria for the selection of drivers; (4) training of the driver on what actions to take in the event of accidents; and (5) the briefing of interested emergency response personnel along the transportation route.

Similarly, for rail transportation the control measures that are routinely applied to waste shipments include: (1) application of a rigorous quality assurance and control program to ensure the quality of the package, cars, liners (where applicable) and lids; (2) utilizing the commercial rail car tracking system to watch the progress of Fernald waste shipments; (3) working with the commercial rail carrier to ensure the availability of adequate emergency response plans; and (4) the briefing and training (if requested) of emergency response personnel along the transportation route.

In the event of an accident, the truck driver has been directed to immediately contact the appropriate response authority, the carrier company representative, and the Fernald communications center. The truck driver is briefed on emergency response techniques and is equipped with a spill kit. In the event the driver is incapable of performing the initial on-scene response duties, this obligation moves to the first responder. Fire and police responders are trained to gain access to the shipping papers in the cab or call the dispatcher. The shipping papers and/or dispatcher direct the responder to the Fernald Communication Center (24 hours a day). The Communication Center puts the Fernald duty officer in contact with the responder to provide information on the nature of the hazard and possible response actions. The Fernald emergency response center makes the necessary contacts to the DOE and local stakeholders and provides any necessary support to the on scene event coordinator. For rail incidents, the rail carrier company personnel are trained in emergency response techniques. The rail carrier will perform the necessary notification to local response authorities and provide assistance to the response as appropriate. The rail carrier will contact the Fernald communications center following the incident. The Fernald communications center will again provide necessary notifications and any necessary support to the on scene event coordinator.

Balancing Criterion No. 4: Implementability

This criterion favors the proposed revised cleanup plan due to less complexity of operations and a resulting greater confidence in its ability to be successfully implemented.

The equipment and operations required to retrieve the Silo 3 material from the silo, and package the treated or untreated material for transportation to the disposal facility are common to both cleanup alternatives. Chemical stabilization of the leachable metals for the current cleanup plan requires additional equipment and unit operations over and above those envisioned to support the proposed remedy. In addition, assuring that the process accomplishes adequate chemical stabilization to meet the TCLP limits requires additional sampling and process controls to monitor the characteristics of the feed stream and control the stabilization recipe. Additional product sampling to verify attainment of TCLP limits, and the ability to reprocess treated waste failing to meet the limits is also required.

As documented in the 1998 Silo 3 ESD, a primary factor in the selection of the currently approved remedy for Silo 3 was the significant implementability issues associated with treatment of the material due to its unique physical, chemical and radiological characteristics. The dispersible nature of the Silo 3 material, in combination with its thorium-230 content, results in dust control and contamination concerns. The need to mitigate these concerns in the design of equipment such as the material handling and mixing equipment associated with a the chemical stabilization process contemplated by the current cleanup plan, further increases the complexity of the design, operation, process control, and maintenance aspects of the remedy.

This additional equipment and greater number of unit operations increases the operational and maintenance complexity and risk of operational upsets, and thereby results in a greater implementability risk for the current plan, than those that would be expected by the proposed revised cleanup plan. Some operational challenges are expected during the implementation of the liquid addition system for the Proposed Plan. As previously stated, DOE expects that these will be overcome during the mock up testing.

In accordance with the National Contingency Plan, those operations activities to be performed at the Fernald site are exempted from the requirement to obtain federal, State, or local permits. Therefore, neither cleanup plan will be required to obtain permits, such as air emission permits, or waste storage permits, for the activities conducted at the Fernald site. As outlined in the ARARs for Silo 3 Remedial Action (Attachment 2 in the Supplement to the Proposed Plan), both cleanup plans will meet the substantive requirements, such as air emission and waste management requirements, which would otherwise be imposed by permits. Both alternatives include off-site disposal of the Silo 3 materials at either the Nevada Test Site or a permitted commercial disposal facility. The administrative feasibility associated with obtaining the necessary approvals for acceptance at the Nevada Test Site is equivalent for either cleanup plan. The licensing process for the acceptance of the treated waste material at the representative commercial facility (Envirocare) is considered to be more complex.

The schedule for implementation of the currently approved remedy including design, construction, operations and post-treatment system cleanout and demolition has been estimated at 43 months. The schedule duration to implement the same scope for the proposed revised remedy is estimated at 35 months. The differences are attributable to the added design engineering for the more complex treatment process, and to the added schedule duration to execute the operations and shipping program associated with currently approved remedy.

Balancing Criterion No. 5: Cost

The cost evaluation is based on estimates documented in the supplement to this Proposed Plan. The cost estimates were developed for (1) capital costs; (2) engineering, project management, construction management and startup costs; (3) operations and maintenance (O&M) and system shutdown costs; (4) transportation and disposal costs; and (5) decontamination & demolition (D&D) costs. The accuracy of both estimates is considered +50/-30 percent, consistent with CERCLA guidance. For purposes of comparative analysis, treated waste is assumed to be shipped by truck to the Nevada Test Site for each alternative.

The following summarizes the major cost elements for the currently approved plan and the proposed revised cleanup plan alternatives. Costs associated with the D&D of the Silo 3 structure have not been included. Similarly, the costs for addressing any contaminated soil in the Silo 3 area have been excluded from both options. A more detailed basis for the cost estimate is provided Attachment 4 in the supplement to this Proposed Plan.

Summary Cost Data ($ Million)

	Current Cleanup Plan	Proposed Revised Cleanup Plan
Capital Cost	20.0	14.0
Engineering, Proj. Mgmt., Const. Mgmt. and Startup Cost	15.0	15.0
Operation and Maintenance Cost	7.0	4.0
Transportation and Disposal Cost	11.0	7.0
D&D Cost	2.0	2.0
Total Cost	**55.0**	**42.0**

The cost estimate for the currently approved remedy varies from the rough order of magnitude value provided in the 1998 Silo 3 ESD as a result of more detailed conceptual engineering performed to describe and estimate the remedy. The error band (+50/-30 percent) around the estimated cost for the currently approved remedy presented in the table overlaps with the band around the estimate for the chemical stabilization and off-site shipment alternative presented in the original Operable Unit 4 Feasibility Study.

Due to the incremental life-cycle costs of providing treatment to stabilize arsenic, cadmium, chromium, and selenium to achieve TCLP limits, the estimated cost for the current cleanup plan is estimated at $13 million greater than the proposed revised plan. These incremental costs include additional capital costs to support the installation of the chemical stabilization system, increased operational costs attributable to additional staff and analytical demand, and increased shipping costs due to the almost 50 percent increase in volume to be shipped under the current cleanup plan.

It should be noted that the difference between the two alternatives ($13 million) is within the errors expected from estimating (plus 50 percent, minus 30 percent), and therefore should not be heavily relied upon in decisionmaking. While a more precise estimate of the cost differences between the two alternate remedies cannot be made without the benefit of more detailed engineering, it can be reasonably expected that the cost to implement the currently approved remedy will be higher than that to implement the proposed revised plan. These added costs would be attributable to the added design, construction, operation and demolition scope associated with the more complex treatment approach dictated by the currently approved remedy.

As previously discussed, it is estimated to require 43 months to implement the currently approved remedy and 35 months to implement the proposed revised remedy. The driving difference between these two schedules is the increased operation and shipping duration for the currently approved remedy attributable to the added complexities of the treatment process and the added volume for shipment.

Modifying Criterion No. 1: State Acceptance

The Ohio EPA has had an opportunity to review and participate in the proposed change to the Silo 3 remedy and concurs with the recommendation.

Modifying Criterion No. 2: Community Acceptance

During the public comment period, interested persons or organizations may comment on the two alternatives and the recommended implementation strategy for the Silo 3 Proposed Plan. DOE and EPA will consider comments provided by the community in making the final alternative selection. The comments will be addressed in a document called a Responsiveness Summary, which will then be part of the ROD Amendment for Silo 3.

Statutory Preference For Treatment As Principal Element

Under Section 121 of CERCLA, DOE and EPA are required to reach a finding for the proposed amendment to the ROD that the selected remedial alternative satisfies a statutory preference for remedies that employ treatment to permanently and significantly reduce the volume, toxicity, or mobility of hazardous constituents as a principal element. The finding is to be made through the detailed comparison of the two alternatives, considering site-specific factors and the five primary balancing criteria contained in Section 300.430 of the National Contingency Plan.

On the basis of the detailed comparisons described above, DOE and EPA conclude that the modified Silo 3 treatment process satisfactorily achieves the statutory preference for treatment as a principal element and provides sufficient additional risk reduction in relation to cost.

If the treatment step cannot be satisfactorily implemented due to overriding technical or short-term worker risk impediments, then the formal contingency action explained above (additional double packaging of materials in the protective shipping containers) is also deemed to provide an appropriate balance of risk reduction, effectiveness, and cost to satisfy Section 121 requirements and preferences under the site-specific circumstances giving rise to the need for the contingency action.

National Environmental Policy Act Considerations

It is DOE policy to integrate National Environmental Policy Act (NEPA) requirements into the procedural and documentation requirements of CERCLA, wherever practicable. This policy is embodied within DOE Order 5400.4 defining the roles and responsibilities of the DOE regarding compliance with CERCLA and the integration of the remedial process with NEPA.

The incorporation of NEPA values into the original Operable Unit 4 Feasibility Study and Proposed Plan resulted in a broader and more detailed analysis of the potential environmental impacts associated with implementing the alternatives. The original Operable Unit 4 Feasibility Study and Proposed Plan also included a broad evaluation of cumulative impacts of all Fernald site remediation activities. The resulting integrated process and documentation package for Operable Unit 4 was termed a *Feasibility Study/Proposed Plan – Environmental Impact Statement*.

Integrated CERCLA/NEPA documents (i.e., Feasibility Studies and Proposed Plans) were prepared for each of the four ensuing operable units at the Fernald site. Cumulative impacts were evaluated and updated as each remaining operable unit prepared its Feasibility Study and Proposed Plan documents.

NEPA regulations (10 CFR 1021) require that DOE prepare a Supplemental Environmental Impact Statement when the agency has made a substantial change in a proposed action, or if there are new significant circumstances in the proposed Environmental Impact Statement action that are relevant to environmental concerns. Case law confirms, however, that an agency does not need to supplement an Environmental Impact Statement every time new information comes to light. The agency is required to take a hard look at the environmental impacts of its planned action, and to apply a "rule of reason" in deciding whether or not to prepare a Supplemental Environmental Impact Statement.

In applying this rule of reason, the agency should evaluate factors related to the new information or circumstances for the action. These factors might include the environmental significance and probable accuracy of the new information or circumstances, the care that the agency used to evaluate the information and its impact, and the degree to which the information supports the agency's decision of whether to prepare a Supplemental Environmental Impact Statement. In addition, DOE's NEPA regulations allow the preparation of a "Supplemental Analysis" where the decision to prepare a Supplemental Environmental Impact Statement is unclear.

Four Supplemental Analyses have been prepared evaluating changes to the original Operable Unit 4 Feasibility Study and Proposed Plan Environmental Impact Statement:

- January 9, 1996 – evaluating shipping material for disposal via truck as opposed to the combination of rail/truck evaluated in the Operable Unit 4 Feasibility Study and Proposed Plan Environmental Impact Statement.

- August 20, 1996 – evaluating the Silo 3 remediation alternatives, including on-site treatment with disposal at the Nevada Test Site or a permitted commercial disposal facility, and transportation of untreated Silo 3 material to an off-site facility.

- March 3, 1998 – evaluating Accelerated Waste Retrieval of the Silos 1 and 2 material.

- March 13, 2000 – considering of alternatives for the remediation of the Silos 1 and 2 material.

No additional impacts were identified as a result of these reevaluations, and in each case, DOE determined that no additional NEPA evaluation or documentation was required.

This Proposed Plan utilizes the same CERCLA/NEPA strategy by integrating the Remedial Investigation and Feasibility Study documentation previously completed by all five operable units at the site. This includes the original Operable Unit 4 Feasibility Study, Proposed Plan, and ROD, the revised Silos 1 and 2 Feasibility Study, Proposed Plan, and ROD Amendment, the ESD for Silo 3, and the previously identified Supplemental Analyses.

The potential change recommended by DOE in this Proposed Plan is bounded by the alternatives evaluated in the original Feasibility Study and Proposed Plan Environmental Impact Statement and the subsequent Supplemental Analyses. Therefore, it is DOE's determination that potential NEPA issues associated with the change recommended in this Proposed Plan have been adequately evaluated and that no additional NEPA documentation or evaluation is necessary.

In accordance with both CERCLA and NEPA processes, these documents are made available to the public for comment. Public involvement is an important factor in the decision-making process for site remediation. Public comments will be considered in the selection of a revised remedy for Silo 3 material, which will be presented in a ROD Amendment. Applying the integrated approach for CERCLA and NEPA, DOE plans to prepare and issue a single ROD Amendment, which will be signed by both DOE and EPA. The contents of the documents prepared for the remedial actions at the Fernald site are not intended to represent a statement on the legal applicability of NEPA to remedial actions conducted under CERCLA.

FINDINGS AND CONCLUSIONS

DOE and EPA are proposing a change to the remedy for Silo 3 to a revised plan that offers cost and schedule benefits while still maintaining a health-protective, compliant remedy. This change is being considered as a result of a recent revision to the waste acceptance criteria at the Nevada Test Site. As a result of the change in criteria, the disposal facility at the Nevada Test Site can now receive the Silo 3 waste untreated and still meet health-protective disposal requirements for the facility. On this basis, DOE and EPA have developed a new proposed cleanup plan for Silo 3 that takes advantage of the revised disposal facility acceptance criteria, but also seeks to address key concerns of involved stakeholders. This revised approach eliminates the RCRA TCLP test as a required performance measure for the treatment of the Silo 3 waste, and in its place adopts a best-management approach involving the addition of waste treatment reagents to the waste prior to final packaging. The treatment reagents are designed to meaningfully reduce both the dispersability and leachability of the Silo 3 materials to best-management-practice performance levels.

In the event that the delivery systems designed to add the reagents cannot be made operationally viable and/or result in unacceptable worker health and safety exposure conditions, a contingent approach will be implemented to double package the material before off-site transport. Both the primary action (treatment reagents) and the contingency action (double packaging) have been developed to respond to stakeholder concerns regarding the potential for re-suspension and dispersion of the Silo 3 materials in the event of a catastrophic transportation accident involving the breach of the shipping containers en-route to final disposal.

DOE and EPA evaluated the proposed revised cleanup plan against the nine remedy selection criteria in the CERCLA National Contingency Plan, and compared the results to those for the currently approved 1998 Silo 3 ESD cleanup plan. The comparison shows that both remedies meet the threshold criteria established by the National Contingency Plan for overall protection of human health and the environment, and compliance with ARARs.

When comparing the five primary balancing criteria for the two alternatives, DOE and EPA find that the two alternatives are essentially equivalent with respect to long-term protectiveness and permanence. Under both options the waste will be shipped off site to an appropriate disposal facility in full conformance with health-protective waste acceptance criteria.

Both the currently approved and the proposed revised cleanup plans provide for treatment of the waste materials prior to disposal at the Nevada Test Site or a permitted commercial disposal location. Although the currently approved plan would provide some incremental decrease in the mobility of the waste over that provided by the proposed revised cleanup plan, the incremental benefits provided by this decrease are judged not to be significant to the long-term protectiveness of the remedy. In addition, the nominal decrease in mobility is accompanied by a significant increase in final waste volume compared to the proposed revised cleanup plan, due to the volume of additives required for the treatment process in the currently approved plan.

Both alternatives are implementable, although DOE and EPA conclude that the proposed revised remedy would be easier to implement overall due to the elimination of the more elaborate treatment system contemplated by the currently approved remedy to satisfy RCRA TCLP performance requirements.

The schedules for implementing the two alternatives are comparable (both satisfy enforceable milestone requirements for Operable Unit 4); the proposed revised remedy, however, offers meaningful schedule improvements attributable to a shorter operations and shipping duration. In terms of short-term effectiveness, both remedies are comparable. Fewer shipments would be expected under the proposed revised remedy, with the calculated risks during transportation associated with the proposed revised remedy being slightly higher but still within the acceptable range established for the remedy by the 1998 Silo 3 ESD. The proposed revised remedy will be less costly to implement than the currently approved cleanup plan due to the adoption of a more straightforward treatment approach that results in fewer packages to ship. Ohio EPA supports the proposed changes to the remedy, and the final criterion (community acceptance) will be evaluated after DOE and EPA receive public comments on this Proposed Plan.

In summary, DOE and EPA conclude that the proposed revised cleanup plan for Silo 3 represents the best overall balance of the evaluation criteria; provides effectiveness proportionate to its cost; and meets the CERCLA statutory preference for remedies that employ treatment as a principal element. As a result, DOE and EPA are recommending the implementation of the proposed revised remedy as the final remedy for Silo 3.

PUBLIC INVOLVEMENT ACTIVITIES

The community is encouraged to read and provide comments on the revised cleanup plan for Silo 3 at the Fernald Environmental Management Project. A final remedy selection will be made only after hearing and considering community comments and concerns. Based on those comments, the preferred plan may be modified, based on information gathered from the community during the comment period.

DOE and EPA will consider public comments received during a 30-day comment period from April 30 to May 30, 2003. A public meeting will be held May 13, 2003 at 6:30 PM at the Crosby Senior Center in Crosby Township, Ohio to explain the Proposed Plan and accept oral and written comments.

Additional copies of the Proposed Plan and the supporting documents are available from the Administrative Record locations both at the Fernald Public Environmental Information Center and at the EPA offices in Chicago, Illinois. Addresses for these two Administrative Record locations are provided below. In addition to the prepaid comment form attached to this Proposed Plan, your comments may also be submitted electronically or by mail to:

Mr. Gary Stegner	Mr. Jim Saric
U.S. Department of Energy Fernald Closure Project P.O. Box 538705 Cincinnati, OH 45253-8705 Email: gary.stegner@fernald.gov 513-648-3153	U.S. EPA, SRF-5J 77 W. Jackson Blvd. Chicago, IL 60604-3590 Email: saric.james@epamail.epa.gov 312-886-0992

OHIO EPA INVOLVEMENT

The **OHIO EPA** is participating in the RI/FS and remedial action processes at the FEMP. For additional information concerning the state's role in the cleanup process at the FEMP or regarding the specifics of this Proposed Plan contact:

Tom Schneider
Fernald Project Manager
Ohio Environmental
Protection Agency
401 E. Fifth St.
Dayton, OH 45402-2911

513-285-6466

The date, time, and location of the public meeting and the dates for the comment period will be announced in the local media and are posted at the Administrative Record locations. Addresses and hours for the Administrative Record locations are as follows:

Public Environmental Information Center	U.S. EPA Region V
Located at the Fernald Closure Project Site 7400 Willey Road Cincinnati, OH 45013-9402 513-648-7480 Tuesday and Thursday, 7:30 a.m. to 4:30 p.m.	U.S. EPA, SRF-5J 77 W. Jackson Blvd. Chicago, IL 60604 312-886-0992

Key Documents For Administrative Record File

Fernald Environmental Management Project (FEMP):

- 1993a, *Remedial Investigation Report for Operable Unit 4.* Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (AR Index Numbers Vol. I-III: U-006-304.15 – 17)
- 1994a. *Feasibility Study for Operable Unit 4.* Prepared under contract for the U.S. Department of Energy: Fernald Field Office, Fernald, OH. (AR Index Numbers No. U-006-405.3)
- 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. (AR Index Numbers Vol. I-IV: No. U-006-404.13 – 16)
- 1994. *Record of Decision for Operable Unit 4*. EPA ID OH6890008976: ROD ID EPA/ROD/R05-65/287. (AR Index No. U-006-501.5) [abstract at hhtp://www.epa.gov/superfund/sites/rodsites/0504934.htm]
- 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. (AR Index No. U-006-503.11)

COMMENT FORM

Your input on the Proposed Plan for amending the Operable Unit 4 ROD to accommodate the revised cleanup plan for Silo 3 is important. Public comments assist DOE and EPA in selecting the final cleanup plan.

You may use the space below to write your comments about both of the alternatives described in this Proposed Plan. After making your comments, please fold, tape (no staples), and mail this prepaid form. We must receive your comments on or before the close of the public comment period on May 30, 2003. If you have questions about the comment period or the upcoming public meeting, contact Gary Stegner in DOE's Public Information Office at (513) 648-3153. Those with electronic capabilities may submit their comments to DOE via E-mail to: gary.stegner@fernald.gov.

(BELOW INFORMATION IS OPTIONAL)

Name: ______
Address: ______
City: ______
Phone: ______

MAILING LIST ADDITIONS

Please add my name to the Fernald Mailing List to receive additional information on the cleanup progress at the Fernald Environmental Management Project.

Yes ________ **No** ________

NO POSTAGE
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MAILED IN THE
UNITED
STATES

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POSTAGE WILL BE PAID BY THE ADDRESSEE

GARY STEGNER
PUBLIC INFORMATION
FERNALD CLOSURE PROJECT
US DEPARTMENT OF ENERGY
PO BOX 538705
CINCINNATI OH 45253-9985

Fold Here

Tape

Fold Here

Tape

For More Information

Additional information or related cleanup documents are available to the public at the following location:

Public Environmental Information Center
Fernald Closure Project
7400 Willey Road
Hamilton, OH 45013-9402

513-648-3153

SUPPLEMENTAL INFORMATION

REVISED PROPOSED PLAN FOR OPERABLE UNIT 4 SILO 3 REMEDIAL ACTION AT THE UNITED STATES DEPARTMENT OF ENERGY FERNALD CLOSURE PROJECT

FERNALD, OHIO

April 2003

Prepared Under DOE Contract No. DE-AC24-01OH20115
By Fluor Fernald, Inc.

FERNALD
Closure Project

40430-RP-0014
Revision 0
FINAL

REVISED PROPOSED PLAN FOR SILO 3 SUPPLEMENTAL INFORMATION

TABLE OF CONTENTS

ATTACHMENT 1

DOE-NEVADA LETTER DOCUMENTING ACCEPTABILITY OF UNTREATED SILO 3 MATERIAL AT THE NEVADA TEST SITE

Department of Energy
National Nuclear Security Administration
Nevada Operations Office
P.O. Box 98518
Las Vegas, NV 89193-8518

JUN 20 2002

Stephen H. McCracken, Director, FEMP, Cincinnati, OH

DISPOSAL OF FERNALD SILOS WASTE MATERIALS AT THE NEVADA TEST SITE (NTS)

This is to inform you that Fernald Silos materials, including the Silo 3 untreated material (all of which is statutorily exempt from the Resource Conservation and Recovery Act), may be accepted for disposal at the NTS as 11(e)(2) byproduct material following the successful completion of the NTS waste approval process.

If you have any questions regarding this letter, please feel free to contact Jhon T Carilli, of my staff, at (702) 295-0672.

Carl P. Gertz
Assistant Manager
for Environmental Management

WMD:JTC-240

cc:
S. A. Robison, DOE/HQ (EM-31)
Cloverleaf
J. M. Sattler, DOE/Fernald,
Cincinnati, OH
N. K. Akgunduz, DOE/Fernald,
Cincinnati, OH

ATTACHMENT 2

ARARs

FOR SILO 3 REMEDIAL ACTION

TABLE 2-1

ARARS FOR SILO 3 REMEDIAL ACTION
REMEDIAL ACTION ALTERNATIVES, CHEMICAL-SPECIFIC

Medium	Clean Air Act (CAA)	Requirement	ARAR/TBC	Rationale for Implementation
Air	Radionuclide Emissions (Except Airborne Radon-222), 40 CFR Part 61 Subpart H.	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that might cause any member of the public to receive, in any year, an effective dose equivalent (EDE) of 10 mrem or greater per year. Monitoring is required at release points having potential to discharge radionuclides that could cause an EDE in excess of 1% of the standard (0.1 mrem/yr) to any member of the public.	Applicable	Radioactive materials within Silo 3 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 (NESHAP) applies to operating units.
Air	Radon-222 Emissions, 40 CFR Part 61 Subpart Q.	No source at a DOE facility shall emit more than 20 pCi/m^2s of radon-222 as an average for the entire source during periods of storage and disposal.	Applicable	A ‘source’ is defined by NESHAP Subpart Q as ‘any building, structure, pile, or impoundment used for interim storage or disposal that is or contains waste material containing radium in sufficient concentration to emit radon-222 in excess of this standard prior to remedial action.” Temporary staging of Silo 3 material during the process of packaging and transportation to the disposal facility does not constitute a ‘source for the purposes of this standard. This standard is applicable to the facility used for disposal of the Silo 3 material.

TABLE 2-1 (Continued)

<table>
<tr><th>Medium</th><th>DOE</th><th>Requirement</th><th>ARAR/TBC</th><th>Rationale for Implementation</th></tr>
<tr><td>Air</td><td>Radiation Protection of the Public and the Environment, Proposed 10 CFR Part 834.</td><td>Residual concentrations of radionuclides in the air within uncontrolled areas are limited to those listed below (for known mixtures of radionuclides, the sum of the ratios of the observed concentration of each radionuclide to its corresponding limit must not exceed 1.0.). Derived Concentration Guide
(µCi/mL)
<table>
<tr><th>Isotope</th><th>D[a]</th><th>W</th><th>Y</th></tr>
<tr><td>Actinium-227</td><td>2 x 10^{-15}</td><td>7 x 10^{-15}</td><td>1 x 10^{-14}</td></tr>
<tr><td>Lead-210</td><td>9 x 10^{-13}</td><td>------[b]</td><td>-------</td></tr>
<tr><td>Polonium-210</td><td>1 x 10^{-12}</td><td>1 x 10^{-12}</td><td>-------</td></tr>
<tr><td>Protactinium-231</td><td>------</td><td>9 x 10^{-15}</td><td>1 x 10^{-14}</td></tr>
<tr><td>Radium-224</td><td>------</td><td>4 x 10^{-12}</td><td>-------</td></tr>
<tr><td>Radium-226</td><td>------</td><td>1 x 10^{-12}</td><td>-------</td></tr>
<tr><td>Radium-228</td><td>------</td><td>3 x 10^{-12}</td><td>-------</td></tr>
<tr><td>Technetium-99</td><td>1 x 10^{-8}</td><td>2 x 10^{-9}</td><td>-------</td></tr>
<tr><td>Strontium-90[c]</td><td>5 x 10^{-11}</td><td>------</td><td>9 x 10^{-12}</td></tr>
<tr><td>Thorium-228</td><td>-------</td><td>5 x 10^{-14}</td><td>4 x 10^{-14}</td></tr>
<tr><td>Thorium-230</td><td>-------</td><td>4 x 10^{-14}</td><td>5 x 10^{-14}</td></tr>
<tr><td>Thorium-232</td><td>-------</td><td>7 x 10^{-15}</td><td>1 x 10^{-14}</td></tr>
<tr><td>Uranium-234</td><td>4 x 10^{-12}</td><td>2 x 10^{-12}</td><td>9 x 10^{-14}</td></tr>
<tr><td>Uranium-235</td><td>5 x 10^{-12}</td><td>2 x 10^{-12}</td><td>1 x 10^{-13}</td></tr>
<tr><td>Uranium-236</td><td>5 x 10^{-12}</td><td>2 x 10^{-12}</td><td>1 x 10^{-13}</td></tr>
<tr><td>Uranium-238</td><td>5 x 10^{-12}</td><td>2 x 10^{-12}</td><td>1 x 10^{-14}</td></tr>
</table>
[a] D, W, and Y (days, weeks, years) represent lung retention classes; removal halftimes assigned to the compounds with classes D, W, and Y are 0.5, 50, and 500 days, respectively. Exposure conditions assume an inhalation rate of 8,400 m^3 of air per year (based on an exposure over 24 hours per day, 365 days/ year).
[b] A dashed line means that no limit has been established.
[c] The value shown for daily derived concentration guide (DCG) is for strontium radionuclides with a f_1 value of 3 x 10^{-1}. The value shown for yearly DCG is for strontium radionuclides for a f_1 value of 1 x 10^{-2}.</td><td>To be considered</td><td>Remediation of the Silo 3 material has the potential to release radionuclides.</td></tr>
</table>

TABLE 2-1 (Continued)

Medium	DOE (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Air	Residual Radioactive Material, DOE Order 5400.5 Chap. IV, 6.b (proposed 10 CFR Part 834).	Interim Storage The above-background concentration of radon-222 in air above an interim storage facility must not exceed: 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 0.5 pCi/L above background or above any location outside the site.	To be considered	Management of radium and thorium bearing waste might result in the release of radon gas to the environment.
Water	Radiation Protection of the Public and the Environment, Proposed 10 CFR Part 834.	Residual concentrations of radionuclides in water that may be ingested are listed below. These DCGs for the COCs are based on a committed EDE of 100 mrem/yr, assuming ingestion of 2 liters/day. Note that these DCGs apply only if ingestion is the single pathway of exposure. Ingested Water DCGs Isotope (µCi/mL) Actinium-227 1x10^{-8} Lead-210 3x10^{-8} Polonium-210 8x10^{-8} Protactinium-231 1x10^{-8} Radium-224 4x10^{-7} Radium-226 1x10^{-7} Radium-228 1x10^{-7} Technetium-99 1x10^{-4} Strontium-90 1x10^{-6} Thorium-228 4x10^{-7} Thorium-230 3x10^{-7} Thorium-232 5x10^{-8} Uranium-234 5x10^{-7} Uranium-235 6x10^{-7} Uranium-236 5x10^{-7} Uranium-238 6x10^{-7}	To be considered	Remediation of the Silo 3 material has the potential to release radionuclides.

TABLE 2-1 (Continued)

<table>
<tr><th>Medium</th><th>CWA</th><th>Requirement</th><th>ARAR/TBC</th><th>Rationale for Implementation</th></tr>
<tr><td>Water</td><td>Ohio Water Quality Standards, Ohio Administrative Code (OAC) 3745-1-04.</td><td>“Five Freedoms” for surface water:

Surface waters of the state shall be free from:
• objectionable suspended solids;
• floating debris, oil and scum;
• materials that create a nuisance;
• toxic, harmful or lethal substances; and
• nutrients that create nuisance growth.</td><td>Relevant and Appropriate</td><td>Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.</td></tr>
<tr><td>Water</td><td>Ohio Water Quality Standards, OAC 3745-1-07.</td><td>Use Designations and Criteria

All pollutants or combinations of pollutants shall not exceed, outside the mixing zone, the Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designations listed in Tables 7-1 through 7-15 of this rule.

The following constituents of concern (COCs) for Operable Unit 4 have warm water habitat criteria concentrations outside the mixing zone as follows:

<table>
<tr><th>30-day Criteria Constituent</th><th>average conc.[a] (ug/l)</th><th>conc. (ug/l)</th></tr>
<tr><td>antimony</td><td>650</td><td>190</td></tr>
<tr><td>arsenic</td><td>360</td><td>190</td></tr>
<tr><td>beryllium</td><td>Tab. 7-10[b] Tab. 7-11[c]</td><td></td></tr>
<tr><td>cadmium</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>chromium Tab. 7-10</td><td>Tab. 7-11</td><td></td></tr>
<tr><td>copper</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>cyanide</td><td>46</td><td>12</td></tr>
<tr><td>lead</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>mercury</td><td>1.1</td><td>0.20</td></tr>
<tr><td>nickel</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>selenium</td><td>20</td><td>5.0</td></tr>
<tr><td>silver</td><td>Tab. 7-10 1.3</td><td></td></tr>
<tr><td>thallium</td><td>71</td><td>16</td></tr>
</table>
</td><td>Relevant and Appropriate</td><td>Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.</td></tr>
</table>

TABLE 2-1 (Continued)

<table>
<tr>
<td>Water</td>
<td>Ohio Water Quality Standards,
(OAC) 3745-1-07 (continued).</td>
<td>
<table>
<tr><td>30-day Criteria
Constituent</td><td>average conc.[a]
(ug/l)</td><td>conc.
(ug/l)</td></tr>
<tr><td>zinc</td><td>Tab. 7-10 Tab. 7-11</td><td></td></tr>
<tr><td>30-day Criteria
Constituent</td><td>average conc.[a]
(ug/l)</td><td>conc.
(ug/l)</td></tr>
<tr><td>2-butanone160000</td><td>7100</td><td></td></tr>
<tr><td>4-nitrophenol</td><td>790</td><td>35</td></tr>
<tr><td>acentone</td><td>550000</td><td>78000</td></tr>
<tr><td>aldrin</td><td>----</td><td>0.01</td></tr>
<tr><td>bis(2-ethylhexyl)
phthalate1100</td><td>8.4</td><td></td></tr>
<tr><td>carbon tetrachloride1800</td><td></td><td>280</td></tr>
<tr><td>DDT</td><td>----</td><td>0.001</td></tr>
<tr><td>Dieldrin</td><td>----</td><td>0.005</td></tr>
<tr><td>di-n-butyl-
phthalate350</td><td>190</td><td></td></tr>
<tr><td>diethylphthalate</td><td>2600</td><td>120</td></tr>
<tr><td>dimethylphthalate</td><td>1700</td><td>73</td></tr>
<tr><td>endosulfan[d]</td><td>----</td><td>0.003</td></tr>
<tr><td>endrin</td><td>----</td><td>0.002</td></tr>
<tr><td>fluoranthene</td><td>200</td><td>8.9</td></tr>
<tr><td>methylene chloride</td><td>9700</td><td>430</td></tr>
<tr><td>PCBs</td><td>----</td><td>0.001</td></tr>
<tr><td>phenol</td><td>5300</td><td>370</td></tr>
<tr><td>tetrachloroethene</td><td>540</td><td>73</td></tr>
<tr><td>toluene</td><td>2400</td><td>1700</td></tr>
</table>
[a] Criteria concentration shall be met outside mixing zone.
[b] Criteria concentration based on hardness of water. See Table 7-10 for calculation to determine maximum concentration outside the mixing zone.
[c] 30-day average criteria based on hardness of water. See Table 7-11 for calculation to determine allowable 30-day average concentration outside the mixing zone.
[d] No designation was made as to whether endosulfan referred to endosulfan I or endosulfan II or the sum total of each.

The remaining COCs for OU4 will have criteria concentration levels based on calculated acute aquatic criteria or chronic aquatic criteria.
</td>
<td></td>
<td></td>
<td></td>
</tr>
</table>

TABLE 2-2

ARARS FOR SILO 3
REMEDIAL ACTION ALTERNATIVES, LOCATION-SPECIFIC

NEPA/EPA	Requirement	ARAR/TBC	Rationale for Implementation
Endangered Species Protection, 50 CFR Part 402 (ORC 1518, 1513.25 and OAC 1501-18-1-01).	Federal agencies must not jeopardize the continued existence of any endangered or threatened species, or destroy or adversely modify critical habitat of such species.	Applicable	The FEMP is located within the range of the Indiana bat, a federally listed endangered species, which has been sighted at the FEMP. Therefore, this requirement is applicable. Any potential impacts of the remedial actions on this species must be evaluated and appropriate action taken.
NEPA/DOE	Requirement	ARAR/TBC	Rationale for Implementation
Compliance with Floodplain/Wetlands Environmental Review Requirements, 10 CFR Part 1022 (Executive Order 11990).	DOE actions in a wetland must first evaluate the potential adverse effects that those actions might have on the wetland and consider the natural and beneficial values served by the wetlands.	Applicable	This requirement is applicable because the FEMP is a DOE facility. Several alternatives might result in destruction or modification of wetland areas.

TABLE 2-3

ARARS FOR SILO 3
REMEDIAL ACTION ALTERNATIVES, ACTION–SPECIFIC

AEA/DOE	Requirement	ARAR/TBC	Rationale for Implementation
10 CFR Part 1021.2	DOE actions must be subjected to NEPA evaluation as outlined by the Council on Environmental Quality regulations in 40 CFR Part 1500-1508.	Applicable	This requirement is applicable because the FEMP is a DOE facility, and this requirement requires NEPA evaluation for specific actions at DOE facilities.
CWA	Requirement	ARAR/TBC	Rationale for Implementation
Nationwide Permit Program, 33 CFR Part 330.	The U.S. Corps of Engineers can issue a Nationwide Permit (NWP) as a general permit for certain classes of actions that involve dredge or fill activities in wetlands or navigable waters. Discharges of dredged or fill material into wetlands may require a wetland delineation.	Applicable	Remediation activities may require construction of access roads and utility lines resulting in minor wetland disturbances. Dredge and fill activities related to construction of these access roads and utility lines will be conducted in accordance with the substantive terms and conditions of NWP 14 (Road Crossing), and NWP 12 (Utility Line Backfill and Bedding). OEPA has been granted Section 401 State Water Quality Certification for NWPs 12 and 14.
Discharge of Stormwater Runoff, 40 CFR Part 122.26 (OAC 3745-38).	Stormwater runoff from landfills, construction sites, and industrial activities must be monitored and controlled. A Stormwater Pollution Prevention Plan is required for construction activities that result in a total land disturbance of five or more acres.	Applicable	Required of industrial waste sites and construction sites of greater than five acres that discharge stormwater runoff to the waters of the U.S. Some remedial alternatives evaluated might disturb more than five acres of land.

TABLE 2-3 (Continued)

CWA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Discharge of Treatment System Effluent, 40 CFR Part 125.100. 40 CFR Part 125.104.	Best Management Practices (BMPs) Development and implementation of a BMP program to prevent the release of toxic or hazardous pollutants to waters of the U.S. Development and implementation of a sitewide BMP Program is also required as a condition of the FEMP National Pollution Discharge Elimination System (NPDES) Permit. The BMP program must: • Establish specific objectives for the control of toxic and hazardous pollutants, and • Include a prediction of direction, rate of flow, and total quantity of toxic and hazardous pollutants where experience indicates a reasonable potential for equipment failure.	Relevant and Appropriate	All of the proposed actions have the potential for releases and runoff from this operable unit (OU).
Safe Drinking Water Act (SDWA)	Requirement	ARAR/TBC	Rationale for Implementation
Ohio Water Well Standards, OAC 3745-9-10.	Abandonment of Test Holes and Wells Upon completion of testing, a test hole or well shall be either completely filled with grout or such material as will prevent contaminants from entering groundwater.	Applicable	Test borings and wells might be installed and/or closed as part of these remedial alternatives.

TABLE 2-3 (Continued)

UMTRCA	Requirement	ARAR/TBC	Rationale for Implementation
Implementation of Health and Environmental Protection Standards for Uranium Mill Tailings, 40 CFR Part 192 Subpart C.	This subpart contains guidance, criteria, and supplemental standards for compliance with Subparts A and B of 40 CFR Part 192.	Relevant and Appropriate	Radioactive materials in this OU 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.
RCRA Subtitle C	Requirement	ARAR/TBC	Rationale for Implementation
Hazardous Waste Determinations, 40 CFR Part 262.11 (OAC 3745-52-11).	Any generator of waste must determine whether or not the waste is hazardous. The procedures for determination include: • Identification of whether a particular material of concern is a “solid waste”; • Identification of whether a particular exclusion applies to the material eliminating it from definition as a “solid waste”; • Identification of whether a particular solid waste might be classified as a hazardous waste; and • Determination of whether a material otherwise classified as a “hazardous waste” might be excluded from RCRA regulation.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	These procedures are established to determine whether wastes are subject to the requirements of RCRA. The materials in Silo 3 are specifically exempt from the applicability of RCRA requirements. However, certain specific RCRA requirements, as identified in the remainder of this table, have been identified as relevant and appropriate to the onsite management (storage, transportation) of Silo 3 material. Hazardous waste determination requirements of 40CFR 262.11 are relevant and appropriate to determine whether wastes generated during remediation of Silo 3 material, such as debris generated during decontamination (e.g., concrete scabbling) must be treated, stored, and disposed in accordance with RCRA.

TABLE 2-3 (Continued)

RCRA Subtitle C	Requirement	ARAR/TBC	Rationale for Implementation
Empty Containers, 40 CFR Part 261.7 (OAC 3745-51-7).	Containers that have held hazardous wastes are "empty" and exempt from further RCRA regulations if one or more of the following are met: • No more than 2.5 cm (1 inch) of residue remains on the bottom of their inner liner; • Less than 3% by weight of total capacity remains (less than or equal to 110 gallon container); and • Less than 0.3% by weight of total capacity remains (greater than 110 gallon container). Containers that have held acutely hazardous ("P" listed) wastes are "empty" and exempt from further RCRA regulation if: • They or their inner liners have been triple rinsed with an adequate solvent or the inner liner has been removed from the container.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Containers used to treat or store the contents of Silo 3 might contain residues that exhibit hazardous waste characteristics which must be removed before the containers might be reused or disposed.
Generators Who Transport Hazardous Waste for Off-site Treatment, Storage, or Disposal; 40 CFR Parts 262.20 - 33 and 263.20 - 31 (OAC 3745-52-20 through 33 and OAC 3745-53-20 through 31).	Any generator who transports hazardous waste for off-site treatment, storage or disposal must originate and follow-up the manifest for off-site shipments.	Applicable	Any residues determined to be RCRA hazardous waste removed from this OU for off-site treatment, storage, or disposal might be subject to the manifest requirements.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Standards; 40 CFR Part 264 Subpart B (OAC 3745-54-13 through 16).	General Standards • Waste Analysis - OAC 3745-54-13: Operators of a facility must obtain a detailed chemical and physical analysis of a representative sample of each hazardous waste to be treated, stored, or disposed of at the facility prior to treatment, storage, or disposal. • Security - OAC 3745-54-14: Operators of a facility must prevent the unknowing or unauthorized entry of persons or livestock into the active portions of the facility, maintain a 24-hour surveillance system, or surround the facility with a controlled access barrier and maintain appropriate warning signs at facility approaches. • Inspections - OAC 3745-54-15: Operators of a facility must: (1) develop a schedule and regularly inspect monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment that are important to preventing, detecting or responding to environmental or human health hazards; (2) promptly or immediately remedy defects; and (3) maintain an inspection log. • Training - OAC 3745-54-16: Operators must train personnel, within six months of their assumption of duties at a facility, in hazardous waste management procedures relevant to their positions, including emergency response training.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Residues that exhibit a characteristic similar to RCRA hazardous waste, removed from this OU, might be treated, stored, and disposed in accordance with TSD facility standards. These requirements are relevant and appropriate because the residues are sufficiently similar to hazardous waste.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Preparedness and Prevention; 40 CFR Part 264 Subpart C and 40 CFR Part 264.31 (OAC 3745-54-31).	Treatment, storage, and disposal facility (TSDF) operators must design, construct, maintain and operate facilities to minimize the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of hazardous waste to air, soil, or surface water which might threaten human health or the environment.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Residues removed from this OU might be treated, stored, and disposed in accordance with TSD facility standards. These requirements are relevant and appropriate because the residues are sufficiently similar to hazardous waste.
40 CFR Part 264.32 (OAC 3745-54-32).	Facilities must be equipped with an internal communication or alarm system, a telephone, or a two-way radio for calling outside to emergency assistance, fire control, and spill control. Decontamination equipment and water must be at an adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems.		
40 CFR Part 264.33 (OAC 3745-54-33).	Fire protection, spill-control and decontamination equipment, and communication and alarm systems must be tested and maintained, as necessary, to ensure proper emergency operation.		
40 CFR Part 264.34 (OAC 3745-54-34).	Personnel must have immediate access to emergency communication or alarm systems whenever hazardous waste is being handled at the facility.		
40 CFR Part 264.35 (OAC 3745-54-35).	Aisle space must be sufficient to allow unobstructed movement of personnel, fire and spill control, and decontamination equipment.		
40 CFR part 264.37 (OAC 3745-54-37).	Operators must attempt to make arrangements, appropriate to the waste handled, for emergency response by local and state fire, police and medical personnel.		

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Treatment, Storage, or Disposal Facility Contingency Plan and Emergency Procedures; 40 CFR Part 264 Subpart D and 40 Part CFR 264.51 (OAC 3745-54-51).	Each facility operator must have a contingency plan designed to minimize hazards to human health or the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to the air, soil, or surface/groundwater.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Residues removed from this OU might be treated, stored, and disposed in accordance with TSD facility standards. These requirements are relevant and appropriate because the materials in Silo 3 are sufficiently similar to hazardous waste.
40 CFR Part 264.52 (OAC 3745-54-52).	Contingency plans should address procedures to implement a response to incidents involving hazardous waste, and provide for: internal and external communications, arrangements with local emergency authorities, an emergency coordinator list, a facility emergency equipment list indicating equipment descriptions and locations, and a facility personnel evacuation plan.		
40 CFR Part 264.55, .56 (OAC 3745-54-55 through 56).	Each facility must have an emergency coordinator who: (1) has responsibility for coordinating emergency response measures; (2) is on the premises or on call at all times; (3) is thoroughly familiar with all aspects of the contingency plan, facility operations, location and characteristics of waste handled, location of pertinent records, and facility layout; and (4) has the authority to commit the resources necessary to implement the contingency plan in the event of an emergency.		

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
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).	An operator must close facilities in a manner that: • Minimizes the need for further maintenance; • Minimizes post-closure escape of hazardous constituents; and • Complies with specific, unit-type closure requirements. Contaminated equipment, structures and soils must be properly disposed and decontaminated. Following closure, a survey plot showing the location of hazardous waste disposal units, with respect to surveyed benchmarks, must be filed with the legal total zoning authority.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	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.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Container Storage, 40 CFR Part 264 Subpart I 40 CFR Part 264.171 - 178 (OAC 3745-55-71 through -78).	Containers of RCRA hazardous waste must be: • Maintained in good condition; • Compatible with hazardous waste to be stored; • Closed during storage (except to add or remove waste); and • Managed in a manner that will not cause the container to rupture or leak. Storage areas must be inspected weekly for leaking and deteriorated containers and containment systems. Containers must be placed on a sloped, crack-free base, and protected from contact with accumulated liquid. A containment system with a capacity of 10 percent of the volume of the largest container of free liquids must be provided. Spilled or leaked waste must be removed in a timely manner to prevent overflow of the containment system. Incompatible materials must be separated. Incompatible materials stored near each other must be separated by a dike or other barrier. At closure, hazardous waste and residue from the containment system must be removed, and containers, liners, bases, and soils must be removed or decontaminated.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	These requirements are relevant and appropriate for alternatives utilizing containers for temporary storage or storage before disposal. These requirements are relevant and appropriate because the residues in the Silo are sufficiently similar to hazardous waste.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Tank Systems, 40 CFR Part 264 Subpart J (OAC 3745-55-91 through 96).	Design, operating standards, and inspection requirements for tank units within which hazardous waste is stored or treated. Includes the following: • Tank design must be compatible with the material being stored. • Tank must be designed and have sufficient strength to store or treat waste in order to ensure that it will not rupture or collapse. • Tank must have secondary containment that is capable of detecting and collecting releases to prevent migration of wastes or accumulated liquids to the environment.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Design criteria, operating standards, and inspections for tank treatment units might be relevant and appropriate for alternatives utilizing treatment or storage in a tank prior to disposal. These requirements are relevant and appropriate because the residues in the Silo are sufficiently similar to hazardous waste.
Closure Requirements for Tanks, 40 CFR Part 264.197 (OAC 3745-55-97).	At closure, the facility owner must do the following: • Remove waste residues; • Remove or decontaminate tank system components; • Remove or decontaminate contaminated soils and structures; • Manage all of the above as hazardous wastes; and • If all contaminated soils cannot be removed, meet the landfill requirements of 40 CFR Part 264.310.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Silo 3 is a tank, according to the definitions of 40 CFR Part 264.10, which contains wastes sufficiently similar to hazardous waste. These requirements are relevant and appropriate because the circumstances and wastes subject to potential release are similar to the releases that RCRA is designed to address. These standards will also pertain to closure of any tanks and appurtenances used to store or treat these residues during remediation.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Miscellaneous Units, 40 CFR Part 264 Subpart X (40 CFR 264.601, .602 and OAC 3745-57-91 and 92).	Environmental performance standard, monitoring, inspection, and post-closure care for treatment in miscellaneous units as defined in 40 CFR Part 260.10.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	Miscellaneous units might be utilized under various alternatives to remediate waste that is sufficiently similar to hazardous wastes.
Corrective Action for Solid Waste Management Units (SWMUs), 40 CFR Part 264 Subpart S and 40 CFR Part 264.552,.553.	Corrective action management units (CAMUs) might be designated at the site as areas where remediation wastes (solid, hazardous, or contaminated media and debris) might be placed during the process of remediation. Temporary units consisting of tanks and container storage units might be used to store and treat hazardous waste during the process of corrective action.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	During the process of remediation, waste materials might require temporary management in containment buildings, temporary units, stockpiles, or other land based units for the purpose of staging, treating or disposing the material. Materials generated from remediation of the Silo 3 material are considered remediation wastes. Some of the waste material might exhibit a RCRA characteristic, or otherwise be sufficiently similar to hazardous waste to make this requirement relevant and appropriate.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Containment Buildings, 40 CFR Part 264 Subpart DD and 40 CFR Part 264.1101, .1102.	Hazardous waste and debris might be placed into units known as containment buildings for the purpose of interim storage or treatment. Containment buildings must be fully enclosed to prevent exposure to the elements and ensure containment of managed wastes. Floor and containment walls must be designed and constructed of materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit. Surfaces coming in contact with hazardous waste must be chemically compatible with waste. Primary barriers must be constructed to prevent migration of hazardous constituents into barrier. Secondary containment systems including secondary barriers and leak detection systems must also be constructed for containment buildings used to manage wastes containing free liquids. Controls must be implemented to ensure: the primary barrier is free of significant cracks, corrosion, or other deterioration that may allow release of hazardous waste; the level of hazardous waste does not exceed height of containment walls and is otherwise maintained within containment walls; tracking of waste out of unit by personnel or equipment used in handling waste is prevented; and fugitive dust emissions are controlled at the level of no visible emissions.	Relevant and Appropriate (This requirement will be applicable to non-excluded solid wastes that exhibit a hazardous characteristic.)	During the process of remediation, waste materials might require temporary management for the purpose of staging or treating the material. Some of the waste material might exhibit a RCRA characteristic, or otherwise be sufficiently similar to hazardous waste to make this requirement relevant and appropriate.

TABLE 2-3 (Continued)

RCRA Subtitle C (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Radiation Dose Limit (All Pathways), Proposed 10 CFR Part 834.	The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an EDE greater than 100 mrem from all exposure pathways.	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.
CAA	Requirement	ARAR/TBC	Rationale for Implementation
Control of Fugitive Dust, OAC 3745-17-08.	Visible emissions of fugitive dust generated during grading, loading, or construction operations and other practices that emit fugitive dust shall be minimized or eliminated.	Relevant and Appropriate	The implementation of remedial action alternatives will require the movement of dirt and other material likely to result in fugitive dust emissions. This requirement is relevant and appropriate because the FEMP is not located in an area subject to this regulation.
Prevention of Air Pollution Nuisance, ORC 3704.01-.05 and OAC 3745-15-07.	Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared a public nuisance and is prohibited.	Applicable	During the remediation process, some potential exists for emissions of radionuclides and toxic chemicals to the air, which might endanger individuals or damage property.

TABLE 2-3 (Continued)

CAA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Control of Visible Particulate Emissions from Stationary Sources, OAC 3745-17-07.	Discharge of particulate emissions of a shade or density greater than 20 percent opacity into ambient air from any stack is prohibited. Transient limits are included in this regulation.	Applicable	Treatment operations for various alternatives might result in the release of particulate material.
Permit to Install, OAC 3745-31-05(A)(3).	The director shall issue a permit to install if he/she determines that the installation or modification and operation of the air contaminant source will employ the best available technology.	Relevant and Appropriate	Although an administrative permit to install is not required for alternatives involving treatment, the substantive requirements of this section must be met by employing Best Available Technology (BAT) for treating particulate and other off-gas emissions.

TABLE 2-3 (Continued)

CAA (continued)	Requirement	ARAR/TBC	Rationale for Implementation
Restrictions on Particulate Emissions from Industrial Processes, OAC 3745-17-11.	This requirement establishes numerical emission release limits for particulate material from industrial sources. Any source (operation, process, or activity) shall be operated so that particulate emissions do not exceed allowable emission rates specified in this regulation [based on processing weights (Table 1) or uncontrolled mass rate of emissions (Figure II) of OAC 3745-17-11]. A source complies with Table 1 requirements if its rate of particulate emission is always equal to or less than the allowable rate of particulate emission based on the maximum capacity of the source: Process Rate at Maximum Capacity (lb/hr) — Allowable Rate of Particulate Emission (lb/hr)[1] -- 100 — 0.551 200 — 0.877 400 — 1.40 600 — 1.83 800 — 2.22 1000 — 2.58 -- [1] Excerpted from Table 1 of OAC 3745-17-11.	Applicable	Treatment operations for various alternatives might result in release of particulate material that might exceed these standards.

TABLE 2-4

OTHER REQUIREMENTS FOR SILO 3 REMEDIAL ACTION ALTERNATIVES

Title	Requirement	Rationale for Implementation
OSHA Worker Protection Requirements, 29 CFR Parts 1904 and 1910.	Establishes requirements to protect workers who could be exposed to radiation, noise, hazardous wastes, or other contaminants or hazards at the remediation site.	This OU is a remediation site under CERCLA. Compliance with 29 CFR Part 1910.120 is required for sites undergoing remediation by 40 CFR Part 300.150.
DOT Requirements for Transportation of Hazardous Materials, 49 CFR Parts 171-173, 177, 178.	Hazardous materials may not be transported on public highways except in accordance with these regulations: • Part 171, General Requirements. • Part 172, this part establishes shipping papers, marking, labeling, placarding, and emergency response information requirements. • Part 173, this part establishes packaging and other shipping requirements for hazardous materials, including radioactive materials. • Part 177, Requirements of the Transporter. • Part 178, Specifications for Shipping Containers.	Applicable to those alternatives which involve transportation of the waste materials off-site. Radioactive materials and materials sufficiently similar to hazardous wastes might be shipped off-site.
Highway Improvement Act of 1982, 23 USC 127.	Establishes vehicle weight limits for interstate highways.	Applicable to those alternatives which involve transportation of the waste materials off-site.
Hazardous Materials Transportation Act, 49 USC 1801-1812.	Establishes requirements for minimizing environmental impacts of spills or releases of hazardous materials.	Applicable to those alternatives which involve transportation of the waste materials off-site. Radioactive materials and materials sufficiently similar to hazardous wastes might be shipped off-site.

TABLE 2-4 (Continued)

Title	Requirement	Rationale for Implementation
NTS Waste Acceptance Criteria.	Establishes which wastes may be disposed at a facility.	The NTS waste acceptance criteria would be applicable to disposals at the NTS. NTS operates under DOE Order 435.1, "Radioactive Waste Management."
National Historic Preservation Act, 16 USC 470 et seq.	Protects sites listed or eligible for listing in the National Register of Historic Places.	Required by law for the alternatives affected.
Archaeological and Historic Preservation Act, 16 USC 469.	Preserves artifacts and data associated with archaeological finds.	Required by law for the alternatives affected.
American Indian Religious Freedom Act, 25 USC 1996.	Provides for tribal access by native peoples to grave sites and sites of cultural, symbolic, or religious significance.	Required by law for the alternatives affected.
Native American Graves Protection and Repatriation Act, 25 USC 3001.	Provides for return of human remains and cultural objects from Native American graves to affiliated tribes.	Required by law for the alternatives affected.
Protection and Enhancement of Cultural Environment, Executive Order 11593.	Requires inventory of site for potential historic places for eligibility in the National Register of Historic Places.	Required by law for the alternatives affected.
Fish and Wildlife Coordination Act, 16 USC 66 et seq.	Requires consultation with other state agencies on activities that might affect any body of water for the conservation of fish and wildlife resources.	Required by law for the alternatives affected.

TABLE 2-4 (Continued)

Title	Requirement	Rationale for Implementation
Archaeological Resources Protection Act, 16 USC 470 (a).	Requires permit for removal of any archaeological resources from federal lands.	Required by law for the alternatives affected.
Antiquities Act and Historic Sites Act, 16 USC 431-433 and 16 USC 461-467.	Requires identification and preservation of cultural resources on federal lands; includes natural landmarks.	Required by law for the alternatives affected.
Farmland Protection Policy Act, 7 USC 4201 et. Seq.	Requires protection and maintenance of farmland for its beneficial use as a national resource.	Required by law for the alternatives affected.
Occupational Radiation Protection, 10 CFR Part 835.	Provides standards for occupational radiation protection of workers at DOE facilities.	Required by law for safety and worker protection at DOE facilities (replaces former DOE Order 5480.11).
DOE Order	Title	Rationale for Implementation
5400.3	Hazardous and Mixed Waste Program	Contractual obligation for activities at DOE facilities.
5400.5	Radiation Protection of the Public and the Environment	Contractual obligation for activities at DOE facilities.
451.1A	NEPA Compliance Program	Contractual obligation for activities at DOE facilities.
5480.1B	Environmental, Safety, and Health Program for DOE Operations	Contractual obligation for activities at DOE facilities.
460.1A	Packaging and Transportation Safety	Contractual obligation for activities at DOE facilities.
460.2	Departmental Materials Transportation and Packaging Management	Contractual obligation for activities at DOE facilities.

Table 2-4 (Continued)

DOE Order	Title	Rationale for Implementation
5480.4	Environmental Protection, Safety, and Health Protection Standards	Contractual obligation for activities at DOE facilities.
440.1A	Worker Protection for DOE Federal and Contractor Employees	Contractual obligation for activities at DOE facilities.
435.1	Radioactive Waste Management	Contractual obligation for activities at DOE facilities.
414.1	Quality Assurance	Contractual obligation for activities at DOE facilities.
430.1A	Life Cycle Asset Management	Contractual obligation for activities at DOE facilities.

ATTACHMENT 3

TRANSPORTATION RISK EVALUATION FOR SILO 3 REMEDIAL ACTION

ATTACHMENT 3
TRANSPORTATION RISK EVALUATION

As supporting backup for the Silo 3 Proposed Plan, this attachment provides an evaluation of the short-term radiological risks accompanying the transportation of Silo 3 material from the Fernald Environmental Management Project (FEMP) to an off-site disposal facility.

OBJECTIVES AND APPROACH

The transportation risks were evaluated to permit a technical comparison of the two alternatives described in the Silo 3 Proposed Plan:

- The currently-approved Silo 3 remedy, which involves treatment via chemical stabilization/solidification or polymer encapsulation to achieve RCRA TCLP performance standards; and
- The proposed revised Silo 3 remedy, which involves a best-management approach to reduce the dispersability and leachability of the Silo 3 wastes through the addition of liquid reagents as a pre-packaging step. As part of the proposed revised remedy, a contingency action to double package the Silo 3 wastes will be implemented in the event the addition of the liquid reagents causes operational difficulty and is discontinued. For this proposed remedy, no credit was taken for the potential reduction in dispersability of Silo 3 wastes that might result from the addition of the reagents or from double packaging.

The radiological risks to the public and workers during transportation were calculated using the RADTRAN5 computer model and code developed by Sandia National Laboratories. RADTRAN5 estimates radiation doses to populations from routine (accident-free) transportation, dose risk from potential transportation accidents, and maximum exposed individual dose estimates. Calculation of accident-free population dose considers persons residing adjacent to the route, persons in vehicles sharing the route, and persons at stops. Potential dose risks are also calculated for populations that are downwind from hypothetical releases associated with accidents of varying severity. Dose risk from an accident includes the conditional probability of an accident of a particular severity. The population dose risk units are reported in person-rem.

To permit a fair comparison of the two alternatives, the mode of transportation was assumed for both alternatives to be direct truck shipments from the FEMP to the Nevada Test Site (NTS). To support other ongoing evaluations at the FEMP, this attachment also provides an evaluation of risks associated with other modes of transportation, and an alternate disposal location. The other transportation modes included an intermodal option (combined rail and truck) to the NTS, a direct truck option to a representative permitted commercial disposal facility (PCDF), and a direct rail option to a PCDF. For purposes of this evaluation, Envirocare of Utah was identified as a representative PCDF. For all the evaluations, this attachment provides a detailed discussion of the model input parameters, key assumptions, and the model outputs that in turn support the short-term risk assessment findings in the Proposed Plan.

KEY ASSUMPTIONS FOR THE MODEL

This section summarizes the model assumptions and inputs based on the Silo 3 preliminary design concepts, coupled with regulatory-based and weight-based transportation requirements for safe waste transport.

For both alternatives evaluated, it was assumed that the Silo 3 material would be loaded into soft-sided containers that are then overpacked into cargo containers (Sea/Lands) for ease of handling and shipping operations. For direct truck shipments, it was assumed that seven soft-sided containers would be placed into the Sea/Land and that each truck shipment would consist of one Sea/Land container. For direct rail shipments, it was assumed that nine soft-sided containers would be placed into the Sea/Land and that each flatcar would consist of four Sea/Land containers. For intermodal shipments, it was assumed that seven soft-sided containers would be placed into each Sea/Land container. Only seven soft-sided containers would be placed into a Sea/Land container for intermodal due to the legal weight limitations for truck shipments. For the rail leg of the intermodal shipments, four Sea/Land containers would be placed onto a flatcar, and for the truck leg of the intermodal shipments, one Sea/Land container would be placed onto each truck.

Based on the treated waste volume, the currently approved remedy will require an estimated 2810 soft-sided containers. With seven soft-sided containers per Sea/land, 402 truck shipments will be required to transport the Silo 3 material to the NTS. Intermodal shipments would consist of 101 rail shipments and 402 truck shipments. Direct rail would consist of 79 rail shipments.

For the proposed revised remedy, an estimated 1910 soft-sided containers will be required. With seven soft-sided containers per Sea/Land, 273 truck shipments will be required to transport Silo 3 material to the NTS. Intermodal shipments would consist of 69 rail shipments and 273 truck shipments. Direct rail shipments would consist of 54 rail shipments. As a conservative assumption for the proposed revised remedy, no credit was taken in the model for any potential reduction in dispersability of the Silo 3 material resulting from the addition of the planned additives, or the contingency double packaging, that are both part of the proposal. In effect, the material was modeled as untreated material. It is understood that the addition of the additives (and the contingency double packaging, if found to be necessary), will result in an incremental benefit that is considered important to the FEMP and its stakeholders. However, no attempt was made to capture this benefit quantitatively in the model, which therefore results in a conservative projection of risk for the proposed revision.

Proposed Transportation Routes

Truck Shipments to NTS. The proposed truck route to NTS consists of traveling State Route (SR) 128 in Ohio to the Interstate (I)-74 interchange then heading northwest on I-74 to the I-70 interchange in Indianapolis, Indiana. Trucks would then travel on I-70 through western Indiana and Illinois to the I-270 bypass north of St. Louis, Missouri. Trucks would then continue on I-70 to the I-435 interchange just east of Kansas City, Missouri. Shipments would travel north on 1-435 to the I-29 interchange and continue north on I-29 to Nebraska SR 41. Trucks would continue west on SR-41 to north on United States (US) 77 to the I-80 interchange just west of Lincoln, Nebraska. Trucks would then continue on I-80 west through Nebraska, Wyoming, Utah, and into Nevada. In Nevada, trucks would travel south on alternate US 93 to the US 6 interchange in Ely, Nevada, to the US 95 interchange in Tonopah to the NTS.

This route would pass through the following major cities: Indianapolis, Indiana; St. Louis Missouri; Kansas City, Missouri; St. Joseph, Missouri; Lincoln, Nebraska; Cheyenne, Wyoming; and Salt Lake City, Utah. Truck routes would use interstate bypasses, where such bypasses exist.

Intermodal Shipments to NTS. The rail portion of the intermodal shipments would follow the same route currently being used by the waste Pits Remedial Action Project (WPRAP). The rail carrier would switch from CSX to Union Pacific in East St. Louis, Illinois. Shipments would switch to truck at an intermodal facility in Milford, Utah. From Milford, Utah, truck shipments would travel north SR 21 in Utah to SR 487 in Nevada. Trucks would continue on SR 487 to west onto US 6/50 to north on US 93 to the US 6 interchange in Ely, Nevada. Shipments would continue west on US 6 to the US 95 interchange in Tonopah and continue south on US 95 to the NTS.

Truck Shipments to Envirocare of Utah. The proposed truck route to Envirocare of Utah consists of traveling State Route (SR) 128 in Ohio to the Interstate (I)-74 interchange then heading northwest on I-74 to the I-70 interchange in Indianapolis, Indiana. Trucks would then travel on I-70 through western Indiana and Illinois to the I-270 bypass north of St. Louis, Missouri. Trucks would then continue on I-70 to the I-435 interchange just east of Kansas City, Missouri. Shipments would travel north on I-435 to the I-29 interchange and continue north on I-29 to Nebraska SR 41. Trucks would continue west on SR-41 to north on United States (US) 77 to the I-80 interchange just west of Lincoln, Nebraska. Trucks would then continue on I-80 west through Nebraska, Wyoming, into Utah. In Utah, trucks would continue on I-80 into Tooele County and take local roads to Clive, Utah and Envirocare of Utah.

This route would pass through the following major cities: Indianapolis, Indiana; St. Louis Missouri; Kansas City, Missouri; St. Joseph, Missouri; Lincoln, Nebraska; Cheyenne, Wyoming; and Salt Lake City, Utah. Truck routes would use interstate bypasses, where such bypasses exist.

Direct Rail Shipments to Envirocare of Utah. Direct rail shipments to Envirocare would follow the same route currently being used by the WPRAP. Rail carrier would switch from CSX to Union Pacific in East St. Louis, Illinois.

RISK EVALUATION – MODEL INPUTS

The U.S. Department of Transportation (DOT) requires carriers to utilize routes that minimize radiological risk when transporting radioactive material (DOT Class 7 hazardous material). When determining radiological risk, the DOT regulation 49 Code of Federal Regulation (CFR) Part 397.101(a)(2) requires the carrier to consider available information, such as, accident rates, population densities, and transit time.

RADTRAN5 relies on various parameters, which are defined by the user, for calculating dose. This information relates to the radioactive material, the package, the vehicle, and the route. It includes parameters for the number of shipments, the number of containers per shipment, the radionuclide content of the container, the radiation dose associated with the container, and the radiation dose associated with the shipment. Table 1 presents the user-defined package-specific and vehicle-specific parameters associated with the proposed transportation routes. Where possible, “standard” RADTRAN5 values for parameters were used if they were not specific to the radioactive material, package, vehicle, or route.

TABLE 1
PACKAGE-SPECIFIC AND VEHICLE-SPECIFIC PARAMETERS FOR RADTRAN5 ANALYSIS

PARAMETER	DIRECT TRUCK		INTERMODAL		DIRECT RAIL	
	CURRENTLY APPROVED REMEDY	PROPOSED REVISED REMEDY	CURRENTLY APPROVED REMEDY	PROPOSED REVISED REMEDY	CURRENTLY APPROVED REMEDY	PROPOSED REVISED REMEDY
Number of Shipments	402	273	101 rail 402 truck	69 rail 273 truck	79	54
Number of Overpack Containers per Shipment	1	1	4 rail 1 truck	4 rail 1 truck	4	4
Characteristic Package Dimension (m)	7.08	7.08	7.08	7.08	7.08	7.08
Dose Rate 1 m from Vehicle (mrem/hr)	0.96	3.1	0.92 rail 0.96 truck	2.5 rail 3.1 truck	1.13	2.5
Characteristic Vehicle Dimension (m)	7.08	7.08	28.32 rail 7.08 truck	28.32 rail 7.08 truck	28.32	28.32
Number of Crew Members	2	2	2	2	2	2
Average Distance from Package to Crew Members (m)	4.9	4.9	4.9 truck only	4.9 truck only	N/A	N/A
Crew View Package Dimension (m)	3.56	3.56	3.56 truck only	3.56 truck only	N/A	N/A

Table 2 presents the radionuclide input parameters for RADTRAN5. For purposes of the modeling, the radionuclide chains were broken down into sub-chains of the main radionuclides: Ac-227, Pa-231, Pb210, Ra-226, Th-228, Th-230, U-235, and U-238. Table 3 then provides the radionuclide content per Sea/Land container for both alternatives. As stated previously, it is assumed that seven - 3 yd^3 soft-sided containers are placed in a Sea/Land container for truck and intermodal shipments and nine – 3 yd^3 soft-sided containers are placed in a Sea/Land for direct rail shipments.

TABLE 2
RADIONUCLIDE PARAMETERS

Radionuclide	U-238	U-235	Th-232	Th-230	Ac-227	Ra-226	Pa-231	Pb-210
Half-life (days)	1.63E+12	2.57E+11	5.11E+12	2.81E+07	7.95E+03	5.84E+05	1.20E+07	8.14E+03
Photon Energy (meV/dis)	2.37E-02	2.69E-02	2.68E+00	1.55E-03	4.27E-01	1.72E+00	1.50E-02	4.81E-03
Cloud Shine DCF (rem-m^3/Ci-sec)	3.17E-03	2.62E-02	4.18E-01	6.44E-05	5.41E-02	2.98E-01	4.70E-03	2.13E-04
Ground Shine DCF (rem-m^2/Ci-sec)	9.56E-06	5.33E-05	7.27E-04	2.40E-07	1.24E-04	4.44E-04	1.30E-05	1.13E-06
CEDE Inhalation DCF (rem/Ci)	2.51E+08	1.23E+08	7.91E+08	2.85E+08	6.61E+08	1.40E+08	8.58E+08	2.30E+07
CEDE Inhalation DCF to gonads (rem/Ci)	1.92E+04	1.05E+04	3.03E+06	6.48E+05	4.22E+07	4.61E+06	1.13E+04	2.67E+06
One Year Lung DCF (rem/Ci)	1.25E+09	6.13E+08	3.29E+09	6.66E+08	1.42E+09	6.76E+08	1.66E+09	2.33E+06
One Year Marrow DCF (rem/Ci)	3.14E+05	1.59E+05	1.69E+08	1.55E+08	1.58E+08	2.84E+06	6.39E+08	9.22E+06

TABLE 3
RADIONUCLIDE CONTENTS FOR TRANSPORTATION OPTIONS

Radionuclide	Raw Material pCi/g	Curies per Overpack Container			
		Currently Approved Remedy		Proposed Revised Remedy	
		Truck/Intermodal	Rail	Truck/Intermodal	Rail
Ac-227	925	5.70E-03	7.33E-03	1.36E-02	1.53E-02
Pa-231	627	3.86E-03	4.97E-03	9.21E-03	1.04E-02
Pb-210	3,480	2.14E-02	2.76E-02	5.11E-02	5.75E-02
Ra-226	3,870	2.38E-02	3.06E-02	5.69E-02	6.40E-02
Th-228	747	5.19E-03	6.67E-03	1.10E-02	1.24E-02
Th-230	60,200	3.71E-01	4.77E-01	8.85E-01	9.95E-01
U-235	117	7.21E-04	9.27E-04	1.72E-03	1.93E-03
U-238	1,780	1.10E-02	l .41E-02	2.62E-02	2.94E-02

RADTRAN5 requires data that expresses the likelihood of accidents of a given severity for urban, suburban, and rural population areas. These conditional probabilities are called “severity fractions” in RADTRAN, and there is an indexed “severity category” corresponding to each severity fraction. For each accident severity category, the user inputs data on the fraction of material that could be expected to be released from a container during an accident, the fraction of material released that can become airborne, and the fraction of airborne material that can become respirable. The accident release fractions for treated and untreated Silo 3 material is presented in Tables 4 and 5, respectively. For the currently approved remedy, airborne fraction and release fraction were obtained from the “ASME Technical Peer

Review Report on Airborne Release Fractions.” For the proposed remedy, no credit was taken for any reduction in dispersability that may have resulted from the addition of additives to control dispersion. The airborne release fraction of 0.01 is the interim “bounding value” recommended for powders by the ASME in their Peer Review of DOE-HDBK-3010-94 *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. The respirable fraction is the calculated mean fraction, of Silo 3 material, that has a particle size of less than 10 µm.

TABLE 4
ACCIDENT RELEASE FRACTIONS – CURRENTLY APPROVED REMEDY

Severity Category	Release Fraction	Airborne Fraction	Respirable Fraction
1	0.0	N/A	N/A
2	0	N/A	N/A
3	3.125E-02	1.0E-04	5.0E-02
4	6.25E-02	1.0E-04	5.0E-02
5	1.25E-01	1.0E-04	5.0E-02
6	2.50E-01	1.0E-04	5.0E-02
7	5.00E-01	1.0E-04	5.0E-02
8	1	1.0E-04	5.0E-02

TABLE 5
ACCIDENT RELEASE FRACTIONS – PROPOSED REVISED REMEDY

Severity Category	Release Fraction	Airborne Fraction	Respirable Fraction
1	0.0	N/A	N/A
2	0.0	N/A	N/A
3	3.125E-02	1.0E-02	3.6E-0l
4	6.25E-02	1.0E-02	3.6E-0l
5	1.25E-01	1.0E-02	3.6E-01
6	2.50E-01	1.0E-02	3.6E-0l
7	5.00E-01	1.0E-02	3.6E-01
8	1	1.0E-02	3.6E-01

RISK EVALUATION – MODEL RESULTS

As stated previously, RADTRAN5 estimates the dose-risk to the public resulting from accident-free transport of radiological material and dose-risk to populations that are downwind from hypothetical releases associated with accidents of varying severity.

Tables 6 and 7 present data on the estimated dose received by the maximally exposed individual and the cumulative dose received by the public resulting from accident-free transport of Silo 3 material, respectively. Table 7 also presents the estimated exposed population, which includes the population residing adjacent to the route, the population sharing the route, and the population at or near the rest stops.

TABLE 6
ESTIMATED DOSE TO MAXIMUM EXPOSED INDIVIDUAL (REM) – ACCIDENT FREE TRANSPORT

Route		Currently Approved Remedy	Proposed Revised Remedy
Direct Truck to NTS		2.17E-05	4.76E-05
Intermodal to NTS	Rail	2.51E-05	4.66E-05
	Truck	2.17E-05	4.76E-05
Direct Truck to Envirocare		2.17E-05	4.76E-05
Direct Rail to Envirocare		2.41E-05	3.65E-05

TABLE 7
ESTIMATED CUMULATIVE DOSE TO EXPOSED POPULATION – ACCIDENT FREE TRANSPORT

Route	Currently Approved Remedy		Proposed Revised Remedy	
	Dose (person-rem)	Population	Dose (person-rem)	Population
Direct Truck to NTS	1.72	1.04E+06	3.78	1.04E+06
Intermodal to NTS	0.72	1.06E+06	1.37	1.06E+06
Direct Truck to Envirocare	1.43	7.81E+05	3.13	7.81E+05
Direct Rail to Envirocare	0.58	9.87E+05	0.88	9.87E+05

For determining the incremental lifetime cancer risk (ILCR), the cumulative dose was evenly distributed amongst the exposed population to provide an average dose per individual. This was determined to be a reasonably exposed individual for calculating the ILCR compared to using the maximum exposed individual. The maximum exposed individual assumes one person is standing in the same spot for all shipments and is exposed to all shipments without the benefit of shielding, even from a building. This is not a realistic scenario to expect during transportation of the Silo 3 material and is considered inconsistent with the intent of the definition of a reasonably exposed individual presented in the NCP. Therefore, the ILCR was calculated using an even distribution of the cumulative dose over the exposed population.

The risk from exposure to ionizing radiation is measured in latent cancer fatalities (LCF), which is the number of potential cancer fatalities estimated as a result of radiation exposure. An incremental lifetime cancer risk (ILCR) - the increased potential of an individual developing a cancer over a lifetime as a result of exposure - can be determined by comparing the potential number of cancers against the total exposed population. LCFs are calculated by Eq.1.

$$LCF = H_E \bullet CRF \qquad \text{(Eq.1)}$$

where,

H_E = collective effective dose equivalent for exposed population
LCF = latent cancer fatalities
CRF = cancer risk factor, LCF/person-rem

The cancer risk factor for members of the public is 5 x 10^{-4} per rem. These values are used in the RADTRAN5 computer model and are from the latest edition of ICRP-30.

Table 8 presents the estimated ILCRs calculated for the reasonably exposed individual resulting from the dose received during accident-free transportation. The dose to the reasonably exposed individual was calculated by evenly distributing the cumulative dose over the exposed population to derive an average dose.

TABLE 8
ILCR FOR REASONABLY EXPOSED MEMBER OF PUBLIC – ACCIDENT FREE TRANSPORT

Route	Currently Approved Remedy		Proposed Revised Remedy	
	Dose (person-rem)	ILCR	Dose (person-rem)	ILCR
Direct Truck to NTS	1.65E-06	8.27E-10	3.63E-06	1.82E-09
Intermodal to NTS	6.79E-07	3.40E-10	1.29E-06	6.45E-10
Direct Truck to Envirocare	1.83E-06	9.15E-10	4.01E-06	2.01E-09
Direct Rail to Envirocare	5.88E-07	2.94E-10	8.87E-07	4.43E-10

RADTRAN5 also calculates the dose risk to the public based on exposure from a hypothetical accident. Dose risk from an accident includes the conditional probability of an accident of a particular severity. The population dose risk units are reported in person-rem. As with accident-free transportation, the resulting dose-risk is a cumulative dose over an exposed population. The cumulative dose is determined from the sum of the product of the probability of an accident occurring and the resulting dose to the public from the accident. As stated previously, there are eight classes of severity for accidents ranging from high probability, low consequence accidents (Severity Class 1) to low probability, high consequence accidents (Severity Class 8). Class 1 and 2 accidents do not result in any exposure to the public because the container remains intact. Classes 3 through 8 result in increased exposure do to the increased amount of material released from the package, which at a Severity Class 8 is a total loss of containment of all packages in the Sea/Land container. Tables 9 through 16 present the estimated risk to the population resulting from a hypothetical accident for each treatment and transportation alternative. The tables present the probability of a specific severity category accident occurring, the dose-risk to the exposed population resulting from the accident, and the ILCR assuming an even distribution of dose across the exposed population.

TABLE 9
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT TRUCK TO THE NTS CURRENTLY APPROVED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	4.54E+05
Rural	1.33E+04
Urban	3.16E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	1.69E-02	6.40E-02	3.52E-04	8.76E-04	2.55E-05	3.92E-03	9.64E-13	9.57E-13	6.20E-13
4	3.88E-03	1.47E-02	8.05E-05	1.75E-03	5.10E-05	7.86E-03	1.92E-12	1.92E-12	1.24E-12
5	5.09E-04	4.29E-03	9.40E-06	3.50E-03	1.02E-04	1.57E-02	3.85E-12	3.84E-12	2.49E-12
6	1.33E-04	2.35E-03	1.85E-06	7.01E-03	2.05E-04	3.14E-02	7.72E-12	7.69E-12	4.97E-12
7	5.15E-06	2.08E-04	1.43E-07	1.40E-02	4.08E-04	6.29E-02	1.54E-11	1.53E-11	9.96E-12
8	4.54E-07	4.11E-05	1.26E-08	2.80E-02	8.18E-04	1.25E-01	3.08E-11	3.07E-11	1.98E-11

TABLE 10
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT INTERMODAL TO THE NTS CURRENTLY APPROVED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

	Rail	Truck
Suburban	5.43E+05	4.24E+05
Rural	9.53E+03	1.11E+04
Urban	3.23E+06	3.27E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	3.43E-02	1.75E-02	1.33E-02	4.05E-03	5.41E-05	1.60E-02	2.10E-12	1.31E-12	1.23E-12
4	3.58E-03	2.58E-03	1.34E-03	7.88E-03	8.72E-05	3.19E-02	4.07E-12	2.11E-12	2.45E-12
5	2.83E-04	6.15E-04	8.91E-05	1.51E-02	1.48E-04	6.39E-02	7.80E-12	3.58E-12	4.91E-12
6	2.10E-05	2.56E-04	3.32E-06	2.19E-02	2.00E-04	1.25E-01	1.13E-11	4.86E-12	9.62E-12
7	3.12E-06	3.07E-05	1.49E-06	6.09E-02	6.06E-04	2.54E-01	3.15E-11	1.47E-11	1.96E-11
8	2.61E-07	5.97E-06	1.24E-07	1.21E-01	1.20E-03	5.10E-01	6.26E-11	2.90E-11	3.93E-11

TABLE 11
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT TRUCK TO THE NTS PROPOSED REVISED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	4.54E+05
Rural	1.33E+04
Urban	3.16E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	1.15E-02	4.35E-02	2.39E-04	1.24E+00	3.63E-02	5.61E+00	1.37E-09	1.36E-09	8.88E-10
4	2.63E-03	9.95E-03	5.47E-05	2.49E+00	7.28E-02	1.12E+01	2.74E-09	2.74E-09	1.77E-09
5	3.45E-04	2.91E-03	6.38E-06	5.01E+00	1.46E-01	2.24E+01	5.52E-09	5.50E-09	3.54E-09
6	9.05E-05	1.60E-03	1.26E-06	9.97E+00	2.91E-01	4.46E+01	1.10E-08	1.09E-08	7.06E-09
7	3.50E-06	1.14E-04	9.72E-08	1.99E+01	7.20E-01	8.96E+01	2.19E-08	2.71E-08	1.42E-08
8	3.09E-07	2.79E-05	8.55E-09	3.98E+01	1.16E+00	1.79E+02	4.38E-08	4.36E-08	2.83E-08

TABLE 12
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT INTERMODAL TO THE NTS PROPOSED REVISED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

	Rail	Truck
Suburban	5.43E+05	4.24E+05
Rural	9.53E+03	1.11E+04
Urban	3.23E+06	3.27E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	2.80E-02	1.19E-02	9.10E-03	4.86E+00	7.74E-02	2.27E+01	2.51E-09	1.88E-09	1.74E-09
4	2.45E-03	1.76E-03	9.12E-04	1.12E+01	1.24E-01	4.55E+01	5.79E-09	3.01E-09	3.48E-09
5	1.93E-04	4.19E-04	6.09E-05	2.16E+01	2.10E-01	9.10E+01	1.12E-08	5.09E-09	6.97E-09
6	1.43E-05	1.74E-04	2.27E-06	3.13E+01	2.85E-01	1.78E+02	1.62E-08	6.91E-09	1.36E-08
7	2.13E-06	2.09E-05	1.02E-06	8.64E+01	8.18E-01	3.63E+02	4.47E-08	1.98E-08	2.78E-08
8	1.78E-07	4.07E-06	8.47E-08	3.63E+02	1.70E+00	7.27E+02	1.88E-07	4.12E-08	5.57E-08

TABLE 13
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT TRUCK TO ENVIROCARE CURRENTLY APPROVED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	4.48E+05
Rural	1.37E+04
Urban	3.07E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	1.38E-02	5.01E-02	2.51E-04	8.62E-04	2.65E-05	3.82E-03	9.62E-13	9.69E-13	6.22E-13
4	3.15E-03	1.15E-02	5.75E-05	1.73E-03	5.29E-05	7.63E-03	1.93E-12	1.93E-12	1.24E-12
5	4.14E-04	3.36E-03	6.71E-06	3.45E-03	1.06E-04	1.54E-02	3.86E-12	3.87E-12	2.50E-12
6	1.08E-04	1.84E-03	1.32E-06	6.94E-03	2.12E-04	3.06E-02	7.74E-12	7.74E-12	4.98E-12
7	4.19E-06	1.63E-04	1.02E-07	1.38E-02	4.23E-04	6.13E-02	1.54E-11	1.54E-11	9.98E-12
8	3.69E-07	3.22E-05	8.99E-09	2.76E-02	8.48E-04	1.22E-01	3.09E-11	3.09E-11	1.99E-11

TABLE 14
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT RAIL TO ENVIROCARE CURRENTLY APPROVED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	5.44E+05
Rural	1.04E+04
Urban	3.26E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	2.58E-02	7.82E-03	1.04E-02	5.39E-03	1.00E-04	2.06E-02	4.95E-12	4.81E-12	3.16E-12
4	2.58E-03	7.82E-04	1.04E-03	1.08E-02	2.01E-04	4.12E-02	9.90E-12	9.65E-12	6.31E-12
5	1.94E-04	1.30E-04	6.91E-05	2.15E-02	4.02E-04	8.25E-02	1.98E-11	1.93E-11	1.27E-11
6	9.34E-06	1.32E-05	2.50E-06	4.30E-02	8.03E-04	1.65E-01	3.96E-11	3.86E-11	2.53E-11
7	2.15E-06	6.95E-06	1.15E-06	8.65E-02	1.60E-03	3.30E-01	7.95E-11	7.68E-11	5.07E-11
8	1.79E-07	1.30E-06	9.62E-08	1.73E-01	3.22E-03	6.59E-01	1.59E-10	1.55E-10	1.01E-10

TABLE 15
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT TRUCK TO ENVIROCARE PROPOSED REVISED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	4.48E+05
Rural	1.37E+04
Urban	3.07E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	9.35E-03	3.41E-02	1.71E-03	1.23E+00	3.75E-02	5.43E+00	1.37E-09	1.37E-09	8.84E-10
4	2.14E-03	7.80E-03	3.91E-05	2.46E+00	7.54E-02	1.09E+01	2.75E-09	2.75E-09	1.78E-09
5	2.81E-04	2.28E-03	5.56E-06	4.91E+00	1.51E-01	1.78E+01	5.48E-09	5.51E-09	2.90E-09
6	7.36E-05	1.25E-03	8.97E-07	9.85E+00	3.02E-01	4.36E+01	1.10E-08	1.10E-08	7.10E-09
7	2.84E-06	1.10E-04	6.94E-08	1.97E+01	6.06E-01	8.70E+01	2.20E-08	2.21E-08	1.42E-08
8	2.51E-07	2.19E-05	6.11E-09	3.94E+01	1.21E+00	1.73E+02	4.40E-08	4.42E-08	2.82E-08

TABLE 16
ESTIMATED RISK TO EXPOSED POPULATION – HYPOTHETICAL ACCIDENT DIRECT RAIL TO ENVIROCARE PROPOSED REVISED REMEDY

Population Distribution

(Persons under the plume footprint for a single accident)

Suburban	5.44E+05
Rural	1.04E+04
Urban	3.26E+06

Accident Severity Class	Accident Probability			Dose-Risk (person-rem)			Individual Risk (ILCR)		
	Suburban	Rural	Urban	Suburban	Rural	Urban	Suburban	Rural	Urban
3	1.77E-02	5.35E-03	7.10E-03	7.63E+00	1.43E-01	2.93E+01	7.01E-09	6.88E-09	4.49E-09
4	1.77E-03	5.35E-04	7.10E-04	1.53E+01	2.86E-01	5.87E+01	1.41E-08	1.38E-08	9.00E-09
5	1.32E-04	8.90E-05	4.73E-05	3.08E+01	5.72E-01	1.17E+02	2.83E-08	2.75E-08	1.79E-08
6	6.38E-06	9.00E-06	1.71E-06	6.14E+01	1.14E+00	2.35E+02	5.64E-08	5.48E-08	3.60E-08
7	1.47E-06	4.75E-06	7.88E-07	1.23E+02	2.29E+00	4.70E+02	1.13E-07	1.10E-07	7.21E-08
8	1.23E-07	8.90E-07	6.57E-08	2.45E+02	4.57E+00	9.41E+02	2.25E-07	2.20E-07	1.44E-07

For the hypothetical accident scenario, the highest ILCR to the reasonably maximum exposed individual occurs as a result of a Severity Category 8 accident. The highest ILCR resulting from a Severity Category 8 accident occurs in both rural and suburban areas for truck shipments and suburban areas for both intermodal and direct rail shipments. For treated Silo 3 material, the highest ILCR is estimated to be 3.08E-11 for truck shipments to the NTS, 6.26E-11 for intermodal shipments to the NTS, 3.09E-11 for truck shipments to Envirocare, and 1.59E-10 for direct rail shipments to Envirocare. For untreated Silo 3 material, the highest ILCR is estimated to be 4.38E-08 for truck shipments to the NTS, 8.95E-08 for intermodal shipments to the NTS, 4.40E-08 for truck shipments to Envirocare, and 2.25E-07 for direct rail shipments to Envirocare.

For each accident severity category, RADTRAN5 also calculates the maximum individual downwind doses at the mean downwind centerline distance for each isopleth. The individual doses calculated are a sum of the cloudshine, inhalation, and groundshine exposure pathways. The calculated values can be used to determine whether Federal exposure guidelines might be exceeded and, if so, at what distances from the accident site. The DOE limits for annual exposure are a total effective dose equivalent for an occupational worker of 5 rem and 0.1 rem for occupational workers who are minors and members of the public. These limits are typically applied to routine operations at DOE facilities and not to accidents.

In addition, RADTRAN5 is typically used only to estimate dose to members of the public during and accident and not to hazardous material responders. The accident-scenario dose levels calculated by RADTRAN5 for members of the public assume that that evacuation requires 24 hours. These same 24-hour dose levels can be applied to first responders wearing no personal protective equipment, or can be interpolated based on a reasonable time of exposure to first responders before they don the appropriate protective equipment. Based on the doses calculated by RADTRAN5, there would not be any exposures resulting from an accident involving shipment of treated Silo 3 material that would exceed Federal exposure limits for either occupational workers or members of the public. From an occupational perspective, only a Severity Class 7 or 8 rail accident involving untreated Silo 3 material would result in the potential for a worker being exposed to a dose greater than 5 rem.

Assuming a 24-hour exposure without any personal protective equipment, an occupational worker, or first responder would be exposed to 100% of the external dose associated with the released material and be exposed to 100% of the respirable material released. It must be recognized that although the very conservative assumptions described here assume a 24-hour exposure without any personal protective equipment, first responders are trained to assure that the proper protective equipment is in place prior to approaching an accident scene, and to immediately establish controlled access to the accident to prevent access by workers and members of the public without protective equipment. Further, the actual likelihood that a 24-hour period would be required for a member of the public to be evacuated from the accident site is extremely small.

For shipments of untreated Silo 3 material, a rail accident of Severity Class 7 or 8 would result in a 24-hour dose exceeding Federal exposure limits for an occupational worker within 33 meters (108 feet) and 68 meters (223) feet respectively. Occupational workers who are minors and members of the public could receive a 24-hour dose in excess of Federal exposure limits as a result of accidents involving truck shipments of untreated Silo 3 material if within 33 meters (108 feet) for Severity Class 4, 68 meters (223 feet) for Severity Class 5, 105 meters (345 feet) for Severity Class 6, 244 meters (801 feet) for Severity Class 7, and 369 meters (1211 feet) for Severity Class 8. Occupational workers who are minors and members of the public also could receive a 24-hour dose in excess of Federal exposure limits as a result of accidents involving rail shipments of untreated Silo 3 material if within 105 meters (345 feet) for Severity Categories 3 and 4, 244 meters (801 feet) for Severity Category 5, 369 meters (1211 feet) for Severity Category 6, 561 meters (1841 feet) for Severity Category 7, and 1020 meters (3347 feet) for

Severity Category 8. Tables 17 through 22 present the maximum individual 24-hour doses resulting from Severity Category 3 and higher accidents calculated by RADTRAN5 for truck shipments, intermodal rail shipments, and rail shipments. Severity Categories 1 and 2 are not included because they do not result in a release of any material or any dose exposures. For truck shipments the dose to the maximum exposed individual would be the same regardless of location of the accident, rural, suburban, or urban setting, and regardless of whether the material is being transported to the NTS or Envirocare. Because there are seven soft-sided containers per Sea/Land for intermodal rail shipments compared to nine per Sea/Land for direct rail, there is a difference in the 24-hour dose received by the maximum exposed individual between intermodal and direct rail shipments.

TABLE 17

MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT TRUCK SHIPMENT CURRENTLY APPROVED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	6.53E-05	1.31E-04	2.62E-04	5.23E-04	1.05E-03	2.09E-03
68	3.28E-05	6.57E-05	1.31E-04	2.63E-04	5.26E-04	1.05E-03
105	1.59E-05	3.19E-05	6.38E-05	1.28E-04	2.55E-04	5.11E-04
244	6.16E-06	1.23E-05	2.47E-05	4.94E-05	9.88E-05	1.98E-04
369	2.96E-06	5.92E-06	1.18E-05	2.37E-05	4.74E-05	9.47E-05
561	1.41E-06	2.82E-06	5.64E-06	1.13E-05	2.26E-05	4.51E-05
1020	5.35E-07	1.07E-06	2.14E-06	4.28E-06	8.57E-06	1.71E-05
1630	2.53E-07	5.07E-07	1.01E-06	2.03E-06	4.06E-06	8.11E-06
2310	1.18E-07	2.36E-07	4.72E-07	9.44E-07	1.89E-06	3.77E-06
4270	4.45E-08	8.91E-08	1.78E-07	3.56E-07	7.13E-07	1.43E-06
5470	2.03E-08	4.06E-08	8.12E-08	1.62E-07	3.25E-07	6.50E-07
11100	9.62E-09	1.93E-08	3.85E-08	7.71E-08	1.54E-07	3.08E-07
13100	3.56E-09	7.12E-09	1.42E-08	2.85E-08	5.70E-08	1.14E-07
21300	1.68E-09	3.36E-09	6.71E-09	1.34E-08	2.69E-08	5.37E-08
40500	7.66E-10	1.53E-09	3.07E-09	6.13E-09	1.23E-08	2.45E-08
70000	4.09E-10	8.19E-10	1.64E-09	3.28E-09	6.55E-09	1.31E-08
89900	2.49E-10	5.00E-10	9.99E-10	2.00E-09	4.00E-09	7.99E-09
121000	1.63E-10	3.27E-10	6.54E-10	1.31E-09	2.61E-09	5.23E-09

TABLE 18
MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT INTERMODAL RAIL SHIPMENT CURRENTLY APPROVED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	2.61E-04	5.23E-04	1.05E-03	2.09E-03	4.19E-03	8.37E-03
68	1.31E-04	2.63E-04	5.26E-04	1.05E-03	2.10E-03	4.20E-03
105	6.37E-05	1.28E-04	2.55E-04	5.11E-04	1.02E-03	2.04E-03
244	2.47E-05	4.94E-05	9.88E-05	1.98E-04	3.95E-04	7.90E-04
369	1.18E-05	2.37E-05	4.74E-05	9.47E-05	1.89E-04	3.79E-04
561	5.63E-06	1.13E-05	2.26E-05	4.51E-05	9.03E-05	1.81E-04
1020	2.14E-06	4.28E-06	8.57E-06	1.71E-05	3.43E-05	6.86E-05
1630	1.01E-06	2.03E-06	4.06E-06	8.11E-06	1.62E-05	3.24E-05
2310	4.71E-07	9.44E-07	1.89E-06	3.77E-06	7.55E-06	1.51E-05
4270	1.78E-07	3.56E-07	7.13E-07	1.43E-06	2.85E-06	5.70E-06
5470	8.11E-08	1.62E-07	3.25E-07	6.50E-07	1.30E-06	2.60E-06
11100	3.85E-08	7.71E-08	1.54E-07	3.08E-07	6.17E-07	1.23E-06
13100	1.42E-08	2.85E-08	5.70E-08	1.14E-07	2.28E-07	4.56E-07
21300	6.70E-09	1.34E-08	2.69E-08	5.37E-08	1.07E-07	2.15E-07
40500	3.06E-09	6.13E-09	1.23E-08	2.45E-08	4.91E-08	9.82E-08
70000	1.64E-09	3.28E-09	6.55E-09	1.31E-08	2.62E-08	5.24E-08
89900	9.98E-10	2.00E-09	4.00E-09	7.99E-09	1.60E-08	3.20E-08
121000	6.52E-10	1.31E-09	2.61E-09	5.23E-09	1.05E-08	2.09E-08

TABLE 19
MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT DIRECT RAIL SHIPMENT CURRENTLY APPROVED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	3.36E-04	6.73E-04	1.35E-03	2.69E-03	5.38E-03	1.08E-02
68	1.69E-04	3.38E-04	6.76E-04	1.35E-03	2.70E-03	5.41E-03
105	8.19E-05	1.64E-04	3.28E-04	6.57E-04	1.31E-03	2.63E-03
244	3.17E-05	6.35E-05	1.27E-04	2.54E-04	5.08E-04	1.02E-03
369	1.52E-05	3.05E-05	6.09E-05	1.22E-04	2.44E-04	4.87E-04
561	7.24E-06	1.45E-05	2.90E-05	5.80E-05	1.16E-04	2.32E-04
1020	2.75E-06	5.51E-06	1.10E-05	2.20E-05	4.41E-05	8.81E-05
1630	1.30E-06	2.61E-06	5.21E-06	1.04E-05	2.09E-05	4.17E-05
2310	6.06E-07	1.21E-06	2.43E-06	4.85E-06	9.70E-06	1.94E-05
4270	2.29E-07	4.58E-07	9.16E-07	1.83E-06	3.67E-06	7.33E-06
5470	1.04E-07	2.09E-07	4.18E-07	8.35E-07	1.67E-06	3.34E-06
11100	4.95E-08	9.91E-08	1.98E-07	3.96E-07	7.93E-07	1.59E-06
13100	1.83E-08	3.66E-08	7.32E-08	1.46E-07	2.93E-07	5.86E-07
21300	8.62E-09	1.73E-08	3.45E-08	6.91E-08	1.38E-07	2.76E-07
40500	3.94E-09	7.89E-09	1.58E-08	3.15E-08	6.31E-08	1.26E-07
70000	2.10E-09	4.21E-09	8.42E-09	1.68E-08	3.37E-08	6.74E-08
89900	1.28E-09	2.57E-09	5.14E-09	1.03E-08	2.06E-08	4.11E-08
121000	8.39E-10	1.68E-09	3.36E-09	6.72E-09	1.34E-08	2.69E-08

TABLE 20
MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT TRUCK SHIPMENT PROPOSED REVISED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	9.81E-02	1.97E-01	3.93E-01	7.86E-01	1.57E+00	3.14E+00
68	4.93E-02	9.87E-02	1.97E-01	3.95E-01	7.89E-01	1.58E+00
105	2.39E-02	4.79E-02	9.59E-02	1.92E-01	3.84E-01	7.67E-01
244	9.26E-03	1.85E-02	3.71E-02	7.42E-02	1.48E-01	2.97E-01
369	4.44E-03	8.89E-03	1.78E-02	3.56E-02	7.12E-02	1.42E-01
561	2.12E-03	4.24E-03	8.48E-03	1.70E-02	3.39E-02	6.78E-02
1020	8.03E-04	1.61E-03	3.22E-03	6.44E-03	1.29E-02	2.57E-02
1630	3.80E-04	7.61E-04	1.52E-03	3.05E-03	6.09E-03	1.22E-02
2310	1.77E-04	3.54E-04	7.09E-04	1.42E-03	2.83E-03	5.67E-03
4270	6.68E-05	1.34E-04	2.68E-04	5.35E-04	1.07E-03	2.14E-03
5470	3.04E-05	6.10E-05	1.22E-04	2.44E-04	4.88E-04	9.76E-04
11100	1.44E-05	2.89E-05	5.79E-05	1.16E-04	2.32E-04	4.63E-04
13100	5.34E-06	1.07E-05	2.14E-05	4.28E-05	8.56E-05	1.71E-04
21300	2.52E-06	5.04E-06	1.01E-05	2.02E-05	4.03E-05	8.07E-05
40500	1.15E-06	2.30E-06	4.61E-06	9.21E-06	1.84E-05	3.69E-05
70000	6.14E-07	1.23E-06	2.46E-06	4.92E-06	9.84E-06	1.97E-05
89900	3.75E-07	7.50E-07	1.50E-06	3.00E-06	6.00E-06	1.20E-05
121000	2.45E-07	4.91E-07	9.82E-07	1.96E-06	3.93E-06	7.85E-06

TABLE 21
MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT INTERMODAL RAIL SHIPMENT PROPOSED REVISED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	3.92E-01	7.86E-01	1.57E+00	3.14E+00	6.29E+00	1.26E+01
68	1.97E-01	3.95E-01	7.89E-01	1.58E+00	3.16E+00	6.32E+00
105	9.57E-02	1.92E-01	3.84E-01	7.67E-01	1.53E+00	3.07E+00
244	3.70E-02	7.42E-02	1.48E-01	2.97E-01	5.94E-01	1.19E+00
369	1.78E-02	3.56E-02	7.12E-02	1.42E-01	2.85E-01	5.69E-01
561	8.46E-03	1.70E-02	3.39E-02	6.78E-02	1.36E-01	2.71E-01
1020	3.21E-03	6.44E-03	1.29E-02	2.57E-02	5.15E-02	1.03E-01
1630	1.52E-03	3.05E-03	6.09E-03	1.22E-02	2.44E-02	4.87E-02
2310	7.07E-04	1.42E-03	2.83E-03	5.67E-03	1.13E-02	2.27E-02
4270	2.67E-04	5.35E-04	1.07E-03	2.14E-03	4.28E-03	8.57E-03
5470	1.22E-04	2.44E-04	4.88E-04	9.76E-04	1.95E-03	3.90E-03
11100	5.78E-05	1.16E-04	2.32E-04	4.63E-04	9.26E-04	1.85E-03
13100	2.14E-05	4.28E-05	8.56E-05	1.71E-04	3.42E-04	6.85E-04
21300	1.01E-05	2.02E-05	4.03E-05	8.07E-05	1.61E-04	3.23E-04
40500	4.60E-06	9.21E-06	1.84E-05	3.69E-05	7.37E-05	1.47E-04
70000	2.46E-06	4.92E-06	9.84E-05	1.97E-05	3.94E-05	7.87E-05
89900	1.50E-06	3.00E-06	6.00E-06	1.20E-05	2.40E-05	4.80E-05
121000	9.80E-07	1.96E-06	3.93E-06	7.85E-06	1.57E-05	3.14E-05

TABLE 22
MAXIMUM INDIVIDUAL 24-HOUR DOSE – HYPOTHETICAL ACCIDENT DIRECT RAIL SHIPMENT PROPOSED REVISED REMEDY

Centerline (meters)	Severity Category 3	Severity Category 4	Severity Category 5	Severity Category 6	Severity Category 7	Severity Category 8
33	5.05E-01	1.01E+00	2.02E+00	4.04E+00	8.09E+00	1.62E+01
68	2.53E-01	5.08E-01	1.02E+00	2.03E+00	4.06E+00	8.12E+00
105	1.23E-01	2.47E-01	4.93E-01	9.86E-01	1.97E+00	3.95E+00
244	4.76E-02	9.54E-02	1.91E-01	3.82E-01	7.63E-01	1.53E+00
369	2.28E-02	4.57E-02	9.15E-02	1.83E-01	3.66E-01	7.32E-01
561	1.09E-02	2.18E-02	4.36E-02	8.72E-02	1.74E-01	3.49E-01
1020	4.13E-03	8.27E-03	1.65E-02	3.31E-02	6.62E-02	1.32E-01
1630	1.95E-03	3.92E-03	7.83E-03	1.57E-02	3.13E-02	6.27E-02
2310	9.10E-04	1.82E-03	3.64E-03	7.29E-03	1.46E-02	2.92E-02
4270	3.44E-04	6.88E-04	1.38E-03	2.75E-03	5.51E-03	1.10E-02
5470	1.57E-04	3.14E-04	6.27E-04	1.25E-03	2.51E-03	5.02E-03
11100	7.43E-05	1.49E-04	2.98E-04	5.95E-04	1.19E-03	2.38E-03
13100	2.75E-05	5.50E-05	1.10E-04	2.20E-04	4.40E-04	8.80E-04
21300	1.29E-05	2.59E-05	5.19E-05	1.04E-04	2.07E-04	4.15E-04
40500	5.91E-06	1.18E-05	2.37E-05	4.74E-05	9.48E-05	1.90E-04
70000	3.16E-06	6.33E-06	1.27E-05	2.53E-05	5.06E-05	1.01E-04
89900	1.93E-06	3.86E-06	7.72E-06	1.54E-05	3.09E-05	6.17E-05
121000	1.26E-06	2.52E-06	5.05E-06	1.01E-05	2.02E-05	4.04E-05

FINDINGS AND CONCLUSIONS

The short-term transportation risk evaluation produced the following findings and conclusions:

- Both the currently approved remedy and the proposed revised remedy meet the 1 x 10^{-6} ILCR threshold condition established by the 1998 Silo 3 ESD for both accident-free and hypothetical accidents.

- Although both remedies meet the 1 x 10^{-6} threshold established by the Silo 3 ESD, the currently approved remedy shows incrementally less radiological risk overall; this is because no modeling credit was taken for the planned dispersability-control additives in the proposed revised remedy, and the material was conservatively modeled as untreated material. The differences in radiological risk between the two alternatives -- even with this conservative approach -- are considered inconsequential, since both meet the 1 x 10^{-6} acceptance target.

- The benefits of adding the dispersability control additives (or the contingency double packaging, if needed) under the proposed revised remedy will further narrow the estimated differences in radiological risk between the two alternatives.

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ATTACHMENT 4

COST ANALYSIS
FOR SILO 3 REMEDIAL ACTION

ATTACHMENT 4 – COST ANALYSIS

CURRENT APPROVED REMEDY (On-site Treatment to meet TCLP limits)

Project Management, Engineering, Construction Management and Startup:	$14,952,041
Capital Costs:	$20,107,530
Operations and Maintenance (O&M)/Shutdown:	$6,772,369
Transportation and Disposal:	$10,637,535
Decontamination & Demolition (D&D):	$2,034,081
Total	**$54,503,555**

PROPOSED REVISED REMEDY (Conditioning during packaging for dispersability/metals mobility)

Project Management, Engineering, Construction Management and Startup:	$13,847,002
Capital Costs:	$15,298,850
Operations and Maintenance (O&M)/Shutdown:	$4,206,594
Transportation and Disposal:	$7,223,997
Decontamination & Demolition (D&D):	$1,857,206
Total	**$42,433,649**

SUMMARY OF MAJOR COST ELEMENTS

COST ELEMENT	CURRENT REMEDY	PROPOSED REVISED REMEDY
Project Management, Engineering, Construction Management & Startup	**$14,952,041**	**$13,847,002**
Capital Cost	**$20,107,530**	**$15,298,850**
Operations & Maintenance/ Shutdown		
Soft-sided Containers	$1,067,379	$725,513
Inner Liners	$18,792	$16,719
Loading Frames	$37,236	$19,260
Lifting Frames	$11,128	$11,128
Chemicals/ Additives	$1,111,134	$55,192
Misc. Equipment/PPE	$390,964	$339,604
Labor	$4,135,736	$3,039,178
Total Operations & Maintenance/Shutdown	**$6,772,369**	**$4,206,594**
Transportation & Disposal		
Cargo Containers	$3,010,980	$2,044,770
Shipping	$1,978,644	$1,343,706
Labor	$564,344	$383,248
Disposal	$5,083,567	$3,452,273
Total Transportation & Disposal	**$10,637,535**	**$7,223,997**
Decontamination & Demolition	**$2,034,081**	**$1,857,206**
TOTAL COST	**$54,503,555**	**$42,433,649**

ASSUMPTIONS AND BASIS OF COST ESTIMATE – CURRENT REMEDY

GENERAL ASSUMPTIONS:

- 5,100 yd^3 Silo 3 material in-situ.

- The Silo 3 material is dry, powdery material with a moisture content ranging from 3-10% moisture. The optimum moisture content is 20%, which results in a crumbly material.

- Equipment design and processes for retrieval of material from the silo, conveyance to the process facility, and packaging are the same for both alternatives. The specific additives and resulting waste loadings assumed under the current and proposed revised remedies affect the size of the buildings, equipment needed, operations rate, final waste form, number of packages, shipping containers and truck shipments, final disposal cost, and D&D costs.

- Treatment of Silo 3 material to achieve TCLP limits for metals will be accomplished utilizing the chemical stabilization formula developed during Fernald treatability testing. The treatment formula assumes addition of 48 parts 15% ferrous sulfate solution, 30 parts of lime, 10 parts of portland cement, and 14 parts of water. The waste loading for this treated waste is 47.9 weight%.

- Treatment results in a greater volume of material for packaging and disposal, as well as increased material density. A volume and density increase is assumed due primarily to the addition of additives (52.1 weight-percent). Volume increase also reflects the effect of 'bulking' during material handling.

- Volume increase: 3,247 cy (8,347 cy treated material vs. 5,100 cy in-situ)
  Density increase: 11.1 lbs/cf [58.5 lbs/cf treated vs. 47.4 lbs/cf untreated (observed)]

- Transportation and disposal costs assume shipment by truck to the Nevada Test Site (NTS).

- All costs include appropriate escalation.

PROJECT MANAGEMENT, ENGINEERING, CONSTRUCTION MANAGEMENT AND STARTUP

- Project Management costs include project management activities to support all phases of the project from conceptual design through completion.

- Engineering costs include the development of conceptual, preliminary and final design, safety basis documentation, Title III (construction support) documentation, and design closeout activities. Costs also include oversight of the design effort, conduct of design data development laboratory testing, development of the Remedial Design Package and Health and Safety Plan, and preparation of long-lead procurement documentation.

- Engineering cost for the Current Remedy includes engineering effort for design of the treatment processes, equipment and facilities required for the chemical stabilization process, including equipment and facilities for the addition of additives such ferrous sulfate, lime, and portland cement, hoppers, feeders, mixers, and mixing tanks.

- Construction Management includes construction management activities, such as infrastructure coordination, planning and bidding support, subcontract oversight and acceptance testing.

- Startup includes startup management activities, development of operating procedures, maintenance plans, operations training, and conduct of system operability tests (SOTs) and the readiness review.

CAPITAL COSTS

- Capital costs include material, equipment, labor, and subcontracts for the construction of the processing facility. Equipment procurements such as the retrieval equipment (pneumatic and mechanical) and packaging systems include necessary testing and demonstration.

- The Silo 3 construction subcontract costs include subcontracts for civil, structural, mechanical and electrical scope.

- Retrieval and packaging facilities include the silo enclosure, the retrieval facility (excavator room), packaging facility, cargo containment, and miscellaneous support trailers.

- Equipment required to implement the treatment process for the current remedy includes additive feeders, mixers, hoppers, sampling equipment, load cells, instrumentation for flow measurement, and sampling equipment.

- The process building is sized to accommodate the additional hoppers, feeders, mixers, and mixing tanks associated with the current remedy.

OPERATIONS AND MAINTENANCE

- Operations and Maintenance (O&M) costs are based on a requirement of 86,700 manhours to accomplish:
  - Retrieval of Silo 3 material from the silo;
  - Treatment (utilizing the chemical stabilization formula developed during Fernald treatability testing). Batch processing is assumed, to accomplish the addition of additives and adequate mixing of the additives and Silo 3 material prior to packaging;
  - Sampling of the material conducted to ensure disposal facility waste acceptance criteria (WAC) is met, in addition to routine (IH, workplace, rad) sampling.
  - Preparing and filling the soft-sided packages; and
  - Loading packages into shipping containers.

- O&M costs also include technical support provided by equipment vendors.

- Labor costs for shipping are included in the transportation and disposal costs.

- The maximum capacity of the retrieval equipment is 6 to 10 cy per hour. The capacity of the batch stabilization process is 4.5 cy per hour. Therefore, an overall average production rate of 4.5 cy per hour is assumed for the retrieval, processing, and packaging facility.

- The operations schedule is based on working 4 days per week with 7.5 productive hours/shift (day). The balance of the available hours per shift are attributed to maintenance, donning and doffing of PPE, and required breaks due to stay-time requirements.

- Operations includes the cost for preparing the access opening in the silo when retrieval switches from pneumatic to mechanical, using the excavator.

- Operations personnel will be required to wear PPE for worker protection during retrieval and packaging. PPE costs include coveralls and air-supplied respirators.

- Miscellaneous equipment costs include process filters and consumables used during operations for swiping, surveying bags, and decontamination of surfaces for free-release.

- The cost of packaging the treated Silo 3 material in 3 yd^3 IP-2 soft-sided containers is based upon:

  - 2783 soft-sided containers are required for the calculated volume of treated Silo 3 material. An additional 27 containers, for a total of 2810 soft-sided containers, are assumed to be utilized to account for filling efficiency and overpacking of secondary waste, including process filters.

  - It is assumed that secondary waste that contains process material (i.e., process filters) will be disposed of at the NTS.

  - An inner liner/bag will be used inside the soft-sided package to allow cinching around the fill spout to reduce the spread of contamination.

  - Loading frames will be used to give soft-sided container shape during filling.

  - The material is packaged at two packaging lines. The packaging rate is limited by the 4.5 cy/hour batch-processing rate. A packaging rate of 1.5 soft-sided containers packaged per hour is assumed (4.5 cy/hour processing rate; 3 cy per container).

- Preparation for Shipment includes loading of the soft-sided containers into the cargo containers, assuming:.

  - Seven (7) soft-sided containers per cargo container.
  - Lifting frames used to lift soft-sided containers and load them into top loading cargo containers.

- Shutdown cost reflects those activities necessary to place the Silo 3 facilities in a controlled state ready for dismantlement. This includes isolation of utilities to the facilities, removal of gross quantities of hold-up material in equipment and gross decontamination of the equipment and facilities. Costs for fixative is included in the miscellaneous equipment cost.

<u>O&M Costs</u>

Soft-sided containers (2810 containers @ $379.85/container) = $1,067,379

Inner Liners/Bag (2810 bags @ $6.69/bag) = $18,792

Loading Frames (2 frames rented for 3 months; 12 frames rented for 14 months @ $214/frame per month) = $37,236

Lifting Frames (2 frames @ $5,564/frame) = $11,128

Chemical Additives (ferrous sulfate, lime, portland cement per vendor quotes) = $1,111,134

Misc. Equipment/PPE = $390,964

Labor:	Operations & Maintenance labor:	$3,879,455 (based on 86,700 manhours)
	Other Labor & Subcontract cost*:	$256,281
	Total O&M Labor Cost =	$4,135,736

*Includes (Shutdown, technical support for cutting the Silo opening, WAC precertification and routine sampling, other technical support)

TRANSPORTATION AND DISPOSAL

- Shipping schedule assumes real time shipping with minimum storage of containers on site. Shipping occurs twice weekly.
- Disposal schedule is same duration as operations schedule with one-month lag.
- Shipping of soft-sided containers in cargo containers (e.g., sealand) by truck.
- The number of packages in cargo container is limited by weight limit for truck shipment load (40,000 – 42,000 lbs.).
- One (1) cargo container (e.g., sealand) per flatbed truck shipped to the NTS = 402 Truck Shipments. The waste loading affects the total number of packages produced, nearly doubling the quantity.
- Truck carriers available (already under contract with Fernald).
- Full cargo container fleet purchased assuming cargo containers buried. Entire cargo container disposed of (volume =1,360 ft^3/sealand).
- Treated waste disposed at NTS.

Transportation & Disposal Costs

Cargo containers (402 containers @ $7,490/container) = $3,010,980

Shipping (402 shipments @ $4,922/truck) = $1,978,644

Labor (not included in O&M estimate) 15,356 manhours (separate crew for preparation of trucks for shipment) = $564,344

NTS Disposal (402 cargo containers x 1,360 ft^3 @ $9.30/ ft^3) = $5,083,567

DECONTAMINATION AND DEMOLITION (D&D)

- Cost for D&D the Silo 3 facility assumes a subcontracted price for D&D of the retrieval, treatment, and packaging facilities and equipment.
- Disposal of major building debris assumed on-site in the OSDF cell.
- Does not include D&D/removal of Silo 3 or soil removal costs.

Costs

D&D of the Silo 3 treatment facility = $2,034,081

ASSUMPTIONS AND BASIS OF COST ESTIMATE - PROPOSED REVISED REMEDY

GENERAL ASSUMPTIONS:

- 5,100 yd^3 Silo 3 material in-situ.
- The Silo 3 material is dry, powdery material with a moisture content ranging from 3-10% moisture. The optimum moisture content is 20%, which results in a crumbly material.
- Equipment design and processes for retrieval of material from the silo, conveyance to the process facility, and packaging are the same for both alternatives. The specific additives and resulting waste loadings assumed under the current and proposed revised remedies affect the size of the buildings, equipment needed, operations rate, final waste form, number of packages, shipping containers and truck shipments, final disposal cost, and D&D costs.
- Silo 3 material will be conditioned during the packaging operation with the binding agent (e.g., lignosulfonate) tested during Fernald mock-up testing, plus the addition of a reducing agent (e.g., ferrous sulfate) for stabilization of metal(s). The cost assumes addition of a 15% ferrous sulfate solution and lignosulfonate binder combined in solution, optimizing moisture at 20%.
- The waste loading for conditioned waste is 79%.
- A volume and density increase is assumed due primarily to the 20% addition of the aqueous solution. Volume increase also reflects the effect of ‘bulking’ during material handling.
  Volume increase: 553 cy (5,653 cy treated material vs. 5,100 cy in-situ)
  Density increase: 10.1 lbs/cf [56.3 lbs/cf treated vs. 46.2 lbs/cf untreated (observed)]
- Transportation and disposal costs assume shipment by truck to the Nevada Test Site (NTS).
- All costs include the appropriate escalation.

PROJECT MANAGEMENT, ENGINEERING, CONSTRUCTION MANAGEMENT AND STARTUP

- Project Management costs include project management activities to support all phases of the project from conceptual design through completion.
- Engineering costs include the development of conceptual, preliminary and final design, safety basis documentation, Title III (construction support) documentation, and design closeout activities. Costs also include oversight of the design effort, conduct of design data development laboratory testing, development of the Remedial Design Package and Health and Safety Plan, and preparation of long-lead procurement documentation.
- Engineering cost for the Proposed Revised Remedy includes the engineering effort required to incorporate the equipment and facilities for conditioning the Silo 3 material into the retrieval and packaging design. The change includes adding an area for reagents or additives, revising the use of the wastewater tanks for mixing of additives, and applying the additives by spraying the dry material as it is being packaged.

- Construction Management includes construction management activities, such as infrastructure coordination, planning and bidding support, subcontract oversight and construction acceptance testing.

- Startup includes startup management activities, development of operating procedures, maintenance plans, operations training, and conduct of system operability tests (SOTs) and the readiness review.

CAPITAL COSTS

- Capital Costs include material, equipment, labor, and subcontracts for the construction of the processing facility. Equipment procurements such as the retrieval equipment (pneumatic and mechanical) and packaging systems include necessary testing and demonstration.

- The Silo 3 construction subcontract costs include subcontracts for civil, structural, mechanical and electrical scope.

- Retrieval and packaging facilities include the silo enclosure, the retrieval facility (excavator room), packaging facility, cargo containment, and miscellaneous support trailers.

- Equipment required to implement the Proposed Revised Remedy includes tanks, pumps, piping and instrumentation for the addition of additives to the packages of waste.

OPERATIONS AND MAINTENANCE

- Operations and Maintenance (O&M) costs are based upon a requirement of 60,000 manhours to accomplish:
    - Retrieval of Silo 3 material from the silo;
    - Conditioning the waste;
    - Preparing and filling the soft-sided packages; and
    - Loading packages into shipping containers (e.g., sealands).
- O&M costs also include technical support provided by consultants and equipment vendors.

- Labor costs for shipping are included in the transportation and disposal costs.

- The maximum capacity of the retrieval equipment is 6 to 10 cy per hour. An average production rate of 6 cy/hr is assumed.

- The operations schedule is based on working 4 days per week with 7.5 productive hours/shift (day). The balance of the available hours per shift are attributed to maintenance, donning and doffing of PPE, and required breaks due to stay-time requirements.

- Operations includes the cost for preparing the access opening in the silo when retrieval switches from pneumatic to mechanical, using the excavator.

- Operations personnel will be required to wear PPE for worker protection during retrieval and packaging. PPE costs include coveralls and air-supplied respirators.

- Miscellaneous equipment costs include process filters and consumables used during operations for swiping, surveying bags, and decontamination of surfaces for free-release.

- There is no waste acceptance sampling assumed for this remedy, only routine (IH, workplace, radiological control) sampling.

- The cost of packaging Silo 3 material in 3 yd^3 IP-2 soft-sided containers assumes:

    - 1885 soft-sided containers are required for the calculated volume of Silo 3 material. An additional 25 containers, for a total of 1910 soft-sided containers, are assumed to be utilized to account for filling efficiency and overpacking of secondary waste, including process filters.

    - It is assumed that secondary waste that contains process material will be disposed of at the NTS (i.e., process filters).

    - An inner liner/bag is used inside the soft-sided package to allow cinching around the fill spout to reduce the spread of contamination.

    - Loading frames are used to give the soft-sided containers shape during filling.

    - The material is packaged at two packaging lines. Assuming 1 soft-sided container per hour is filled at each packaging station, the overall production rate (not limited by upstream processing) is 2 bags (6cy) per hour.

- Preparation for Shipment includes the cost of loading of the soft-sided containers into the cargo containers, assuming:

    - Seven (7) soft-sided containers assumed per cargo container.
    - Lifting frames used to lift soft-sided containers and load them into top-loading cargo containers.

- Shutdown costs reflect those activities necessary to place the Silo 3 facilities in a controlled state ready for dismantlement. This includes isolation of utilities to the facilities, removal of gross quantities of hold-up material in equipment and gross decontamination of the equipment and facilities. Costs for fixative is included in the miscellaneous equipment cost.

O&M Costs

Soft-sided containers (1910 containers @ $379.85/container) = $725,513

Inner Liners/Bag (2500 bags (vendor minimum) @ $6.69/bag) = $16,719

Loading Frames (2 frames rented for 3 mos.; 12 frames rented for 7 mos. @ $214/frame per mo.) = $19,260

Lifting Frames (2 frames @ $5,564/frame) = $11,128

Chemical Additives = $55,192

Misc. Equipment/PPE = $339,604

Labor:	Operations & Maintenance labor:	$2,790,633 (based on 60,000 manhours)
	Other Labor & Subcontract cost*:	$248,545
	Total O&M Labor Cost =	$3,039,178

*Includes shutdown, technical support for cutting the Silo opening, routine sampling, other technical support)

TRANSPORTATION AND DISPOSAL

- Shipping schedule assume real time shipping with minimum storage of containers on-site. Shipping occurs twice weekly.
- Disposal schedule is same duration as operations schedule with one-month lag.
- Shipping of soft-sided containers in cargo containers by truck.
- The number of packages in cargo container is limited by weight limit for truck shipment load (40,000 – 42,000 lbs.).
- One (1) cargo container per flatbed truck shipped to the NTS = 273 Truck Shipments.
- Truck carriers available (already under contract with Fernald).
- Full cargo container fleet purchased assuming cargo containers buried. Entire cargo container disposed of (volume =1,360 ft^3/container).
- Conditioned waste disposed at NTS.

Transportation & Disposal Costs

Cargo containers (273 containers @ $7,490/container) = $2,044,770

Shipping (273 shipments @ $4,922/truck) = $1,343,706

Labor [10,429 manhours (separate crew for preparation of trucks for shipment)]= $383,248

NTS Disposal (273 cargo containers x 1,360 ft^3 @ $9.30/ ft^3) = $3,452,273

DECONTAMINATION AND DEMOLITION (D&D)

- Cost for D&D the Silo 3 facility assumes a subcontracted price for D&D of the retrieval, conditioning, and packaging facilities and equipment.
- Disposal of major building debris assumed on-site in the OSDF cell.
- Does not include D&D/removal of Silo 3 or soil removal costs.

Costs

D&D of the Silo 3 facility = $1,857,206