SUPPLEMENTAL INFORMATION

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

December 2002

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

FERNALD
Environmental Management Project

40430-RP-0014
Revision 1
DRAFT

REVISED PROPOSED PLAN FOR SILO 3 SUPPLEMENTAL INFORMATION

8210

TABLE OF CONTENTS

Attachment 1 - DOE-Nevada Letter Concerning Acceptability of Untreated Silo 3 Material at the Nevada Test Site

Attachment 2 - Applicable or Relevant and Appropriate Requirements for Silo 3 Remedial Action

Attachment 3 - Transportation Risk Evaluation for Silo 3 Remedial Action

Attachment 4 - Cost Analysis for Silo 3 Remedial Action

ATTACHMENT 1

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

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

FERNALD
LOG C-1436
2002 JUN 25 A 10:00
FILE: 9530

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 $pCi/m^2 \cdot s$ 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 2-1 (Continued)

Medium	DOE	Requirement	ARAR/TBC	Rationale for Implementation	
Air	Radiation Protection of the Public and the Environment, Proposed 10 CFR Part 834.	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) Isotope / D[a] / W / Y Actinium-227: 2×10^{-15} / 7×10^{-15} / 1×10^{-14} Lead-210: 9×10^{-13} / ------[b] / ------ Polonium-210: 1×10^{-12} / 1×10^{-12} / ------ Protactinium-231: ------ / 9×10^{-15} / 1×10^{-14} Radium-224: ------ / 4×10^{-12} / ------ Radium-226: ------ / 1×10^{-12} / ------ Radium-228: ------ / 3×10^{-12} / ------ Technetium-99: 1×10^{-8} / 2×10^{-9} / ------ Strontium-90[c]: 5×10^{-11} / ------ / 9×10^{-12} Thorium-228: ------ / 5×10^{-14} / 4×10^{-14} Thorium-230: ------ / 4×10^{-14} / 5×10^{-14} Thorium-232: ------ / 7×10^{-15} / 1×10^{-14} Uranium-234: 4×10^{-12} / 2×10^{-12} / 9×10^{-14} Uranium-235: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-236: 5×10^{-12} / 2×10^{-12} / 1×10^{-13} Uranium-238: 5×10^{-12} / 2×10^{-12} / 1×10^{-14} [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}.	To be considered	Remediation of the Silo 3 material has the potential to release radionuclides.	

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)

Medium	CWA	Requirement	ARAR/TBC	Rationale for Implementation
Water	Ohio Water Quality Standards, Ohio Administrative Code (OAC) 3745-1-04.	"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.	Relevant and Appropriate	Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.
Water	Ohio Water Quality Standards, OAC 3745-1-07.	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: 30-day Criteria Constituent — average conc.[a] (ug/1) — conc. (ug/1) antimony — 650 — 190 arsenic — 360 — 190 beryllium — Tab. 7-10[b] — Tab. 7-11[c] cadmium — Tab. 7-10 — Tab. 7-11 chromium — Tab. 7-10 — Tab. 7-11 copper — Tab. 7-10 — Tab. 7-11 cyanide — 46 — 12 lead — Tab. 7-10 — Tab. 7-11 mercury — 1.1 — 0.20 nickel — Tab. 7-10 — Tab. 7-11 selenium — 20 — 5.0 silver — Tab. 7-10 — 1.3 thallium — 71 — 16	Relevant and Appropriate	Pertains to discharges to surface waters as a result of remediation and to on-site surface waters affected by site conditions.

TABLE 2-1 (Continued)

Water	Ohio Water Quality Standards, OAC 3745-1-07 (continued).				

30-day Criteria Constituent	average conc.[a] (ug/l)	conc. (ug/l)
zinc	Tab. 7-10	Tab. 7-11
30-day Criteria Constituent	average conc.[a] (ug/l)	conc. (ug/l)
2-butanone	160000	7100
4-nitrophenol	790	35
acentone	550000	78000
aldrin	----	0.01
bis(2-ethylhexyl) phthalate	1100	8.4
carbon tetrachloride	1800	280
DDT	----	0.001
Dieldrin	----	0.005
di-n-butyl-phthalate	350	190
diethylphthalate	2600	120
dimethylphthalate	1700	73
endosulfan[d]	----	0.003
endrin	----	0.002
fluoranthene	200	8.9
methylene chloride	9700	430
PCBs	----	0.001
phenol	5300	370
tetrachloroethene	540	73
toluene	2400	1700

[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.

8210

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.

8210

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.

8210

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.

8210

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.		

8210

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.		

8210

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 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.)	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.

8210

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.

8210

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.

8210

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.

8210

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.

8210

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.

8210

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, 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 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.

8210

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

8210

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
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

8210

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 intermodal shipments, it was assumed that seven soft-sided containers would be placed into each Sea/Land container with four Sea/Land containers being placed onto a flatcar. For the truck leg of the intermodal shipments, one Sea/Land container would be placed onto each truck. 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.

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 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, 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 21in 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 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 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, Pb-210, 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	1.41E-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-01
4	6.25E-02	1.0E-02	3.6E-01
5	1.25E-01	1.0E-02	3.6E-01
6	2.50E-01	1.0E-02	3.6E-01
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 5×10^{-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	1.29E-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	3.64E-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	3.76E-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

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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

FINDINGS AND CONCLUSIONS

8210

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

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

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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

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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

8210

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

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- 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

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- 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.

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- 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)

8210

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

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ASSUMPTIONS AND BASIS OF COST ESTIMATE - PROPOSED REVISED REMEDY

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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.

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- Construction Management includes construction management activities, such as infrastructure coordination, planning and bidding support, subcontract oversight and construction acceptance testing. 8210

- 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.

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- 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.

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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.

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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