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PROPOSED PLAN FOR REMEDIAL ACTIONS AT OPERABLE UNIT 1
DOE/EA-0938 - FINAL - AUGUST 1994

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PROPOSED PLAN FOR REMEDIAL ACTIONS AT OPERABLE UNIT 1 DOE/EA-0938

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

AUGUST 1994

U.S. DEPARTMENT OF ENERGY
FERNALD FIELD OFFICE

FINAL

Documents Comprising the Draft Final
Feasibility Study/Proposed Plan-Environmental Assesment
for Remedial Actions at Operable Unit 1, the Fernald Environmental Management Project

Draft Final Feasibility Study for Operable Unit 1, Fernald Environmental Management Project, Volume- I-III, Department of Energy, Fernald Field Office, Fernald, Ohio, July 1994.

Final Proposed Plan for Remedial Actions at Operable Unit 1, Fernald Environmental Management Project, Department of Energy, Fernald Field Office, Fernald, Ohio, August 1994.

Incorporated by reference:
Draft Final Remedial Investigation Report for Operable Unit 1, Fernald Environmental Management Project, Volume I-IV, Department of Energy, Fernald Field Office, Fernald, Ohio, May 1994.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
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PROPOSED PLAN
FOR REMEDIAL ACTIONS AT
OPERABLE UNIT 1

TABLE OF CONTENTS

List of Tables . . . . . p-iv

List of Figures . . . . . p-v

List of Acronyms . . . . . p-vi

1.0 Introduction P-1-1

2.0 Description and History of the Fernald Environmental Management Project P-2-1

2.1 History of the FEMP Site P-2-1

2.2 Site Description P-2-2

3.0 Scope and Role of Operable Units P-3-1

3.1 The Operable Unit Concept P-3-1

3.2 Scope and Role of Operable Unit 1 . . . . . P-3-2

3.2.1 Description of Operable Unit 1 . . . . . P-3-2

3.2.1.1 Waste Pit 1 . . . . . P-3-2

3.2.1.2 Waste Pit 2 . . . . . P-3-3

3.2.1.3 Waste Pit 3 . . . . . P-3-3

3.2.1.4 Waste Pit 4 . . . . . P-3-4

3.2.1.5 Waste Pit 5 . . . . . P-3-4

3.2.1.6 Waste Pit 6 . . . . . P-3-5

3.2.1.7 Clearwell P-3-5

3.2.1.8 Burn Pit P-3-5

3.2.2 Operable Unit 1 RI/FS Scope P-3-5

4.0 Summary of Contamination and Risks P-4-1

4.1 Overview of the Nature and Extent of Contamination P-4-1

4.2 Overview of the Baseline Risk Assessment P-4-7

4.2.1 Constituents of Potential Concern (CPCs) P-4-8

4.2.2 Exposure Assessment P-4-8

4.2.2.1 Sources of Exposure P-4-8

4.2.2.2 Source Terms P-4-8

4.2.2.3 Land Use Scenarios P-4-9

4.2.3 Toxicity Assessment P-4-10

TABLE OF CONTENTS
(Continued)

4.2.4 Risk Characterization Results P-4-11

4.2.4.1 Current Land Use P-4-11

4.2.4.2 Future Land Use P-4-22

4.2.5 Summary of Uncertainties P-4-22

4.3 Conclusion P-4-23

5.0 Summary of Alternatives P-5-1

5.1 Alternatives Overview P-5-1

5.2 Common Elements P-5-2

5.3 Alternatives Summary P-5-12

5.3.1 Alternative 1 - No-Action Alternative P-5-12

5.3.2 Alternative 4A - Removal, Treatment (Vitrification), and On-Property Disposal P-5-12

5.3.3 Alternative 4B - Removal, Treatment (Cement Solidification), and On-property Disposal P-5-14

5.3.4 Alternative 5A - Removal, Treatment (Thermal Drying), and Off-site Disposal at Nevada Test Site (NTS) P-5-14

5.3.5 Alternative 5B - Removal, Treatment (Thermal Drying), and Off-site Disposal at Permitted Commercial Facility P-5-16

6.0 Evaluation of Alternatives P-6-1

6.1 Identification of the Preferred Remedial Alternative for Operable Unit 1 . . . . . P-6-1

6.1.1 Comparative Analysis P-6-4

6.1.1.1 Overall Protectiveness P-6-4

6.1.1.2 Compliance with ARARs P-6-4

6.1.1.3 Long-Term Effectiveness and Permanence P-6-5

6.1.1.4 Reduction of Toxicity, Mobility, or Volume P-6-6

6.1.1.5 Short-Term Effectiveness P-6-7

6.1.1.6 Implementability P-6-9

6.1.1.7 Cost P-6-13

6.1.1.8 State Acceptance P-6-13

6.1.1.9 Community Acceptance P-6-14

TABLE OF CONTENTS
(Continued)

6.2 Summary of Preferred Remedial Alternative Impacts P-6-14

6.3 Summary of Basis of Preference P-6-14

7.0 Community Participation P-7-1

References R-1

Glossary G-1

Operable Unit 1 Proposed Plan Remedial Investigation and Feasibility Study
Cross-Reference Matrix C-1

LIST OF TABLES

Table	Title	Page
4-1	Incremental Lifetime Cancer Risk Summary Current Land Use, Current Source Term	P-4-12
4-2	Hazard Index Summary Current Land Use, Current Source Term	P-4-13
4-3	Incremental Lifetime Cancer Risk Summary Current Land Use, Future Source Term	P-4-14
4-4	Hazard Index Summary Current Land Use, Future Source Term	P-4-15
4-5	Incremental Lifetime Cancer Risk Summary Future Land Use (Government Reserve), Future Source Term	P-4-16
4-6	Hazard Index Summary Future Land Use (Government Reserve), Future Source Term	P-4-17
4-7	Incremental Lifetime Cancer Risk Summary Future Land Use (Agricultural Use), Future Source Term	P-4-18
4-8	Hazard Index Summary Future Land Use (Agricultural Use), Future Source Term	P-4-19
4-9	Operable Unit 1 Constituents of Concern	P-4-20
4-10	Uncertainties Associated with Estimated Risks from Operable Unit 1	P-4-24
5-1	Estimated Operable Unit 1 Waste Quantities	P-5-3
5-2	Proposed Remediation Levels in Operable Unit 1 Soils	P-5-5
5-3	Operable Unit 1 Interim Pit Subsurface Remedial Levels	P-5-7
6-1	Evaluation Criteria	P-6-2
6-2	Operable Unit 1 Comparative Analysis of Remedial Alternatives	P-6-3

LIST OF FIGURES

Figure	Title	Page
2-1	FEMP Site and Vicinity	P-2-3
2-2	Waste Storage Area	P-2-4

LIST OF ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Constituent of Concern
CPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
CT	Central Tendency
DOE	U.S. Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FFCA	Federal Facility Compliance Agreement
FMPC	Feed Materials Production Center
FS	Feasibility Study
HI	Hazard Index
HQ	Hazard Quotient
HWMU	Hazardous Waste Management Unit
ILCR	Incremental Lifetime Cancer Risk
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NLCO	National Lead Company of Ohio
NLO	National Lead of Ohio
NPL	National Priorities List
NTS	Nevada Test Site
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OH	Ohio
PAHs	polynuclear aromatic hydrocarbons

LIST OF ACRONYMS
(Continued)

PCBs	polychlorinated biphenyls
PEIC	Public Environmental Information Center
PMF	Probable Maximum Flood
PP	Proposed Plan
PRG	Preliminary Remediation Goals
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SWCR	Site-Wide Characterization Report
SWMU	Solid Waste Management Unit
TSDF	Treatment, Storage and Disposal Facility
UAP	uranyl ammonium phosphate
UCL	Upper Concentration Limit
VOCs	Volatile Organic Compounds
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

INTRODUCTION

This Proposed Plan (PP) has been prepared to support the decision-making process for remediation of the Fernald Environmental Management Project (FEMP) Operable Unit 1, known as the Waste Pit Area. The Fernald site consists of a 425-hectare (1,050-acre) area about 29 kilometers (18 miles) northwest of Cincinnati in southwestern Ohio.

This Proposed Plan addresses the long-term management of contaminated material in the area designated as Operable Unit 1 of the FEMP. The Proposed Plan is a document that the U.S. Department of Energy (DOE), as the lead agency, issues to fulfill requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 117 (a).

As further discussed below, this Proposed Plan documents establishment of DOE's preferred remedial alternative. To address overall remediation of Operable Unit 1, that preferred remedial alternative is:

Alternative 5B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at a Permitted Commercial Waste Disposal Facility.

The FEMP site is included on the National Priorities List (NPL) established by the U.S. Environmental Protection Agency (EPA). Inclusion on the NPL reflects the relative importance placed by the federal government on ensuring the expedient completion of cleanup operations at the FEMP. The facility is owned by DOE, which is the lead agency conducting cleanup activities at the site under its Environmental Restoration and Waste Management Program. The EPA and the Ohio Environmental Protection Agency (OEPA) are the support agencies. In addition, the three agencies actively involve the local community and public in decisions about remediation of the FEMP site. Public involvement is an important factor in the decision-making process for site remediation. A final remedy will be selected only after a public comment period has been held and the information submitted during this time has been reviewed, considered, and responded to. The final remedial action plan, as presented in the Record of Decision for Operable Unit 1, could be different from the preferred alternative,

depending upon new information or approaches the lead agency may consider as a result of public comments.

The purpose of this Proposed Plan is to facilitate public participation in the remedy selection process by:

- Identifying the preferred remedial alternative for Operable Unit 1 and presenting the rationale for the preference
- Describing the other alternatives that were considered in detail within the Feasibility Study (FS) Report for Operable Unit 1
- Soliciting public review and comment on all of the alternatives described in Section 5 of this Proposed Plan
- Providing information on how the public can become involved in the remedy selection process

This Proposed Plan is being issued to fulfill public participation responsibilities under Sections 113(k)(2)(B), 117(a), and 121(f)(1)(g) of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA), jointly referred to as CERCLA. This document highlights information that can be found in greater detail in Remedial Investigation and Feasibility Study (RI/FS) Reports and other documents contained in the Administrative Record file for Operable Unit 1. These documents are more complete sources of information regarding remedial actions to be taken. The Administrative Record, which contains information on Operable Unit 1 and the FEMP site in general, is located at the Public Environmental Information Center, 10845 Hamilton-Cleves Highway, Harrison, Ohio, 45030. The public is encouraged to review those documents in order to gain the understanding needed to comment on this Proposed Plan.

Actual or threatened releases of hazardous substances from this site, if not addressed by the preferred alternative or one of the other active measures considered, may present a potential threat to public health, welfare, or the environment.

Under the terms of the Amended Consent Agreement, cleanup activities have been categorized by environmental issues into five study areas, called operable units. Remediation of each operable unit is an incremental step toward comprehensively addressing FEMP site problems. Distinct RI/FS documents are being developed for each of the five operable units. Those documents include:

- The Remedial Investigation, which presents information on the nature and extent of contamination
- The Baseline Risk Assessment, which evaluates health and environmental effects that might occur if no cleanup action were taken
- The Feasibility Study, which evaluates alternatives for cleanup
- The Proposed Plan, which summarizes key information from the Remedial Investigation, Baseline Risk Assessment, and Feasibility Study, and identifies the preferred alternative for remedial action
- The Responsiveness Summary, which provides responses to public comments to the Proposed Plan
- The Environmental Assessment, which addresses National Environmental Policy Act (NEPA) values
- The Record of Decision, which documents the cleanup decisions made for each operable unit

Revised drafts of the Remedial Investigation and Baseline Risk Assessment for Operable Unit 1 were submitted to EPA and OEPA on February 8, 1994 (DOE 1994a). These documents, as well as the Site-Wide Characterization Report (DOE 1993b), are incorporated into this Operable Unit 1 Feasibility Study/Environmental Assessment by reference. The Feasibility Study for Operable Unit 1 (1994c) was first published in draft in March 1994 and has been revised to reflect comments from EPA and OEPA. Along with the clarification of technical and other information, this revised Proposed Plan incorporates figures and tables within the text of each section (rather than placing them at the end of each section). The results of the Feasibility Study, when combined with input from the general public on the preferred remedial alternative and the other remedial alternatives identified in the Proposed Plan, will form the basis for selecting the remedial action. Input from the public and other interested parties will be obtained during the time frame that this Proposed Plan is available for public review and comment and will be documented in the Responsiveness Summary. The

alternative(s) selected for implementation will be documented in the Record of Decision for Operable Unit 1, a draft of which is scheduled to be submitted to EPA and OEPA on November 4, 1994. Operable Unit 1 reports are available in the Administrative Record, located near the FEMP in the JAMTEK Building, 10845 Hamilton-Cleves Highway, Harrison, Ohio, 45030.

OPERABLE UNIT 1 DESCRIPTION

Operable Unit 1 is also known as the Waste Pit Area—a well-defined 37.7-acre area located in the northwest portion of the FEMP property. Operable Unit 1 is located within the Waste Storage Area, west of the former Production Area. The Waste Storage Area includes all of Operable Units 1 and 4, and portions of Operable Unit 2. Operable Unit 1 consists of the following site facilities and their associated environmental media:

- Waste Pits 1 through 6 and their contents
- Burn Pit and its contents
- Clearwell and its contents
- Miscellaneous structures and facilities such as berms, liners, concrete pads, underground piping, utilities, and fencing

OPERABLE UNIT 1 REMEDIAL INVESTIGATION AND BASELINE RISK ASSESSMENT CONCLUSIONS RELEVANT TO THE PROPOSED PLAN

As stated earlier, the Operable Unit 1 Draft Final Remedial Investigation Report, inclusive of the Operable Unit 1 Baseline Risk Assessment, has been forwarded to the U.S. and Ohio EPA. The Baseline Risk Assessment concluded that the wastes of Operable Unit 1 present a potentially unacceptable risk to human health and the environment. As discussed earlier, the FS identifies and evaluates a range of alternatives to implement required remedial action to address this potential risk. While all the findings of the RI are relevant to this PP, the following general findings are particularly important in developing and evaluating remedial alternatives:

- First, there is a very large volume (more than 600,000 cubic yards) of contaminated material associated with the waste pits.

- Second, the waste pit contents are heterogeneous both in terms of contaminant type and concentration and also in the physical makeup of the wastes.
- Third, that while there is a potential increased risk associated with direct contact exposures, a principal potential threat is associated with exposure to groundwater contaminated by the waste pits. Two important findings are associated with this. Large volumes of contaminated pit materials are in very close proximity to the geologic formation of the sole-source Great Miami Aquifer. In addition, significant portions of the waste pit contents exhibit an elevated moisture content (some are saturated) meaning that there is a large pool of contaminated leachate available for migration into the aquifer formation.
- Finally, while radiological contaminants are the principal sources of risk, there are also potentially unacceptable risks associated with volatile and semi-volatile organic chemicals and heavy metals. Elevated concentrations of these contaminants are found in each of the waste pits. The potential implementability and effectiveness of the identified remedial alternatives must be evaluated in specific consideration of the above findings.

FEASIBILITY STUDY PROCESS AND CONCLUSIONS

In the Feasibility Study, remedial action objectives were developed that focus on eliminating or reducing to acceptable levels human and ecological exposure to the contaminated media of Operable Unit 1.

In light of the Operable Unit 1-specific characteristics and objectives described above, a wide range of potential remedial technologies and process options were identified. Individual technologies and process options were screened against the criteria of effectiveness, implementability and cost. As an example of this process, bioremediation was identified as a potential remedial technology. But because biological treatment is not effective in addressing the principal threats associated with radioactivity, this option is one of many that were not retained for detailed analysis in the FS. Other options, however, such as a variety of mechanical waste removal technologies, were considered potentially viable for Operable Unit 1.

Once the technologies and process options were screened, those surviving the screening process were combined to form preliminary remedial alternatives. Eight cleanup remedies initially were developed in the FS.

These preliminary alternatives were also screened against the criteria of effectiveness, implementability and cost. On the basis of this screening, five remedial alternatives were judged to be appropriate for consideration in the detailed analysis portion of the Feasibility Study. The five alternatives retained were as follows:

- Alternative 1 -- No Action
  - Under this alternative, no further action would be taken at Operable Unit 1. The No-Action Alternative was retained to provide a baseline for comparison of alternatives in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).
- Alternative 4 -- Removal, Treatment, and On-Property Disposal

  Alternative 4A -- Treatment Consists of Vitrification
  - Under this alternative, wastes would be turned into a glass-like matrix and placed in an engineered disposal cell at the Fernald site.

  Alternative 4B -- Treatment Consists of Cement Solidification
  - Under this alternative, the waste would be cement solidified and placed in an engineered disposal cell at the Fernald site.
- Alternative 5 -- Removal, Treatment Consisting of Thermal Drying, and Disposal Off Site

  Alternative 5A -- Disposal at the Nevada Test Site
  - Under this alternative, the waste would be excavated, treated by drying to meet waste acceptance criteria, and shipped by rail to a point near Las Vegas and then trucked to the Nevada Test Site for disposal.

  Alternative 5B -- Disposal at a Permitted Commercial Disposal Facility
  - Under this alternative, the waste also would be excavated and treated by drying to meet waste acceptance criteria, then shipped by rail to a permitted commercial disposal facility.

Institutional controls are an element in each of these alternatives.

To evaluate these remedial alternatives nine evaluation criteria have been developed to address the CERCLA requirements as stated in the NCP (40 CFR 300.430). They are:

Threshold Criteria

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)

Assessments against these two criteria relate directly to evaluation against regulatory requirements. An alternative must satisfy these threshold criteria to be selected as a remedial action.

Balancing Criteria

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

Modifying Criteria

- State acceptance
- Community acceptance

The final two modifying criteria will be evaluated following public and agency comments on this Proposed Plan and will be addressed in the Record of Decision once a final remedial action decision is made.

Except for the No-Action Alternative, the remedial alternatives for Operable Unit 1 would provide a permanent solution to the environmental problems in Operable Unit 1. Each action alternative would reduce exposures and risks to humans and the environment by removing sources of contamination, treating the waste, and isolating the treated materials from the environment in a disposal facility. For each of the remedial alternatives, an equal degree of protectiveness of human health and the environment is provided by removal of contaminated pit wastes and soils to attain health-based action levels. That protectiveness is maintained in Alternatives 4A and 4B by treating the waste to limit contaminant mobility. The wastes are then disposed in an on-site facility designed to preclude human

and ecological intrusion and to reduce impacts to groundwater to acceptable levels. Protectiveness is maintained in Alternatives 5A and 5B by drying the wastes and disposing of them at engineered disposal facilities in the arid west where, due to harsh climatic conditions, there are no resident human populations in the immediate vicinity or usable surface water or groundwater resources.

With one exception, all of the action alternatives can be designed to meet identified ARARs. The exception involves Alternatives 4A and 4B. Specifically, the State of Ohio, at OAC 3745-27-07(B)(5), prohibits sanitary waste landfills from being constructed over sole-source aquifers. The Great Miami Aquifer beneath the site has been designated a sole-source aquifer. This citation has been determined to be relevant and appropriate to Operable Unit 1 remedial actions. Accordingly, a waiver from this regulation would be required to implement either Alternative 4A or 4B.

Two options were considered for the primary treatment technology for Alternatives 4A and 4B. The first is chemical stabilization/solidification, which would involve mixing the waste with cement to generate a cement-like product. The second is treatment by vitrification, which would involve melting the waste in a ceramic melter to generate a fritted glass-like product. Prior to both vitrification and cement solidification, the wastes would be dried. The primary treatment for Alternatives 5A and 5B is physical treatment in the form of drying. Alternatives 4A and 4B offer significant advantages in reduction in contaminant mobility over Alternatives 5A and 5B. Alternative 4A is the most advantageous relative to reduction in toxicity because, due to the high temperatures involved, any residual volatile organics and some semi-volatile organics can be destroyed. There is no significant difference among the other alternatives in reduction in toxicity through treatment. Cement solidification would result in a significant volume increase while each of the other alternatives would realize a slight decrease in volume.

As designed, all action alternatives provide an adequate measure of long-term effectiveness and permanence. This is accomplished by the removal of contaminated materials, and by treatment and disposal in an engineered facility. Alternatives 5A and 5B would be equally effective at reducing residual risks permanently. They are also more effective than Alternatives 4A and 4B, since the pit waste material would be removed from the site. Of particular note is the fact that in the event of

releases from the disposed wastes in Alternatives 5A and 5B, the likelihood of impacting receptors is very low due to harsh socioeconomic and climatic factors at the disposal facility. Releases from disposed waste in failure scenarios for Alternatives 4A and 4B represent a more significant threat primarily due to the presence of the sole-source Great Miami Aquifer and a large nearby residential population.

The technical implementability of Alternatives 5A and 5B is judged to be equal and relatively straightforward as the principal remedial elements (excavation, drying, transportation) are robust technologies that are routinely implemented in industry. Waste heterogeneity should not significantly impact the ability to implement these alternatives. There are greater uncertainties associated with the technical implementability of Alternatives 4A and 4B. Appendix C of this document summarizes treatability work specific to these alternatives. Cement solidification has been previously applied to low-level radioactive wastes at other sites with varying degrees of success. The cement solidification facility would be difficult to operate due to the heterogeneous nature of the wastes in the pits. Heterogeneity also impacts the implementability of vitrification. There are additional uncertainties associated with vitrification because a full-scale facility for vitrification of wastes similar to those in Operable Unit 1 has not been constructed elsewhere. The start-up of a first-of-a-kind facility is expected to be difficult. There are no known administrative barriers against implementation of Alternatives 4A and 4B, except for the ARAR issue of the state prohibition against on-property disposal over a sole-source aquifer. Obtaining a waiver from this regulation would be moderately difficult. While Alternatives 5A and 5B must comply with a variety of transportation regulations, there are no known regulations that would prohibit shipment of Operable Unit 1 wastes.

The short-term risks (excluding transportation) to off-site individuals and non-remediation workers would be approximately the same for all four action alternatives. During transportation of waste materials, Alternative 5A would result in slightly higher risks to communities along the transportation route than Alternative 5B. No transportation risks are associated with Alternatives 4A and 4B. The short-term risks (excluding transportation) to remediation workers would be approximately the same for Alternatives 4A and 4B, with 4B having a slightly higher potential for accidents than 4A. The short-term risks for on-site workers of Alternatives 5A and 5B (excluding transportation and package

handling) would be equal, and somewhat lower than Alternatives 4A and 4B, due to the higher potential for accidents associated with on-property disposal. However, there would be the potential for exposures and accidents associated with transportation and package handling. Taking these risks into account, Alternative 5A would have higher dose equivalents and potential accidents for remediation workers than any of the other action alternatives. Alternative 5B, with less waste handling, would have the potential for substantially fewer accidents than the other alternatives, even after the addition of risks associated with transportation.

Cost estimates are used in the feasibility study process under CERCLA to eliminate those remedial alternatives which are significantly more expensive than competing alternatives but do not offer commensurate performance or overall protection of human health and the environment. The cost estimates developed are order-of-magnitude estimates with an intended accuracy range of -30 to +50 percent. Estimates are considered to be order-of-magnitude because of the uncertainties in the information used to develop the estimates.

The estimated present value costs are:

- Alternative 1: $0
- Alternative 4A: $457,740,000
- Alternative 4B: $404,903,000
- Alternative 5A: $645,870,000
- Alternative 5B: $389,509,000

Based on the detailed and comparative analysis of remedial alternatives in the Feasibility Study, this Proposed Plan identifies the preferred alternative. That preferred remedial alternative is:

Alternative 5B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at a Permitted Commercial Waste Disposal Facility

To address the overall remediation of Operable Unit 1, the preferred alternative consists of the following major components:

- Construction of waste processing and loading facilities and equipment
- Removal of water from open waste pits for treatment at the Advanced Waste Water Treatment facility
- Removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil
- Confirmation sampling of waste pit excavations to establish that proposed remediation levels have been achieved
- Pretreatment (crushing/shredding) of waste
- Drying of waste
- Off-site shipment of waste for disposal at a permitted commercial waste disposal facility
- As a contingency, for any waste that fails to meet the waste acceptance criteria of the permitted commercial waste disposal facility (up to 10 percent of the total waste volume), disposal at the Nevada Test Site (NTS) is permitted
- Decommissioning and removal of the drying treatment unit and associated facilities, as well as miscellaneous structures and facilities within the operable unit; oversized material that is amenable to the selected alternative for Operable Unit 3 would be segregated from Operable Unit 1 waste, decontaminated, and forwarded to Operable Unit 3 to be managed as construction rubble.
- Disposition of remaining Operable Unit 1 residual contaminated soils, as amenable, consistent with selected remedies for contaminated process area soils as documented in the Operable Unit 5 Record of Decision
- Placement of clean backfill into excavations; construction of cover system.

The initial preference for this alternative is based on a number of factors relating to technical implementability, long-term effectiveness, cost, and state and community acceptance. First, the technical implementability of this alternative is judged to be better than for the alternatives involving additional treatment and on-site disposal. The technologies associated with waste excavation, handling, drying, containerization, and off-site transportation are commonly applied throughout various industries. The heterogeneity of the waste pit contents is not likely to adversely affect the implementability of any of these technologies. The waste heterogeneity does impact the ability to treat the wastes using cement solidification or vitrification. The effectiveness of both of these technologies depends on use of the appropriate reagent or additive ratios which, in turn, is dependent on the waste form and type. The waste heterogeneity of Operable Unit 1 would make operational field control of the appropriate reagent or additive ratio difficult. It is also noted that vitrification has never been implemented at the scale that would be required for even a portion of Operable Unit 1 wastes, thereby further increasing uncertainties associated with application of that technology.

The long-term effectiveness of the preferred alternative is judged to be more certain than for the alternatives involving additional treatment and on-site disposal. It is recognized that, if successfully implemented, the additional treatment of cement solidification or vitrification can significantly reduce the contaminant mobility, thereby increasing the long-term effectiveness and permanence of the alternative. There are a combination of three factors, however, that lead to the conclusion that the long-term effectiveness of the preferred alternative is more certain.

- The first factor is that over the long term, despite treatment and placement in an on-site engineered disposal facility, releases from the disposed waste are possible. This statement takes into account the uncertainties discussed above that are associated with technical implementation of cement solidification and vitrification.
- The second factor is the location of the Great Miami Aquifer beneath the FEMP, designated as a sole-source aquifer by EPA under the Safe Drinking Water Act. A release could have significant impacts on this valuable resource.
- The third factor is the fact that at the Nevada Test Site and at the representative permitted commercial waste disposal facility, there are no usable groundwater resources, surface water or residences within many miles

of the disposal location. Thus, there is no sole-source aquifer at either location. Because of these factors, the potential impacts of a release at the Nevada Test Site or the representative permitted commercial waste disposal facility are considered to be less significant than for a similar scenario with on-site disposal. This statement considers the presence of the sole-source Great Miami Aquifer beneath the FEMP and the relatively large number of potential human and ecological receptors in the vicinity of the FEMP. It is also noted that, due to area demographics, there is a greater long-term potential for intrusion into an on-site disposal cell. If, in the future, the facility institutional controls broke down, the FEMP would be attractive for various uses, including agriculture. This is not the case for the potential off-site disposal locations.

State and community acceptance are two of the nine criteria that must be evaluated in selecting a remedial alternative. The State of Ohio has indicated a preference that the waste pit contents, because of their nature, be disposed of off site. Because of this, the State of Ohio, in all likelihood, would more readily accept an alternative that involves the off-site disposal of the waste pit contents. In roundtable sessions with members of the public, a desire to dispose of as much FEMP material off site as possible has been expressed. Because of this, in all likelihood, the community would more readily accept an alternative that involves the off-site disposal of the waste pit contents as long as it can be safely implemented.

The preferred alternative, with disposal at a permitted commercial disposal facility, has a very slight cost advantage compared to cement solidification and on-site disposal. There is a larger cost advantage compared to vitrification and on-site disposal.

Based on the information available at this time, DOE believes the preferred alternative provides the best balance of factors considered among the other alternatives with respect to the evaluation criteria. DOE also believes the preferred alternative satisfies the statutory requirement in CERCLA Section 121(b); namely, the preferred would be protective of human health and the environment, would comply with ARARs, would be cost effective, would utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and would satisfy the statutory preference for treatment as a principal element.

Input from the public is an important element of the decision-making process for cleanup actions at the FEMP site. Comments on the proposed remedial action at the FEMP site will be received during a public review and comment period following issuance of the Draft Feasibility Study/Proposed Plan-Environmental Assessment (FS/PP-EA) for Operable Unit 1 documents. Oral comments may be presented at a public meeting that will be conducted. Written comments may be submitted at that public meeting or mailed to the following address before the close of the public comment period:

Mr. Gary Stegner
Director, Public Information
U.S. DOE Fernald Area Office
P.O. Box 398705
Cincinnati, OH 45239-8705
513-648-3014

Information concerning the schedule for the public meeting and dates for the comment period will be announced in the local media and will be available at the Public Environmental Information Center.

Information relevant to the proposed remedial actions, including the RI Report, Baseline Risk Assessment, FS Report, Proposed Plan, and supporting Operable Unit 1 technical reports and documents are provided in the Administrative Record. The public is encouraged to review the RI/FS in order to gain the understanding needed to comment on the Proposed Plan. The Administrative Record is located at the Public Environmental Information Center, just south of the FEMP site. For information regarding the Public Environmental Information Center, call 513-738-0164.

PUBLIC ENVIRONMENTAL INFORMATION CENTER LOCATION AND HOURS
10845 Hamilton-Cleves Highway
Harrison, OH 45030
Monday and Thursday, 9 a.m. to 8 p.m.
Tuesday, Wednesday and Friday, 9 a.m. to 4:30 p.m.
Saturday, 9 a.m. to 1 p.m.

The Administrative Record for EPA Region V is located at the following address and is open to the public during the following hours:

77 West Jackson
Chicago, Illinois 60604
Monday - Friday, 8:30 a.m. to 5:00 p.m.

1.0 INTRODUCTION

This Proposed Plan addresses the long-term management of contaminated material in the area designated as Operable Unit 1 of the Fernald Environmental Management Project (FEMP), formerly known as the Feed Materials Production Center (FMPC). The Proposed Plan is a document that the U.S. Department of Energy (DOE), as the lead agency, issues to fulfill requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 117(a).

As further discussed below, this Proposed Plan documents establishment of DOE's preferred remedial alternative. To address overall remediation of Operable Unit 1, that preferred remedial alternative is:

Alternative 5B - Removal, treatment (thermal drying), and off-site disposal at a permitted commercial waste disposal facility.

The FEMP site is included on the National Priorities List (NPL) established by the U.S. Environmental Protection Agency (EPA). Inclusion on the NPL reflects the relative importance placed by the federal government on ensuring the expedient completion of cleanup operations at the FEMP. The facility is owned by the DOE, which is the lead agency conducting cleanup activities at the site under its Environmental Restoration and Waste Management Program. The EPA and the Ohio Environmental Protection Agency (OEPA) are the support agencies. In addition, the three agencies actively involve the local community and public in decisions about remediation of the FEMP site. Public involvement is an important factor in the decision-making process for site remediation. A final remedy will be selected only after the public comment period has ended and the information submitted during this time has been reviewed and considered. The final remedial action plan, as presented in the Record of Decision, could be different from the preferred alternative, depending upon new information or approaches the lead agency may consider as a result of public comments.

The purpose of this Proposed Plan is to facilitate public participation in the remedy selection process by:

- Identifying the preferred remedial alternative for Operable Unit 1 and presenting the rationale for DOE's preference
- Describing the other alternatives that were considered in detail within the Draft Final Feasibility Study (FS) Report for Operable Unit 1
- Soliciting public review and comment on all of the alternatives described in Section 5 of this Proposed Plan
- Providing information on how the public can become involved in the remedy selection process

This Proposed Plan is being issued to fulfill public participation responsibilities under Sections 113(k)(2)(B), 117(a), and 121(f)(1)(g) of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA), jointly referred to as CERCLA. This document highlights information that can be found in greater detail in Remedial Investigation and Feasibility Study Reports and other documents contained in the Administrative Record file for Operable Unit 1. These documents are more complete sources of information regarding remedial actions to be taken. The Administrative Record, which contains information on Operable Unit 1 and the FEMP site in general, is located at the Public Environmental Information Center, 10845 Hamilton-Cleves Highway, Harrison, Ohio, 45030. The public is encouraged to review those documents in order to gain the understanding needed to comment on this Proposed Plan.

Actual or threatened releases of hazardous substances from this site, if not addressed by the preferred alternative or one of the other active measures considered, may present a potential threat to public health, welfare, or the environment.

The Proposed Plan includes the following information:

- Section 2 presenting the history and description of the FEMP.
- Section 3 defining the scope and role of Operable Unit 1.

- Section 4 summarizing the nature and extent of contamination in Operable Unit 1, and risks to human health and the environment if no remedial action is taken.
- Section 5 summarizing remedial alternatives considered for Operable Unit 1.
- Section 6 summarizing the evaluation of remedial alternatives and summarizing DOE's preferred remedial alternative.
- Section 7 describing opportunities for public involvement.
- A reference list serving as a bibliography.
- A glossary defining key terms and acronyms.
- A cross-reference matrix identifying other Operable Unit 1 documents that provided topics discussed in this Proposed Plan.

2.0 DESCRIPTION AND HISTORY OF THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

2.1 HISTORY OF THE FEMP SITE

The Feed Materials Production Center (FMPC) was the original name of the Fernald Environmental Management Project (FEMP). The site was constructed in 1950 and 1951 under the authority of the Atomic Energy Commission, later known as the Energy Research and Development Administration and, eventually, the DOE.

The FMPC's primary mission was to process "feed" materials into high-purity uranium metal. In 1951, National Lead Company of Ohio (NLCO), later known as National Lead of Ohio Inc. (NLO), entered into contract with the Atomic Energy Commission as the Operations and Maintenance Contractor for the facility. NLO was the site's prime operating contractor through 1985. On January 1, 1986, Westinghouse Materials Company of Ohio, a wholly owned subsidiary of Westinghouse Electric Corporation, assumed operations and management responsibility for the site.

On March 9, 1985, the U.S. Environmental Protection Agency (EPA) issued a Notice of Noncompliance to the FMPC, identifying EPA's concerns about environmental impacts associated with the facility's past and ongoing operations. On July 18, 1986, a Federal Facility Compliance Agreement (FFCA) was entered into detailing the actions to be taken by the FMPC to assess and investigate the environmental impacts. Pursuant to the FFCA, a Remedial Investigation/Feasibility Study (RI/FS) was initiated in July 1986, to meet CERCLA requirements. In November 1989, the FMPC was named to the National Priorities List (NPL). On April 9, 1990, the EPA and the DOE entered into a Consent Agreement that became effective on June 29, 1990; the Consent Agreement identified five operable units for response actions and revised the deadlines for the RI/FS. The Consent Agreement as amended on September 20, 1991 and effective December 19, 1991, further revised the schedules for the operable units. This Amended Consent Agreement is in effect today.

Production ceased in the summer of 1989, after 37 years of operation, due to a declining demand for uranium feed products. In June 1991, the site was officially closed for production by an act of

Congress. To reflect the evolution to its new mission of environmental restoration, the site was renamed the Fernald Environmental Management Project. Shortly thereafter, the DOE developed the concept of an Environmental Restoration Management Contractor to oversee the site's cleanup and remediation. On December 1, 1992, the Fernald Environmental Restoration Management Corporation (FERMCO) assumed responsibility for managing environmental restoration.

2.2 SITE DESCRIPTION

The FEMP site is a 425-hectare (1,050-acre), government-owned facility located just north of Fernald, Ohio, a small farming community, and lies on the boundary between Hamilton and Butler Counties. Of the total site area, 345 hectares (850 acres) are in Crosby Township of Hamilton County, and 80 hectares (200 acres) are in Ross and Morgan Townships of Butler County. Other nearby communities include Shandon, New Baltimore, Ross, and Harrison (See Figure 2-1). The facility is approximately 29 kilometers (18 miles) northwest of downtown Cincinnati.

Operable Unit 1 is located within the Waste Storage Area, west of the former Production Area (see Figure 2-2). The Waste Storage Area includes all of Operable Units 1 and 4, and portions of Operable Unit 2. Operable Unit 1 consists of the following site facilities and their associated environmental media:

- Waste Pits 1 through 6 and their contents
- Burn Pit and its contents
- Clearwell and its contents
- Miscellaneous structures and facilities such as berms, liners, concrete pads, underground piping, utilities, and fencing

The majority of the wastes disposed in the pits includes general sump sludge, neutralized raffinates, and magnesium fluoride. Detailed descriptions of these wastes can be found in the Operable Unit 1 Remedial Investigation Report. A discussion of the nature and extent of contamination found in Operable Unit 1 is presented in Section 4 of this Proposed Plan.

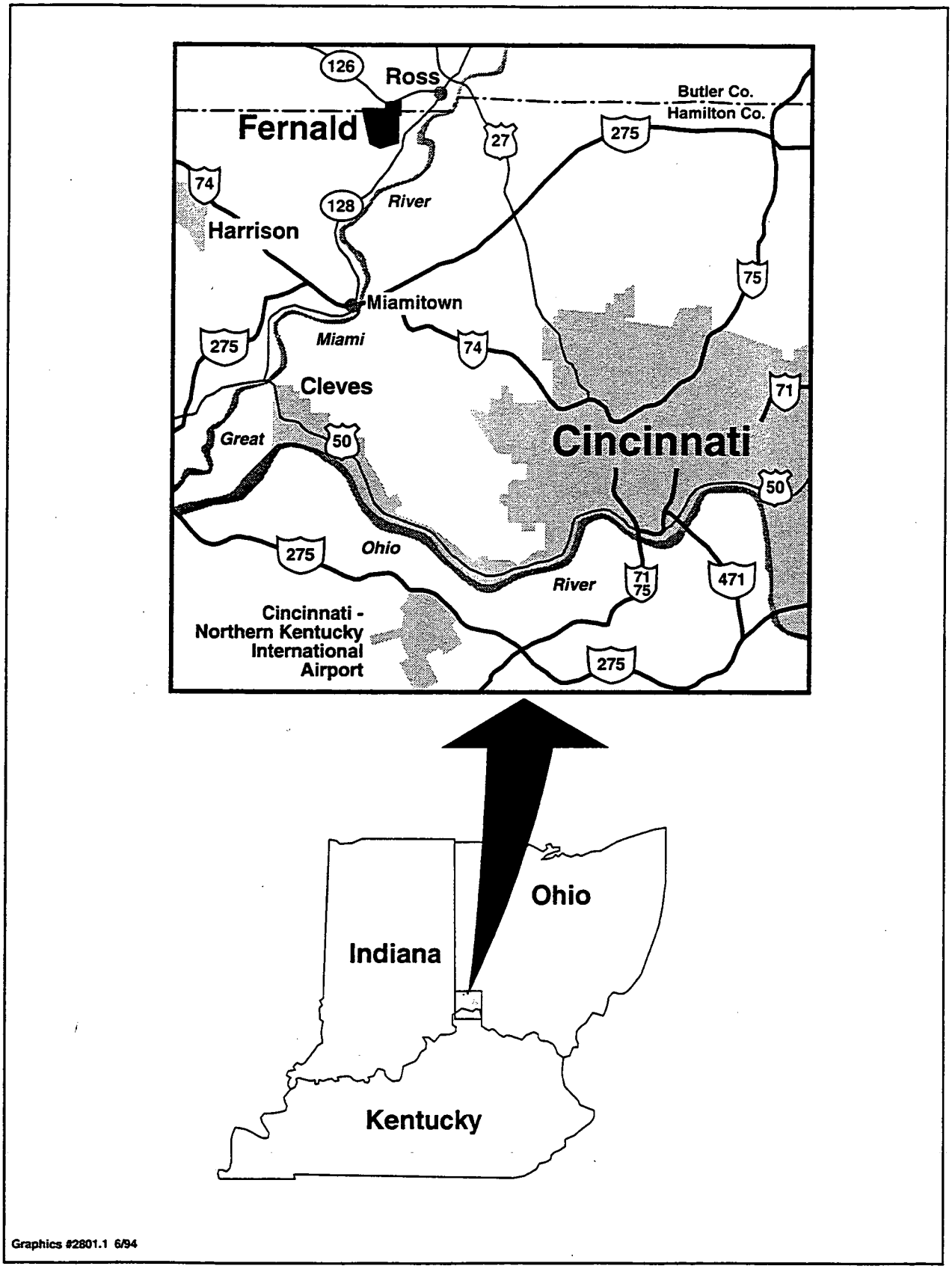
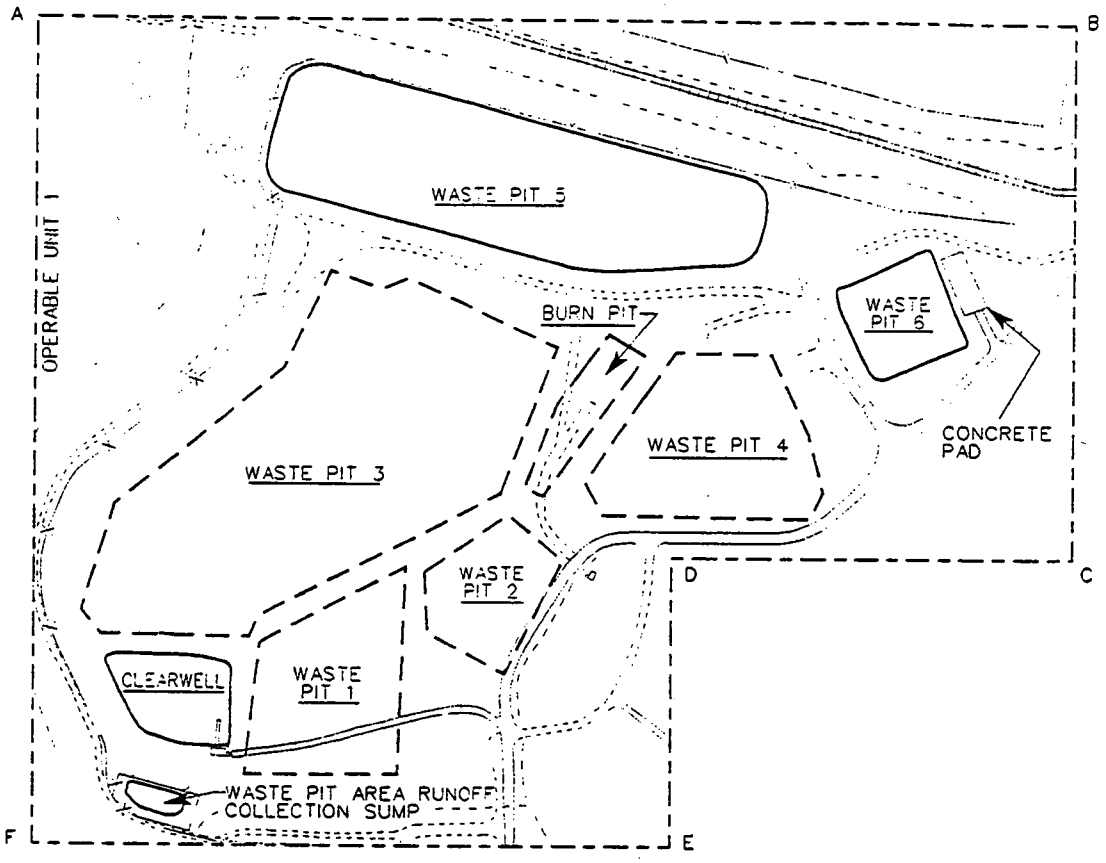


Figure 2-1 FEMP Facility Location Map



NOTES:

1. PITS 1, 2, 3 AND THE BURN PIT ARE COVERED WITH SOIL CAPS AND VEGETATED.
2. PIT 4 HAS AN INTERIM CAP.
3. PITS 5, 6 AND CLEARWELL ARE WATER COVERED
4. COORDINATES SHOWN ARE OHIO STATE PLANAR COORDINATES, ADJUSTED PER THE NORTH AMERICAN DATUM (NAD) OF 1983.

OU1 STATE PLANAR COORDINATES		
POINT	NORTHING	EASTING
A	482364	1377824
B	482364	1379432
C	481499	1379432
D	481499	1378812
E	481033	1378812
F	481033	1377824

LEGEND:

- FENCE LINE
- DRAINAGE WAY
- CSX RAIL LINE
- PAVED ROADWAY
- GRAVEL ROADWAY
- OPERABLE UNIT 1 OUTLINE
- COVERED PIT OUTLINE
- OPEN PIT OUTLINE

SCALE: 0 — 300 FEET

409191-A-410 / OU1/ KNOX/ DS
409194 10.OU1 02-10-94 DON COSS

FIGURE 2-2 OPERABLE UNIT 1 SITE MAP

3.0 SCOPE AND ROLE OF OPERABLE UNITS

3.1 THE OPERABLE UNIT CONCEPT

A major component of the Federal Facility Compliance Agreement (FFCA) was initiation of the Remedial Investigation/Feasibility Study (RI/FS) at the Fernald Environmental Management Project (FEMP). The RI/FS Work Plan (DOE 1988) identified 39 site areas for investigation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These 39 areas were grouped into five "operable units" to expedite the RI/FS process. The operable unit concept became a condition of the April 1990 Consent Agreement between the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) as amended in September 1991.

The Record of Decision (ROD) is the final step in the RI/FS process; it establishes the selected remedial alternative and provides a time frame by which remediation efforts can begin. A summary description of the operable units and the dates that each draft ROD is scheduled to be submitted to the EPA are listed below:

Operable Unit 1:	Six waste pits, a Burn Pit, a Clearwell, and associated media Draft ROD: November 6, 1994
Operable Unit 2:	Two lime sludge ponds, two fly ash piles, a disposal area containing construction rubble, and a solid waste landfill Draft ROD: January 5, 1995
Operable Unit 3:	The former Production Area, consisting of plant buildings, scrap metals, equipment, drummed inventories, and associated media Draft ROD: April 2, 1997
Operable Unit 4:	Four concrete storage silos and associated structures, and equipment Draft ROD: August 9, 1994
Operable Unit 5:	Environmental media (air, water, groundwater, and soils) not associated with other operable units Draft ROD: July 3, 1995

A sixth operable unit, the Comprehensive Site-Wide Operable Unit, was added in 1993 as a provision of the Amended Consent Agreement. This is not a specific site area; it will be used to make a final

site-wide assessment to ensure that ongoing planned remedial actions identified in the RODs for the five operable units will provide a comprehensive remedy which is protective of human health and the environment. The ROD for the Site-Wide Operable Unit will be issued subsequent to those of the five other operable units.

3.2 SCOPE AND ROLE OF OPERABLE UNIT 1

3.2.1 Description of Operable Unit 1

Operable Unit 1 consists of the following site facilities and their associated environmental media:

- Waste Pits 1 through 6 and their contents
- Burn Pit and its contents
- Clearwell and its contents
- Miscellaneous structures and facilities such as berms, liners, concrete pads, underground piping, utilities, and fencing

Since the beginning of uranium production operations in 1951, on-site facilities have been used for the storage of low-level radioactive wastes generated by chemical and metallurgical processes. Specifically, much of these wastes have been deposited in one of the six waste pits or the Clearwell, or burned in the Burn Pit. Waste Pits 1 through 6, the Clearwell, and the Burn Pit make up approximately 5.3 hectares (37.7 acres) and are identified in Figure 2-2. A detailed discussion of each pit's construction, contents, and volume are provided in the Draft Final Operable Unit 1 RI Report (DOE 1994a). A summary of each waste pit follows.

3.2.1.1 Waste Pit 1

Waste Pit 1 was constructed in 1952 and is considered a dry pit, since the waste slurries other than effluent from the general sump were filtered or calcined to remove water before they were placed in the pit. This waste pit received primarily depleted magnesium fluoride slag, and depleted residues with smaller amounts of trailer cake, uranyl ammonium phosphate (UAP) filtrate, graphite/ceramics, and general sump sludge. It was, however, used as a clearwell for liquids removed from Waste Pit 2

in 1958 and 1959. Waste Pit 1 was closed and covered with clean fill in 1959. This waste pit is currently classified as a Solid Waste Management Unit under the Resource Conservation and Recovery Act (RCRA).

3.2.1.2 Waste Pit 2

In 1957, Waste Pit 2 was constructed northeast of Waste Pit 1. Waste Pit 2 is also considered a dry pit and received primarily trailer cake and general sump sludge with smaller amounts of UAP filtrate, raffinate, depleted residues, and graphite/ceramics. Waste Pit 2 was also used as a settling basin for neutralized raffinate during 1958 and 1959, prior to completion of Waste Pit 3, because the drying equipment available at that time could not process all of the raffinate produced by plant operations. Waste Pit 2 was closed and covered with clean fill in 1964. This waste pit is currently classified as a RCRA Solid Waste Management Unit.

3.2.1.3 Waste Pit 3

Waste Pit 3 was placed in service in December 1958 and was the first waste pit built specifically for settling solids from liquid waste streams. Primarily, lime-neutralized raffinate slurries, as well as contaminated storm water from the Burn Pit, were pumped to Waste Pit 3. After Waste Pit 2 was filled, Waste Pit 3 received general sump sludge, raffinate, trailer cake and slag leach with lesser amounts of water treatment sludge and thorium wastes. Starting in December 1958, lime sludge from the Water Treatment Plant was added to supplement the lime used for raffinate neutralization. Also, large quantities of neutralized residues from acid leaching of uranium-bearing magnesium fluoride slag were pumped to Waste Pit 3 during the late 1960s, prior to completion of Waste Pit 5. In 1973, fill material including filter cake, slag leach residue, lime sludge, and flyash was placed in Waste Pit 3 and construction activities were initiated to cover this waste pit with soil. Waste Pit 3 covering activities were complete in 1977. This waste pit is currently classified as a RCRA Solid Waste Management Unit.

3.2.1.4 Waste Pit 4

Waste Pit 4 was constructed in 1960 and received solid wastes that included trailer cake, depleted slag and depleted residues with lesser amounts of thorium wastes and graphite/ceramics, as well as unknown quantities of noncombustible wastes. Process residues included filter sludges, raffinates, graphite, magnesium fluoride slag, and pyrophoric uranium-bearing materials. Thorium metal and residues were hauled to the waste pits in drums and were placed in Waste Pit 4 when additional metal recovery was not economically feasible. At least 100 drums were deposited on the west side of this waste pit. Waste Pit 4 also received noncombustible trash including cans, concrete, asbestos, and construction rubble. Lime was occasionally added to standing water within Waste Pit 4 for uranium precipitation prior to the transfer of liquids to Waste Pit 5 for settling and discharge. Barium-chloride-contaminated floor sweepings were also disposed of in Waste Pit 4 from 1980 to 1983. Disposal activities in Waste Pit 4 were terminated in 1985. The waste pit was closed in 1986 and cover activities started. Waste Pit 4 is currently classified as a RCRA Hazardous Waste Management Unit and has undergone interim closure. During interim closure, the waste pit was covered will fill material, clay, and a polyethylene liner. Final closure of Waste Pit 4 will be completed in conjunction with remedial actions under CERCLA.

3.2.1.5 Waste Pit 5

Waste Pit 5 was constructed and placed into service in 1968. Waste Pit 5 served as a settling basin for slurries in the form of general sump sludge, raffinate, slag leach, water treatment sludge, and thorium waste. Lime sludge was added to this waste pit to supplement the lime used to neutralize the raffinate and heat treatment quench water was discharged directly to Waste Pit 5. The supernatant and sludges produced by the co-precipitation of thorium wastes with barium carbonate and aluminum sulfate, and the precipitation of uranium with calcium oxide were deposited in Waste Pit 5. The discharge of slurred waste materials into Waste Pit 5 was stopped in 1983 and use of this waste pit as a settling basin was discontinued in 1987. Waste Pit 5 is currently covered by water and is classified as a RCRA Hazardous Waste Management Unit.

3.2.1.6 Waste Pit 6

Waste Pit 6 was constructed from September 1978 to June 1979 and received only depleted wastes in the form of depleted slag and depleted residues. Extrusion residue and heat treatment quench water were also deposited in Waste Pit 6. Use of Waste Pit 6 ceased in 1985. Waste Pit 6 is currently covered by water and is classified as a RCRA Solid Waste Management Unit.

3.2.1.7 Clearwell

The Clearwell was constructed in 1959 during Waste Pit 3 construction activities and received surface water runoff from the waste pits and surface liquid (supernatant) from Waste Pits 3 and 5. It acted as a final settling basin prior to periodic discharge to the Great Miami River. The Clearwell is currently classified as a RCRA Solid Waste Management Unit.

3.2.1.8 Burn Pit

The clay used to line Waste Pits 1 and 2 during their construction was obtained from an area immediately northeast of Waste Pit 2, which at that time was called the clay pit. A gravel dumping pad was eventually built up on the north end of the resulting excavation so that trucks could back into the deepest part of the waste pit to dump combustible wastes. Thus, the waste pit became known as the Burn Pit. Although records were not kept on all of the materials or amounts deposited, it is known that the Burn Pit was used primarily to burn combustible materials such as laboratory chemicals; pyrophoric and reactive chemicals; oils; low-level contaminated combustible material, such as pallets and skids; and cafeteria debris. In addition, several materials were deposited directly into the Burn Pit, including cans, bottles, general refuse, and laboratory glassware. The Burn Pit was filled in 1968 during the construction of Waste Pit 5. The Burn Pit is currently classified as a RCRA Solid Waste Management Unit.

3.2.2 Operable Unit 1 RI/FS Scope

The RI/FS for Operable Unit 1 has been conducted to develop a detailed understanding of the nature of the waste materials, their impacts on the surrounding environment, and the potential threat that Operable Unit 1 components pose to human health and the environment. This detailed understanding is required to: (1) support the decision as to whether remedial action is warranted and (2) support the

selection of the most appropriate remedial action alternative to apply to the existing conditions within Operable Unit 1. Operable Unit 1 represents a potential source of contamination to groundwater and other environmental media. Cleanup goals must be formulated to ultimately protect human health and the environment by isolating, removing, or treating the source of contamination.

The RI Report (DOE 1994a) assesses the nature and extent of contamination associated with Operable Unit 1 and also examines the impacts associated with the No-Action Alternative (i.e., taking no action to remediate this operable unit's contamination). Additionally, the Site-Wide Characterization Report (SWCR) (DOE 1993b) supplements the RI evaluation of the No-Action Alternative by providing an assessment of the cumulative environmental impacts associated with existing conditions at the FEMP on a site-wide basis. (The SWCR is available at the Public Environmental Information Center.)

The Draft Final FS Report for Operable Unit 1 (DOE 1994c) evaluates the range of available cleanup alternatives for the permanent disposition of waste contained in Waste Pits 1 through 6, the Burn Pit, Clearwell, and associated contaminated environmental media, including covers, liners, surrounding soil and waters incidental to the remediation of the source units. The Draft Final FS Report, prepared under CERCLA, has been written to incorporate National Environmental Policy Act (NEPA) values (see glossary). In making this decision, the DOE policy integrates NEPA requirements into the CERCLA process. However, it is not the intent of the DOE to make a statement of the legal applicability of NEPA to CERCLA actions. Please note that for evaluation of NEPA values, a representative permitted commercial disposal facility near Clive, Utah, was considered. The Draft Final FS Report for Operable Unit 1 (DOE 1994c) is issued as a Feasibility Study/Proposed Plan-Environmental Assessment (FS/PP-EA). The Draft Final RI Report for Operable Unit 1 (DOE 1994a) is incorporated into the Feasibility Study/Proposed Plan-Environmental Assessment by reference.

4.0 SUMMARY OF CONTAMINATION AND RISKS

This section summarizes the nature and extent of contamination in environmental media associated with Operable Unit 1. It also identifies potential risks to human health posed by the continued storage of these materials within Operable Unit 1 and an overview of the potential risks posed by the Fernald Environmental Management Project (FEMP) to ecological receptors.

4.1 OVERVIEW OF THE NATURE AND EXTENT OF CONTAMINATION

This section summarizes the nature and extent of contamination within environmental media in Operable Unit 1. These environmental media include surface soil, subsurface soil, pit liners and caps, perched groundwater, Great Miami Aquifer groundwater, surface water, sediment, and air. This section also contains an overview of the levels of direct radiation associated with the current conditions within Operable Unit 1. Additional detail on these conditions is provided in Section 4 of the Remedial Investigation (RI) Report for Operable Unit 1, which the public is encouraged to review.

Surface and Vadose Zone Soil

Radiological analyses of surface soil show that uranium is the predominant radionuclide contaminant in Operable Unit 1 surface soils. Uranium-238 was present at above-background (higher than naturally occurring) concentrations at all sample locations. The highest noted uranium-238 activity concentration was 1,500 picoCuries (see glossary) per gram found at a sample point located south of Waste Pit 6 and east of Waste Pit 4. An area east of Waste Pit 2 yielded uranium-238 activity concentrations in the range of 25 to 750 picoCuries per gram.

Chemical analyses of surface soil indicate that cadmium, chromium, manganese, molybdenum, and silver are the principal inorganic contaminants. Organics sampling revealed elevated concentrations of pesticides and polychlorinated biphenyls (PCBs) (see glossary) in those samples within the boundaries of Operable Unit 1. These contaminants correspond to the characteristics of waste material contained in the adjacent waste pits. Pesticides and herbicides were used throughout the lifetime of the waste pits for insect control (principally those waste pits with surface water present,

Waste Pits 5 and 6) and weed/grass control. Because of the pesticide and herbicide use, their presence in the waste pits was anticipated. One sample exhibited excessive levels of polycyclic aromatic hydrocarbons, often referred to as polynuclear aromatic hydrocarbons (PAHs).

Subsurface soil from four geologic zones was analyzed: (1) glacial overburden; (2) upper saturated sand and gravel layer; (3) lower saturated sand and gravel layer; and (4) the deep saturated sand and gravel layer. Principal radiological constituents found within the glacial overburden include uranium-238 and its progeny products (uranium-234, thorium-230, and radon-226). In the upper saturated sand and gravel layers, radionuclide activity concentrations were significantly lower than those found in the glacial overburden. One sample, obtained at a depth of 20.27 meters (66.5 feet), showed levels of uranium-234 and strontium-90 slightly above background (i.e., levels of a chemical or radionuclide found in areas near the FEMP not affected by the site). No radiological constituents exceeded background levels in samples from either the lower or deep saturated sand-and-gravel layer.

Groundwater

Groundwater samples were collected from monitoring wells drilled at various locations within Operable Unit 1. All of the 1000-series monitoring wells (wells within the glacial overburden; refer to Section 4.4 of the Operable Unit 1 RI Report for well locations) in Operable Unit 1 showed elevated concentrations of uranium isotopes. RI/FS program samples indicate that the pattern of elevated uranium concentrations within Operable Unit 1 perched groundwater appears to be centered primarily in the vicinity of Waste Pit 1. An elevated area of uranium concentrations was noted at Well 1073, located near or within the border of Waste Pit 1. It is noted that Well 1073 may intersect waste pit material, thereby affecting groundwater sample contaminant concentrations.

The majority of the radiological contaminants, mainly uranium isotopes, strontium-90, and technetium-99 present in the 2000-series monitoring wells (wells in the upper sand and gravel layer of the Great Miami Aquifer), appear to be localized in the east and northeast portion of Operable Unit 1 in the vicinity of Waste Pit 4, and the Burn Pit. Uranium concentration levels are relatively uniform in all wells located in this area. Groundwater at this depth flows from west to east and the wells located west of the principal source areas (Waste Pit 4 and Burn Pit) contained significantly lower

levels of radionuclides. It appears that these two source areas are the primary contributors of radiological contamination to the upper saturated sand and gravel layer of the Great Miami Aquifer.

Elevated uranium concentrations were detected in all but one 3000-series well (located in the northwest corner of Operable Unit 1, upgradient of the Waste Pit Area). (The 3000-series wells monitor the lower saturated sand and gravel layer of the Great Miami Aquifer.) The highest levels of total uranium occurred in wells located in the northeast part of Operable Unit 1. Due to the limited amount of data on the 4000-series monitoring wells that monitor the lowest portion of the Great Miami Aquifer, the extent of radiological contamination has not been fully characterized at this time. The Great Miami Aquifer will be fully characterized as part of the Operable Unit 5 RI, which includes environmental media such as groundwater. The groundwater monitoring program, performed to comply with certain RCRA requirements, revealed concentrations of technetium-99 in six wells in the Operable Unit 1 area. From these data, it appears that Operable Unit 1 is contributing radiological constituents to the upper and lower saturated sand-and-gravel layers of the Great Miami Aquifer.

The presence of organic constituents in the 1000-series monitoring wells is limited. A well located southwest of Waste Pit 1 was the only well to identify significant organic constituents in the glacial overburden. The organic compounds trichloroethene (540 micrograms/liter), tetrachloroethene (290 micrograms/liter), 1,2-dichloroethylene (120 micrograms/liter), and 1,1-dichloroethane (45 micrograms/liter) were detected in this well. These compounds were also detected in the Waste Pit 1 materials and leachate samples. It appears that the majority of the organic constituents in the glacial till may be linked with the wastes in Waste Pit 1. Ten organic constituents were detected in the 2000-series wells, including acetone, aldrin, bis(2-ethylhexyl) phthalate, heptachlor, carbon disulfide, methylene chloride, 1,1,1-trichloroethane, toluene, 1,2-dichloroethylene, and 1,1-dichloroethane. Wells located in the vicinity of the Burn Pit and Waste Pit 4, and located east of the Clearwell, have detected concentrations of two to four organic constituents each. All three of these waste areas had detectable concentrations of one or more of these organic compounds in their waste material or sediment samples. The 3000-series wells had very limited organic chemical detections. Two of these wells had detectable concentrations of toluene and acetone. Benzene, 1,1-dichloroethane,

tetrachloroethene, and trichloroethene were also detected in one of the two wells. Only four organic constituents were detected, in low concentrations (5 micrograms/liter each), in the 4000-series wells samples: trichloroethene, tetrachloroethene, 1,1-dichloroethane and chlorobenzene. Two common laboratory contaminants were detected in the 4000-series wells during the RCRA program. There is no indication of significant organic contamination of the deep saturated sand and gravel layer of the Great Miami Aquifer in the vicinity of Operable Unit 1. However, the Waste Pit Area does appear to be a contributor to the low levels of organic constituents in the deep saturated sand-and-gravel layer of the Great Miami Aquifer.

Twenty-six inorganic contaminants were detected at above-background levels in the 1000-series wells, mostly correlating to those contaminants detected in the pit waste material and leachate samples. The more significant constituents that are elevated in both the perched groundwater and waste material leachate samples are: calcium, beryllium, copper, cadmium, lead, manganese, magnesium, molybdenum, nickel, selenium, and vanadium. Fifteen inorganic constituents were detected at above-background concentrations in at least one sample collected from the 2000-series wells. These analytes detected at concentrations above background include aluminum, barium, calcium, magnesium, and selenium. The three wells that consistently showed elevated levels of these constituents are located in the northeast section of Operable Unit 1. Since regional aquifer groundwater in the area of the waste pits flows from west to east, it appears that the waste pits are serving as a source of inorganic contamination to the Great Miami Aquifer. Nine inorganic constituents were detected at above-background concentrations in at least one sample collected from the 3000-series wells. These analyses include: aluminum, antimony, barium, calcium, manganese, magnesium, mercury, selenium, and vanadium. Similar to the 2000-series well characterization, it appears that the majority of the inorganic chemical contamination in the 3000-series horizon is located in the northeast portion of the site, possibly indicating Waste Pit 3 as a source. Only five inorganic constituents were detected at above-background concentrations in the 4000-series wells.

It should be noted that Operable Unit 5 has site-wide responsibility for investigation of groundwater, including perched groundwater.

Surface Water and Sediment

A review of data from site studies shows a high degree of variability in the surface water contamination concentration pattern. The reasons for variations in the data could be attributed to the amount of rainfall runoff during the time of sampling, topography that would affect flow from the area, the settling of contaminated suspended solids, and the existence of a contaminant source upgradient of the sampling location.

The highest concentration of contaminants in surface water was detected at drainageways that received surface runoff from Waste Pits 3, 4, 5, and 6. The predominant contaminant is uranium. The two drainageways running east-west between Waste Pits 3, 4, and 5 were found to be contaminated along their total lengths. Another drainageway running southeast and turning southwest between Waste Pits 4 and 6 contained water with elevated uranium concentrations. The drainageways in the north part of Operable Unit 1 were found to be the least contaminated. It should be noted that these drainageways were significantly modified to re-route runoff as part of the Storm Water Control Removal Action, which included removal of some contaminated soils in these areas.

Sediments were sampled along drainageways which are downstream of potential sources of releases within Operable Unit 1. The highest levels of contaminants were detected at locations downgradient from Waste Pit 4. The predominant contaminant was depleted uranium. The drainageway located south of Waste Pits 4 and 6 revealed elevated levels of uranium along its entire length. Another drainageway between Waste Pits 4 and 5 showed elevated uranium concentrations.

Air and Direct Radiation

Airborne radon measurements are routinely collected both on and off the FEMP property as part of the ongoing environmental monitoring program. As part of this program, the FEMP monitors radon concentrations at 21 locations along the FEMP perimeter fence. The average annual radon concentration along the FEMP fenceline for 1989 through 1992 was 0.74 picoCuries per liter in 1989, 0.74 picoCuries per liter in 1990, 0.90 picoCuries per liter in 1991 and 0.57 picoCuries per liter in 1992. The maximum annual radon concentration recorded during this period was 1.5 picoCuries per liter observed at the radon monitoring station located at the northeast corner of the site. None of the

observed radon concentrations exceeded either the DOE guideline of 3.0 picoCuries per liter above background levels or the EPA limit of 4.0 picoCuries per liter for indoor radon concentrations.

The FEMP operates nine on-site air monitoring stations to measure the concentration of airborne radioactive particulates along the site perimeter. The average annual concentration of airborne uranium at each fence line monitoring station was well below the DOE guideline of 0.1 picoCuries per cubic meter during the period 1989 through 1992. Each year, since production operations ceased in 1989, data have shown a general decrease in airborne uranium concentrations along the FEMP fence line since production operations ceased in 1989.

Direct radiation measurements were taken throughout Operable Unit 1 to help assess worker health and safety and to identify appropriate soil sampling locations. Localized areas yielded elevated exposure rates greater than 3 millirad per hour. The highest dose rate, 35 millirad per hour, was located near the southwest perimeter of Waste Pit 6. Radiological analyses of soil samples revealed that uranium-238 and short-lived progeny are the principal constituents causing elevated dose rates.

Ecological Characterization

Radiological constituents were detected at low levels near the analytical detection limit in soil, agricultural crops, and garden produce samples from both off-site control areas and other areas in the vicinity of the FEMP.

Samples collected near Operable Unit 1 suggest limited evidence of uptake, assimilation, and transfer of radiological constituents through ecological food chains. Although concentrations of uranium in soil and vegetation within Operable Unit 1 were the highest in samples obtained on FEMP property, ratios of radionuclide concentrations in the vegetables and soil were generally similar to concentration ratios in garden produce and agricultural crops from control sites and other sites in the FEMP vicinity.

Detectable levels of radionuclides in fish collected from Paddys Run suggest that organisms may have been exposed to constituents (both hazardous and nonhazardous). This finding is consistent with

uranium's known potential to bioconcentrate in aquatic organisms. Operable Unit 1 mammals were free of detectable concentrations of organic constituents. However, elevated levels of arsenic, fluoride, sulfate, and zinc were recorded. Fish collected from Paddys Run yielded no detections of organics or pesticides. However, elevated concentrations of aluminum, arsenic, barium, cadmium, fluoride, mercury, sulfide, and zinc were found.

Results of the ecological chemical characterization demonstrate that the only organic constituents of concern in Operable Unit 1 vegetation is butyl benzyl phthalate. In addition, elevated levels of arsenic, barium, mercury, and zinc were noted.

4.2 OVERVIEW OF THE BASELINE RISK ASSESSMENT

During the Operable Unit 1 Remedial Investigation, an analysis was conducted to estimate the human health risks that could result from exposure to the hazardous wastes of Operable Unit 1 if no remediation is performed beyond that accomplished to date. This analysis is referred to as a Baseline Risk Assessment.

The Baseline Risk Assessment consists of five primary steps. First, chemical and radiological constituents that might cause adverse health effects are determined; this process is called Constituent of Potential Concern (CPC) determination and is discussed in Section 4.2.1. The second step defines how the land will be used, how exposure to contaminants might occur and how receptors (hypothetical inhabitants and visitors to the site) would be exposed; this is called exposure assessment and is discussed in Section 4.2.2. In the third step, the hazardous effects of all CPCs are characterized; this step is termed toxicity assessment and is discussed in Section 4.2.3. The next step of the Baseline Risk Assessment is the hazard assessment where results of the first three steps are combined to determine health hazards for all receptors. This step is summarized in Section 4.2.4. A semi-quantitative analysis of uncertainties and the effect of these uncertainties on the baseline risk assessment is the next step of the Baseline Risk Assessment, and is presented in Section 4.2.5. The public is encouraged to review Section 6 and Appendix E of the Operable Unit 1 RI Report (DOE, 1994a) for detailed information on risks associated with Operable Unit 1.

4.2.1 Constituents of Potential Concern (CPCs)

CPCs are constituents that remain after a two-step statistical and toxicological screening process. That screening process focuses on the chemicals and radionuclides that are of concern to human health. In the first step, statistical analyses compared measured on-property concentrations of each remaining CPC to background concentrations of that constituent in the same media (soil, sediment, surface water, etc.). In the second step, each constituent detected in a given medium was reviewed for its toxicological significance, and those that were not likely to be of human health concern were excluded.

Three categories of CPCs were found: radionuclides, inorganic chemicals and organic compounds. Most of the 13 radioactive CPCs retained were of the uranium and thorium decay series. Inorganic CPCs included silver, arsenic, lead, copper and cyanide. Organic chemicals retained in the CPC list include PCBs, PAHs, dioxins, furans and various organic solvents used on site. [Refer to Appendix E of the RI Report (DOE, 1994a), Section E.2 for a complete listing of CPCs.]

4.2.2 Exposure Assessment

The exposure assessment identifies the sources and pathways of exposure and possible receptors under different land-use scenarios. First, sources of exposure are listed in section 4.2.2.1. The current and future source terms are defined in the section 4.2.2.2. Section 4.2.2.3 describes land use scenarios used in the Operable Unit 1 Baseline Risk Assessment and receptors considered for each scenario.

4.2.2.1 Sources of Exposure

The source terms identified were the waste pit materials in Waste Pits 1 through 6, the Burn Pit, and the Clearwell; surface water in Waste Pits 5 and 6 and the Clearwell; and surface soil within the Operable Unit 1 study area.

4.2.2.2 Source Terms

Two source term configurations were considered: the current and future source terms. The current source-term configuration considers the Waste Storage Area as it exists today.

The future source-term assumes that all maintenance activities within Operable Unit 1 were discontinued. As a result, the cap over Waste Pit 3 was assumed to partially fail, allowing direct exposure to pit contents in 30 percent of the waste pit surface area. Caps and covers on Waste Pits 1, 2, and 4, and the Burn Pit remained intact. Water in Waste Pits 5 and 6 was assumed to evaporate, exposing waste pit contents over half of the surface area of each waste pit. The Clearwell was assumed to have remained filled with water. The surface-water-runoff-control system was assumed nonfunctional under the future source-term scenario as maintenance ceases.

4.2.2.3 Land Use Scenarios

Land use scenarios addressed in the Operable Unit 1 Baseline Risk Assessment are: (1) current land use with access controls; (2) current land use without access controls; (3) future land use with access controls and; (4) future land use without access controls.

Under the first scenario (current land use with access controls), the site access restrictions historically provided by DOE were maintained and no further remedial actions were taken other than those completed to date. The scenario further assumes that no members of the public are allowed access to the site and the integrity of the Waste Storage Area is maintained by inspections and repaired when necessary. Potential receptors for this scenario are: a groundskeeper, an off-property farmer, and an off-property child.

The next land use scenario was current land use without access controls. Under this scenario, strict access controls were relaxed increasing the likelihood of public trespass and livestock grazing on site. This scenario is considered for both the current and future source term as described in the previous section. Receptors considered under this scenario for the current source term are the trespasser and the off-property user of meat and milk products. Receptors considered under this land use scenario for the future source term are: the off-property farmer, the off-property child, the Great Miami River user, the off-property user of meat and milk products, and the groundskeeper.

Two future land use scenarios are considered: future land use with and without access controls. For future land use with access controls (the government reserve), the government retains ownership of

the site, but site maintenance and strict access controls were relaxed. Two receptors were evaluated under this scenario. They were the "expanded trespasser" and the "groundskeeper".

If the government were to relinquish all control over the site, unrestricted use of the site could permit exposure routes associated with development of residences, such as a home and farm, within the boundaries of Operable Unit 1. Access controls are assumed to be absent and no additional remedial actions were assumed. Receptors considered under this scenario are the reasonable maximum exposure (RME) resident farmer and child, the central tendency (CT) resident farmer, the off-property resident farmer and child, the home builder and the off-property user of meat and milk products.

4.2.3 Toxicity Assessment

Two human health hazards were addressed in the toxicity assessment for Operable Unit 1: cancer induction and non-carcinogenic toxicity. Cancer may be induced by exposure to a chemical carcinogen or from ionizing radiation from a radionuclide. Non-carcinogenic toxicity refers to organ tissue effects. These effects are numerous and range from systemic effects such as kidney or liver damage to localized effects such as skin or eye irritation.

Cancer risk is quantified by Incremental Lifetime Cancer Risks (ILCR) and is expressed in terms of the probability that a given receptor will develop cancer due to estimated exposures. For example, if the receptor has an additional one chance in 10,000 of contracting cancer due to these exposures, the probability is expressed as a 10^{-4} (1/10,000) risk. Chemical intakes calculated in the exposure assessment are used in conjunction with the cancer slope factor (CSF) to determine the ILCR.

In the evaluation of potential exposures for the noncarcinogenic assessment, it was assumed that a dose threshold exists below which no toxic effect will occur. This threshold is used to develop an acceptable intake level (the reference dose [RfD]). To determine if Operable Unit 1 constituents may cause toxic effects, the estimated intake (calculated from the exposure assessment) was divided by the acceptable intake. This ratio is called the hazard quotient (HQ). When HQs for multiple CPCs are summed for a particular pathway, the resultant value is the hazard index (HI). If the ratio of

estimated intake to the acceptable intake is greater than one, the site-related intake may increase the impact of non-carcinogenic toxic effects.

4.2.4 Risk Characterization Results

Tables 4-1 through 4-8 present summary results of the baseline risk assessment by land use. These results may be compared to the ranges of generally acceptable risk under CERCLA, which are an incremental lifetime cancer risk of one in one million (10^{-6}) to one in ten thousand (10^{-4}) or a Hazard Index equal to or less than one. A list of chemicals that contribute an ILCR greater than one in one million ($1x10^{-6}$) or a hazard quotient greater than 0.2, and were designated as constituents of concern (COCs) for the Draft Final Feasibility Study (1994c), is presented in Table 4-9.

4.2.4.1 Current Land Use

Current Land Use With Access Controls

Three of the receptors listed in Tables 4-1 and 4-2—the groundskeeper, the off-property farmer, and the off-property child—were evaluated under the assumption that both active maintenance and access controls continue. The maximally exposed individual in this case is the groundskeeper, with ILCR approaching one in ten thousand (10^{-4}) (Table 4-2). These risks are dominated by radiation exposures from isotopes of uranium, thorium, and radium in pit contents and surface soil. The hazard index of systemic toxic effects for the groundskeeper is less than one. Calculated risks to the off-property farmer are just over one in one million (10^{-6}), while calculated risks to the resident child are well below one in one million (10^{-6}). The HI for both the farmer and child are less than one, so no increase in impact of non-carcinogenic toxic effects is expected.

Current Land Use Without Access Controls

If access controls are relaxed, two additional receptors are assumed to become plausible - the trespassing youth, and the off-property user of meat and milk. The greatest health effects are expected to occur to the off-property user of meat and milk products. Most of the total calculated risks to this receptor (about one in one thousand [10^{-3}]) are from the uptake of PCBs by grazing cattle. Radionuclides contribute risks on the order of one in ten thousand (10^{-4}). The HI for this

TABLE 4-1

INCREMENTAL LIFETIME CANCER RISK SUMMARY
CURRENT LAND USE, CURRENT SOURCE TERM

Media	Groundskeeper	Off-property Farmer	Off-property Young Child	Trespassing Youth	Off-property User of Meat and Milk Products
Air					
Radiocarcinogenic Risk	6.0E-06	3.1E-06	1.6E-07	7.1E-07	NA
Chemical Carcinogenic Risk	1.1E-08	1.5E-07	7.8E-08	2.2E-09	NA
Total:[a]	6.0E-06	3.3E-06	2.4E-07	7.1E-07	NA
Surface Soil					
Radiocarcinogenic Risk	7.7E-05	NA	NA	2.7E-05	5.1E-04
Chemical Carcinogenic Risk	1.2E-05	NA	NA	9.4E-06	8.8E-04
Total:[a]	8.9E-05	NA	NA	3.6E-05	1.4E-03
Buried Pit Material					
Radiocarcinogenic Risk	4.6E-05	NA	NA	1.7E-05	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA
Total:[a]	4.6E-05	NA	NA	1.7E-05	NA
On-property Surface Water					
Radiocarcinogenic Risk	NA	NA	NA	NA	2.2E-04
Chemical Carcinogenic Risk	NA	NA	NA	NA	5.6E-06
Total:[a]	NA	NA	NA	NA	2.3E-04
Sum All Media					
Radiocarcinogenic Risk	1.3E-04	3.1E-06	1.6E-07	4.5E-05	7.3E-04
Chemical Carcinogenic Risk	1.2E-05	1.5E-07	7.8E-08	9.4E-06	8.9E-04
Total:[a]	1.4E-04	3.3E-06	2.4E-07	5.4E-05	1.6E-03

NA - Not applicable. Exposure route not evaluated for receptor.

[a] Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

TABLE 4-2
HAZARD INDEX SUMMARY
CURRENT LAND USE, CURRENT SOURCE TERM

Media	Groundskeeper	Off-property Farmer	Off-property Child	Trespassing Youth	Off-property User of Meat and Milk Products
Air	0.0E+00	2.7E-04	1.3E-03	0.0E+00	NA
Surface Soil	2.9E-01	NA	NA	4.9E-01	2.7E+00
On-property Surface Water	NA	NA	NA	NA	2.3E-01
Sum All Media	2.9E-01	2.7E-04	1.3E-03	4.9E-01	2.9E+00

NA - Not applicable. Exposure route not evaluated for receptor.

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1, "Fernald Field Office, Fernald OH.

TABLE 4-3

INCREMENTAL LIFETIME CANCER RISK SUMMARY
CURRENT LAND USE, FUTURE SOURCE TERM

Medium	Trespassing Youth	Great Miami River User
Air		
Radiocarcinogenic Risk	8.5E-05	NA
Chemical Carcinogenic Risk	4.3E-05	NA
Total:[a]	1.3E-04	NA
Surface Soil		
Radiocarcinogenic Risk	1.1E-04	NA
Chemical Carcinogenic Risk	7.4E-05	NA
Total:[a]	1.8E-04	NA
Buried Pit Material		
Radiocarcinogenic Risk	7.2E-06	NA
Chemical Carcinogenic Risk	NA	NA
Total:[a]	7.2E-06	NA
Paddys Run Surface Water		
Radiocarcinogenic Risk	6.6E-08	NA
Chemical Carcinogenic Risk	5.7E-08	NA
Total:[a]	1.2E-07	NA
Paddys Run Sediment		
Radiocarcinogenic Risk	3.5E-06	NA
Chemical Carcinogenic Risk	9.5E-06	NA
Total:[a]	1.3E-05	NA
Great Miami River Surface Water		
Radiocarcinogenic Risk	NA	2.5E-07
Chemical Carcinogenic Risk	NA	2.8E-08
Total:[a]	NA	2.8E-07
All Media		
Radiocarcinogenic Risk	2.0E-04	2.5E-07
Chemical Carcinogenic Risk	1.3E-04	2.8E-08
Total:[a]	3.3E-04	2.8E-07

NA - Not Applicable. Exposure route not evaluated for this receptor.

[a] Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive. A total is provided for reference only.

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1, "Fernald Field Office, Fernald OH.

TABLE 4-4
HAZARD INDEX SUMMARY
CURRENT LAND USE, FUTURE SOURCE TERM

Medium	Trespassing Youth	Great Miami River User
Air	2.5E-01	NA[a]
Surface Soil	1.5E+00	NA
Paddys Run Surface Water	3.9E-02	NA
Paddys Run Sediment	1.1E-01	NA
Great Miami River Surface Water	NA	4.2E-03
All Media	1.9E+00	4.2E-03

[a] NA = Not Applicable. Exposure route not evaluated for this receptor.

SOURCE: U.S. Department of Energy (DOE), 1994, "Remedial Investigation Report for Operable Unit 1," DOE, Fernald Field Office, Fernald, OH.

TABLE 4-5

INCREMENTAL LIFETIME CANCER RISK SUMMARY
FUTURE LAND USE (GOVERNMENT RESERVE)
FUTURE SOURCE TERM

Medium	On-property Groundskeeper	Expanded Trespasser
Air		
Radiocarcinogenic Risk	7.2E-04	1.3E-04
Chemical Carcinogenic Risk	2.2E-04	6.0E-05
Total:[a]	9.4E-04	1.9E-04
Surface Soil/Exposed Pit Material		
Radiocarcinogenic Risk	4.1E-04	2.5E-04
Chemical Carcinogenic Risk	2.1E-04	2.0E-04
Total:[a]	6.2E-04	4.5E-04
Buried Pit Material		
Radiocarcinogenic Risk	4.7E-05	2.6E-05
Chemical Carcinogenic Risk	NA	NA
Total:[a]	4.7E-05	2.6E-05
Paddys Run Surface Water		
Radiocarcinogenic Risk	NA	6.6E-08
Chemical Carcinogenic Risk	NA	5.7E-08
Total:[a]	NA	1.2E-07
Paddys Run Sediment		
Radiocarcinogenic Risk	NA	3.5E-06
Chemical Carcinogenic Risk	NA	9.5E-06
Total:[a]	NA	1.3E-05
All Media		
Radiocarcinogenic Risk	1.2E-03	4.1E-04
Chemical Carcinogenic Risk	4.3E-04	2.7E-04
Total:[a]	1.6E-03	6.8E-04

NA - Not Applicable. Exposure route not evaluated for this receptor.

[a] Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive. A total is provided for reference only.

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1, "Doe, Fernald Field Office, Fernald, OH.

TABLE 4-6

HAZARD INDEX SUMMARY
FUTURE LAND USE (GOVERNMENT RESERVE)
FUTURE SOURCE TERM

Medium	Groundskeeper	Expanded Trespasser
Air	6.2E-01	2.9E-01
Surface Soil/Exposed Pit Material	1.6E+00	3.5E+00
Paddys Run Surface Water	NA	3.9E-02
Paddys Run Sediment	NA	1.1E-01
All Media	2.2E+00	4.0E+00

NA - Not Applicable. Exposure route not evaluated for this receptor.

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1, "Doe, Fernald Field Office, Fernald, OH.

TABLE 4-7

INCREMENTAL LIFETIME CANCER RISK SUMMARY
FUTURE LAND USE (AGRICULTURAL USE)
FUTURE SOURCE TERM

Media	On-property RME Farmer[b]	On-property RME Farmer[b] (User of Perched GW)	On-property CT Farmer	On-property Young Child	Off-property Farmer	Off-property Young Child	Homebuilder	Off-property User of Meat and Milk Products
Air								
Radiocarcinogenic Risk	4.8E-03	4.8E-03	3.5E-04	9.2E-05	2.1E-04	4.2E-06	1.4E-04	1.3E-05
Chemical Carcinogenic Risk	4.8E-03	4.8E-03	3.2E-04	1.2E-03	2.9E-04	7.4E-05	4.5E-05	7.7E-04
Total:[a]	9.6E-03	9.6E-03	6.7E-04	1.3E-03	5.0E-04	7.8E-05	1.9E-04	7.8E-04
Exposed Waste Pit Materials								
Radiocarcinogenic Risk	2.3E-02	2.3E-02	2.2E-03	1.7E-03	NA	NA	7.3E-05	NA
Chemical Carcinogenic Risk	9.5E-03	9.5E-03	5.8E-04	3.8E-03	NA	NA	1.7E-04	NA
Total:[a]	3.3E-02	3.3E-02	2.8E-03	5.5E-03	NA	NA	2.4E-04	NA
Surface Soil								
Radiocarcinogenic Risk	6.7E-04	6.7E-04	3.9E-05	9.9E-05	NA	NA	NA	5.1E-04
Chemical Carcinogenic Risk	1.1E-03	1.1E-03	6.4E-05	5.3E-04	NA	NA	NA	8.8E-04
Total:[a]	1.8E-03	1.8E-03	1.0E-04	6.3E-04	NA	NA	NA	1.4E-03
Buried Pit Material								
Radiocarcinogenic Risk	1.2E-03	1.2E-03	1.6E-04	2.5E-07	NA	NA	6.8E-09	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA	NA	NA	NA
Total:[a]	1.2E-03	1.2E-03	1.6E-04	2.5E-07	NA	NA	6.8E-09	NA
On-property Surface Water								
Radiocarcinogenic Risk	2.5E-04	2.5E-04	1.5E-05	4.2E-05	NA	NA	NA	2.5E-04
Chemical Carcinogenic Risk	6.2E-06	6.2E-06	4.1E-07	1.4E-06	NA	NA	NA	6.2E-06
Total:[a]	2.6E-04	2.6E-04	1.5E-05	4.3E-05	NA	NA	NA	2.6E-04
Groundwater								
Radiocarcinogenic Risk	2.3E-02	5.2E-01	1.6E-03	1.2E-03	1.7E-03	9.1E-05	NA	NA
Chemical Carcinogenic Risk	4.0E-02	9.1E-01	2.8E-03	9.5E-03	0.0E+00	0.0E+00	NA	NA
Total:[a]	6.3E-02	9.6E-01	4.4E-03	1.1E-02	1.7E-03	9.1E-05	NA	NA
All Media								
Radiocarcinogenic Risk	5.3E-02	5.5E-01	4.4E-03	3.1E-03	1.9E-03	9.5E-05	2.1E-04	7.7E-04
Chemical Carcinogenic Risk	5.5E-02	9.3E-01	3.8E-03	1.5E-02	2.9E-04	7.4E-05	2.2E-04	1.7E-03
Total:[a]	1.1E-01	1.5E+00	8.2E-03	1.8E-02	2.2E-03	1.7E-04	4.3E-04	2.5E-03

NA - Not applicable. Exposure route not evaluated for receptor.

[a] Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

[b] Risks calculated and total summed based on the use of the 1-hit equation for calculating risks from higher doses (EPA 1989a).

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1," Fernald Field Office.

TABLE 4-8

HAZARD INDEX SUMMARY
FUTURE LAND USE (AGRICULTURAL USE)

Media	On-property RME Farmer	On-property RME Farmer (User of Perched GW)	On-property CT Farmer	On-property Young Child	Off-property Farmer	Off-property Young Child	Homebuilder	Off-property User of Meat an Milk Products
Air	8.4E+00	8.4E+00	4.3E+00	2.8E+01	5.2E-01	1.7E+00	6.4E+00	1.9E+00
Exposed Waste Pit Materials	2.3E+01	2.3E+01	9.9E+00	9.8E+01	NA	NA	5.4E+00	NA
Surface Soil	5.3E+00	5.3E+00	2.6E+00	2.7E+01	NA	NA	NA	2.7E+00
On-property Surface Water	3.3E-01	3.3E-01	1.5E-01	2.7E+00	NA	NA	NA	3.3E-01
Groundwater	5.0E+02	6.0E+03	2.7E+02	1.4E+03	3.1E+01	8.8E+01	NA	NA
All Media	5.4E+02	6.0E+03	2.9E+02	1.6E+03	3.2E+01	9.0E+01	1.2E+01	4.9E+00

NA - Not applicable. Exposure route not evaluated for receptor.

SOURCE - U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1," Fernald Field Office, Fernald, OH.

TABLE 4-9

OPERABLE UNIT 1
CONSTITUENTS OF CONCERN[a]

	Sediment	Air	Surface Soil	Groundwater	Perched Water	Surface Water
RADIOLOGICAL COCs						
Cs-137	X	X	X			X
Np-237		X	X		X	
Pu-238		X	X	X	X	
Pu-239/240	X	X	X			
Ra-228 + 1 dtr		X				
Sr-90 + 1 dtr		X	X		X	X
Tc-99		X	X	X	X	X
Th-230		X	X	X	X	
Th-232 + 10 dtr	X	X	X		X	
U-234		X	X	X	X	X
U-235 + dtr	X	X	X	X	X	X
U-238 + 2 dtr	X	X	X	X	X	X
INORGANICS						
Antimony			X			
Beryllium	X	X	X			
Cadmium		X	X			
Chromium		X	X		X	
Manganese		X	X	X	X	
Molybdenum		X	X		X	
Mercury		X	X			
Nickel		X	X		X	
Silver		X	X		X	X
Thallium	X	X	X			
Uranium		X	X	X	X	X
Vanadium		X	X			

000057

TABLE 4-9
(Continued)

	Sediment	Air	Surface Soil	Groundwater	Perched Water	Surface Water
PCBs						
Aroclor 1248		X	X			
Aroclor 1254		X	X			
Aroclor 1260		X	X			
PAHs						
Benzo(a)anthracene		X	X			
Benzo(a)pyrene		X	X			
Benzo(b)fluoranthene		X	X			
Benzo(k)fluoranthene			X	X		
Chrysene		X	X			
Indeno(1,2,3-cd)pyrene		X	X			
VOCs						
Tetrachloroethene						X
Vinyl Chloride				X	X	
Polychlorinated Dibenzodioxins						
2,3,7,8-Tetra CDD			X	X		
Hepta CDD			X	X		
Hexa CDD			X	X		
Octa CDD			X	X		
Polychlorinated Dibenzofurans						
Hepta CDF			X	X		
Hexa CDF			X	X		

[a] The criteria for selection was 10^{-7} for ILCR and 0.1 for the HI.

SOURCE: Table D.2-1, "Draft Final Feasibility Study Report for Operable Unit 1," U.S. Department of Energy (DOE), 1994, Fernald Field Office, Fernald, OH.

receptor exceeds 1.0 (2.4), due primarily to antimony, cadmium, and uranium uptake by cattle. Impacts on the hypothetical trespassing youth are much lower (ILCR = 10^{-5} and HI = 0.5), so no increase in impact of non-carcinogenic toxic effects is expected.

Current Land Use Without Access Controls (Future Source Term)

Tables 4-3 and 4-4 present the ILCRs and HIs for the trespassing youth and the Great Miami River user evaluated under this exposure scenario. The trespassing youth incurs a ILCR of one in ten thousand (10^{-4}) and HI of two, but impacts to the Great Miami River user were minimal.

4.2.4.2 Future Land Use

With Access Controls (Government Reserve)

Summaries of cancer risks and hazard indices for receptors evaluated under future land use with access controls are summarized in Tables 4-5 and 4-6. The groundskeeper was projected to incur cancer risks in the order of one in one thousand (10^{-3}). Hazard Indices for the groundskeeper and expanded trespasser were 2.1 and 3.8 respectively, both primarily due to contact with exposed pit material.

Without Access Controls

Summaries of cancer risks and hazard indices for receptors evaluated under future land use without access controls are summarized in Tables 4-7 and 4-8. All receptors were calculated to incur risks in excess of one in ten thousand (10^{-4}). The greatest calculated risks are incurred by the hypothetical on-property farmer (ILCR = 10^{-1}). If domestic use of perched groundwater is included in the analysis, the risks approach one. Uranium and arsenic in groundwater dominate risks to this receptor. Similarly, predicted exposures to all receptors produce HIs exceeding 1. The highest HI (6,100) is produced when the on-property farmer uses perched water. If this potential source is discounted, the highest HI is incurred by the resident child using groundwater from beneath the operable unit (1,600).

4.2.5 Summary of Uncertainties

It is generally recognized that uncertainty is inherent in quantitative risk assessment. The objective of the uncertainty analysis is to identify key site-related variables that contribute most to uncertainty, and

to characterize the nature and magnitude of impact of these uncertainties on the conclusions of the risk assessment.

Table 4-10 summarizes the semi-quantitative evaluation of uncertainty for the Operable Unit 1 Baseline Risk Assessment. Sources of uncertainty were identified for all steps of the risk assessment process: selection of CPCs, exposure assessment, toxicity assessment and risk characterization. The majority of uncertainties tended toward increased conservatism of the risk evaluation. Taken together, the uncertainties identified with site data, exposure parameters, fate and transport particularly with respect to groundwater modeling, toxicity assessment and risk characterization were judged high and could overestimate risk by two or more orders of magnitude.

4.3 CONCLUSION

Actual or threatened releases of hazardous substances from this site, if not addressed by the preferred alternative or one of the other active alternatives considered, may present a potential threat to public health, welfare, or the environment.

TABLE 4-10

UNCERTAINTIES ASSOCIATED WITH ESTIMATED RISKS FROM OPERABLE UNIT 1

Source of Uncertainty	Magnitude[a]	Expected Direction[b]	Remark
Selection of CPCs:			
• Adequacy of database	Low to Moderate	Increases or decreases conservatism	CPCs may be underestimated. Principal constituents were identified.
Exposure Assessment:			
• Calculated exposure point concentrations			
- positive bias in sampling	Moderate	Increases conservatism	Source concentrations based on 95% UCL or maximum. Sampling was biased for radiological CPCs.
- conservative modeling assumptions	High	Increases conservatism	Modeled concentrations were conservative.
• Determination of land uses			
- current scenario	Low	Increases conservatism	Scenario based on current environmental setting.
- future scenario	High	Increases conservatism	Worst case scenario assumed.
• Assumptions for source terms			
- current source term	Low	Increases or decreases conservatism	Current source term assumes waste pits covered and surface water runoff treated.
- future source term	Moderate	Increases conservatism	Future source term assumes failure of Waste Pit 3 cap.
• Selection of receptors			
- current scenario	Low	Increases conservatism	Scenario based on current environmental setting.
- future scenario	High	Increases conservatism	Worst case scenario assumed.
• Determination of exposure factors	Low to moderate	Increases conservatism	Receptor and exposure pathway specific.

TABLE 4-10
(Continued)

Source of Uncertainty	Magnitude[a]	Expected Direction[b]	Remark
Toxicity Assessment:			
• Dose-response assessment			
- chemical CPCs	High	Increases conservatism	Dose-response based on animal data.
- radiological CPCs			
internal	Low	Increases conservatism	Dose-response based on human data.
external	Moderate to high	Increases conservatism	Conservative assumptions made for external exposure.
• Other OU1 CPCs			
- dose-response for PAHs	Low	Increases conservatism	PAHs pose low risk.
- dose-response for PCBs	Low	Increases conservatism	PCBs pose relatively low risk.
- dose-response for dioxins/furans	Low	Increases conservatism	Furans/dioxins relatively low risk.
- dose-response for Rn-222 (indoors)	Low to moderate	Increases conservatism	Assumptions for indoor Rn-222 differ from those made for the CSF.
Risk Characterization:			
• Additivity	Low to moderate	Increases conservatism	Health effects dominated from few CPCs and exposure pathways.
• Effect of tentatively identified compounds (TICs)	Low	Decrease conservatism	Relatively few TICs.
• Failure to consider antagonism	Unknown	Increases conservatism	Data unknown.
• Failure to consider synergism	Unknown	Decreases conservatism	Data unknown.
• Failure to consider segregation of HIs	Low	Increases conservatism	HIs dominated by few CPCs and exposure pathways.
Overall	High	Increases conservatism	High uncertainty from combining low, moderate, and highly uncertain parameters.

[a] Magnitude is assessed qualitatively based on professional judgment and includes the following:
Low-impact risk by a factor of 10 or less.
Moderate-impact risk by a factor of 10 to 100.
High-impact risk by a factor of 100 or more.
[b] Direction is assessed qualitatively where an increased conservatism increases final health effects calculated in risk assessment.

SOURCE: U.S. Department of Energy (DOE), 1994, "Draft Final Remedial Investigation Report for Operable Unit 1," Fernald Field Office, Fernald, OH.

5.0 SUMMARY OF ALTERNATIVES

5.1 ALTERNATIVES OVERVIEW

Remedial alternatives were developed by examining available technologies for cleanup that were potentially applicable to the waste materials within Operable Unit 1. These alternatives were screened to eliminate those that were impractical to implement or ineffective at addressing the hazards associated with the specific waste materials. The alternatives passing through this screening process were subjected to a detailed analysis to examine the merits of each at addressing the concerns associated with the operable unit.

The following eight preliminary alternatives were developed for Operable Unit 1:

- Alternative 1 - No Action
- Alternative 2 - In Situ Containment
- Alternative 3 - In Situ Treatment and Containment
- Alternative 4 - Removal, Treatment, and On-Property Disposal
  - Alternative 4A - Removal, Treatment (Vitrification), and On-Property Disposal
  - Alternative 4B - Removal, Treatment (Cementation), and On-Property Disposal
  - Alternative 4C - Removal, Treatment (Thermal Drying), and On-Property Disposal
- Alternative 5 - Removal, Treatment, and Off-Site Disposal
  - Alternative 5A - Removal, Treatment (Thermal Drying), and Off-Site Disposal at the Nevada Test Site (NTS)
  - Alternative 5B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at a Permitted Commercial Waste Disposal Facility

Along with the No-Action Alternative, Alternatives 4A and 4B (each of which specify on-site disposal), and Alternatives 5A and 5B (each of which specify off-site disposal) passed the screening process. The results of this detailed review are summarized in Section 6. The public is encouraged to review Section 4 of the Operable Unit 1 Draft Final FS Report for a detailed analysis of the remedial alternatives.

This section provides a description of each of the alternatives which underwent a detailed analysis. Each alternative description includes the estimated total cost (refer to Appendix E of the Draft Final Operable Unit 1 Draft Final FS Report [DOE 1994c] for detailed cost estimates and schedules), treatment technologies, engineering controls, institutional controls, and the major applicable or relevant and appropriate requirements (ARARs) associated with each alternative. The No-Action Alternative is presented as a baseline for comparison purposes. However, in reality, DOE would not abandon the site. Existing access controls would be maintained and current multimedia monitoring would be continued.

5.2 COMMON ELEMENTS

Except for the No-Action Alternative, all of the alternatives now being considered for Operable Unit 1 include a number of common components. Each alternative incorporates institutional controls, monitoring measures, and forwarding of all water to the FEMP Advanced Waste Water Treatment facility. Each alternative involves removal of 710,000 cubic yards of pit waste, soil, caps, liners, etc., some form of treatment (vitrification, drying, or cement stabilization), and disposal of Operable Unit 1 wastes. Table 5-1 summarizes waste volumes for each alternative (which are used for the basis of the FS cost estimate), as well as approximate time for completion. Oversize structural-type debris is expected to be encountered during excavation of the waste pit contents. Such material that is not readily amenable to size reduction in the Operable Unit 1 remedial process but that is amenable to the selected alternative for Operable Unit 3 would be segregated from Operable Unit 1 waste, decontaminated by pressure washing prior to transfer, and forwarded to Operable Unit 3 to be managed as construction rubble.

Surface soils, contaminated soils from beneath the excavated pits and some cover soils, as appropriate, will be forwarded to Operable Unit 5 for management, including final disposition. Operable Unit 5 has taken the site lead in identifying and evaluating remedial alternatives for this type of waste stream. The Operable Unit 5 Record of Decision (ROD) will document the method of management for these soils. Groundwater in the Great Miami Aquifer is not addressed as a source medium within the Operable Unit 1 Draft Final FS. Potential remediation of groundwater contamination for the entire FEMP site is being addressed as part of Operable Unit 5. Thus, within the Operable Unit 1 Draft Final FS, groundwater is considered an environmental receptor medium.

TABLE 5-1

ESTIMATED OPERABLE UNIT 1 WASTE QUANTITIES

MATERIAL	DRY MASS (TONS)	NET MASS (TONS)	VOLUME (CY)	WASTE TREATMENT PERIOD
Waste+Caps+Liners	893,772	1,184,248	628,200	NA[a]
3' Subsurface Soil Below Pits	110,452	146,349	81,800	NA
Total Waste+Subsurface Soil	1,004,224	1,330,697	710,000	NA
Surface Soil	14,285	19,000	11,293	NA
Drying Input (Alternatives 5A & 5B)	915,862	1,213,517	NA	5 Years
Drying Output	915,862	1,053,241	NA	NA
Cementation Input (Waste)(Alternative 4B)	915,862	1,053,241	NA	5 Years
Cementation Output	NA	2,300,000	1,300,000	NA
Vitrification Input (Waste)(Alternative 4A)	915,862	1,053,241	NA	10 Years
Vitrification Output	NA	1,145,000	636,000	NA

[a] NA = Not Applicable

Proposed remediation levels are presented in Table 5-2 (for surface soils) and Table 5-3 (for subsurface soils beneath the pits). Note that the levels in Tables 5-2 and 5-3 are interim. Additional input from the Fernald Citizens Advisory Task Force and the public is essential before making final recommendations on land use from a site-wide perspective. The Operable Unit 1 proposed remediation levels will be re-examined by the Operable Unit 5 Feasibility Study Report and Record of Decision, based upon available Operable Unit 5 Feasibility Study conclusions, recommendations from the Fernald Citizens Task Force, and further public comment. Specifically, the risk assessment for the Operable Unit 5 Feasibility Study will include additional trespassing as well as recreational exposure scenarios, which are to be fully developed on a site-wide basis within the Operable Unit 5 Remedial Investigation/Feasibility Study. A full array of trespassing and recreational scenarios from no trespassing through full recreational use of the site will be developed. If found to be necessary, the Operable Unit 5 Record of Decision will modify the Operable Unit 1 proposed remediation levels downward to ensure protectiveness of human health and the environment; the remediation levels will not be adjusted upward.

Each action alternative would meet the chemical-specific ARARs associated with potential releases to groundwater, air, and surface water. Most notable of the chemical-specific ARARs are MCLs, with compliance measured at the waste unit boundary (disposal cell and/or restored pit area). The proposed remediation levels presented in Table 5-2 and 5-3 will be protective of the Great Miami Aquifer to these MCL levels at the restored pit area unit boundary. All action alternatives would comply with the pertinent location-specific ARARs associated with potential releases to groundwater, air, and surface water. An exception to this statement is discussed in Section 5.1.2 of this Proposed Plan regarding the state siting criteria for sanitary waste landfills. Included among the location-specific ARARs would be those associated with discharge of dredged and excavated material into waters of the United States (33 CFR 323), the protection of wetlands (40 CFR 258.12, 40 CFR

TABLE 5-2

PROPOSED REMEDIATION LEVELS IN SOILS

Constituent of Concern	Expanded Trespasser HI = 1 PRG	Expanded Trespasser 10^{-6} ILCR PRG	Background (95th percentile)	ARAR Target	Max. Detected Soil Concentration		Proposed Remediation Levels[a]	HI to Receptors from Proposed Remediation Levels		Risk to Receptors from Proposed Remediation Level	
					Surface	Sub surface		Expanded Trespasser	On-Property Farmer	Expanded Trespasser[b]	On-Property Farmer[c]
Radionuclides (pCi/g)											
Cs-137 + 1 progeny	N/A	1.1	0.71	None	6	<0.2	**1.8**	N/A	N/A	1.6×10^{-6}	2.8×10^{-4}
Np-237 + 1 progeny	N/A	5.0	ND	None	0.5	<0.1	**NR**	N/A	N/A	$<1\times10^{-6}$	1.1×10^{-5}
Pu-238	N/A	120	ND	None	4.1	<0.1	**NR**	N/A	N/A	$<1\times10^{-6}$	5.5×10^{-6}
Pu-239/240	N/A	120	ND	None	0.8	<0.1	**NR**	N/A	N/A	$<1\times10^{-6}$	1.0×10^{-6}
Sr-90 + 1 progeny	N/A	850	ND	None	1.7	0.9	**NR**	N/A	N/A	$<1\times10^{-6}$	1.8×10^{-4}
Th-230	N/A	900	2.0	None	972	3.5	**902**	N/A	N/A	1×10^{-6}	4.4×10^{-4}
U-234	N/A	890	1.2	None	298	17.5	**NR**	N/A	N/A	$<1\times10^{-6}$	6.9×10^{-6}
U-235	N/A	9.2	0.15	None	51	3.9	**9.3**	N/A	N/A	$<1\times10^{-6}$	9.6×10^{-5}
U-238 + 2 progeny	N/A	55	1.2	None	1500	104	**56**	N/A	N/A	1.9×10^{-6}	2.3×10^{-4}
Chemical (mg/kg)											
Antimony	150	N/A	7.7	None	28	NA	**NR**	0.19	3.2	N/A	N/A
Beryllium	130	2.1	0.6	None	0.77	NA	**2.1**	<0.01	0.10	2.5×10^{-5}	1.8×10^{-3}
Cadmium	130	9000	0.82	None	7.7	NA	**NR**	0.06	2.0	$<1\times10^{-6}$	1.7×10^{-7}
Uranium	380	N/A	3.6	None	2100	309	**190**[d]	0.5	1.5	N/A	N/A

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TABLE 5-2
(Continued)

Constituent of Concern	Expanded Trespasser HI = 1 PRG	Expanded Trespasser 10^{-6} ILCR PRG	Background (95th percentile)	ARAR Target	Max. Detected Soil Concentration		**Proposed Remediation Levels**[a]	HI to Receptors from Proposed Remediation Levels		Risk to Receptors from Proposed Remediation Level	
					Surface	Sub surface		Expanded Trespasser	On-Property Farmer	Expanded Trespasser[b]	On-Property Farmer[c]
PAHs (mg/kg)											
Benzo(a)anthracene	NA	39	ND	None	NA	0.098	**NR**	N/A	N/A	$<1x10^{-6}$	$5.8x10^{-6}$
Benzo(a)pyrene	NA	5.7	ND	None	NA	0.042	**NR**	N/A	N/A	$<1x10^{-6}$	$2.3x10^{-5}$
Benzo(b)fluoranthene	NA	47	ND	None	NA	0.059	**NR**	N/A	N/A	$<1x10^{-6}$	$9.7x10^{-6}$
Benzo(k)fluoranthene	NA	110	ND	None	NA	0.046	**NR**	N/A	N/A	$<1x10^{-6}$	$6.6x10^{-6}$
Chrysene	NA	1,300	ND	None	NA	0.088	**NR**	N/A	N/A	$<1x10^{-6}$	$1.6x10^{-7}$
PCBs (mg/kg)											
Arochlor-1254	N/A	0.035	ND	None	NA	1.4	**ND**	N/A	N/A	$1x10^{-6}$	$1.4x10^{-3}$

[a] This PRL column is formatted in bold print for ease of reference only.
[b] Includes the direct radiation, soil ingestion, and inhalation pathways.
[c] Includes all pathways including the indirect pathways due to food crops.
[d] 0.5 times the PRG to protect for multiple chemicals.

NA = Not Available.
N/A= Not Applicable.
ND = Not Detected.
NR = No Remediation Required.

TABLE 5-3

OPERABLE UNIT 1
PROPOSED PIT SUBSURFACE REMEDIAL LEVELS
BASED ON GROUNDWATER MODELING

	Waste Pit 1				Waste Pit 2				Waste Pit 3			
Constituent of Concern	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)[a]	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level**
Radionuclides (pCi/g)												
Sr-90 +1d	8.4E+04	NC	7.7E+00	**NR**	2.1E+05	NC	4.0E+00	**NR**	1.4E+04	1.4E-01	7.1E+00	**NR**
Tc-99	2.5E+00	2.2E-01	0.0E+00	**NR**	5.5E+00	3.3E-01	6.2E+02	**5.5E+00**	7.5E-01	7.7E-02	1.1E+03	**7.5E-01**
Ra-226	4.3E+15		1.0E+02	**NR**	6.1E+15		9.5E+02	**NR**	4.1E+14		4.5E+02	**NR**
Th-230	NC	NC	5.5E+03	**NR**	NC	NC	1.8E+04	**NR**	NC	NC	1.1E+04	**NR**
U-234	2.2E+04	3.4E+02	1.2E+03	**NR**	5.5E+04	6.8E+02	1.8E+04	**NR**	4.1E+03	8.0E+01	9.9E+02	**NR**
U-235 +1d	2.2E+05	3.4E+02	2.6E+02	**NR**	5.5E+04	6.8E+02	1.3E+02	**NR**	3.8E+03	8.0E+01	8.9E+01	**NR**
U-238 +2d	1.3E+04	1.9E+02	1.6E+04	**1.3E+04**	3.1E+04	4.0E+02	1.8E+04	**NR**	2.2E+03	4.6E+01	1.7E+03	**NR**
Np-237+1d	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**	1.1E+01	5.8E-01	2.1E+00	**NR**
Pu-238	NC	NC	1.0E+00	**NR**	NC	NC	3.6E+00	**NR**	1.4E+02	1.4E+02	1.0E+00	**NR**
Chemicals (mg/kg)												
Antimony	NC	NC	1.3E+02	**NR**	NC	NC	5.5E+01	**NR**	2.4E+08	4.5E+02	6.4E+01	**NR**
Boron	8.2E+03	4.5E+02	1.7E+03	**NR**	1.9E+03	8.4E+02	0.0E+00	**NR**	1.5E+03	1.2E+02	0.0E+00	**NR**
Cadmium	NC	NC	1.9E+01	**NR**	NC	NC	1.3E+01	**NR**	1.8E+04	1.8E+02	3.9E+01	**NR**
Copper	NC	NC	0.0E+00	**NR**	NC	NC	1.3E+03	**NR**	3.0E+08	7.5E+03	2.3E+03	**NR**
Lead	NC	NC	5.3E+01	**NR**	NC	NC	7.6E+02	**NR**	3.8E+09	4.3E+04	8.4E+02	**NR**
Mercury	NC	NC	0.0E+00	**NR**	NC	NC	2.6E+00	**NR**	NC	NC	0.0E+00	**NR**

TABLE 5-3
(Continued)

	Waste Pit 1				Waste Pit 2				Waste Pit 3			
Constituent of Concern	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)[a]	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level**
Chemical (mg/kg)												
Aroclor 1221	7.8E-01	4.8E-03	4.6E+00	**7.8E-01**	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Vinyl Chloride	NC	NC	0.0E+00	**NR**	2.7E+01	5.4E-03	1.9E+00	**NR**	NC	NC	0.0E+00	**NR**

	Waste Pit 4				Waste Pit 5				Waste Pit 6			
Constituent	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**
Radionuclides (pCi/g)												
Sr-90 +1d	7.3E+04	NC	1.4E+02	**NR**	3.1E+04	2.0E+01	3.1E+01	**NR**	2.7E+05	1.6E+02	5.1E+00	**NR**
Tc-99	2.6E-01	2.0E-01	2.3E+02	**2.6E-01**	1.4E+00	9.5E-02	3.0E+03	**1.4E+00**	7.3E+00	4.2E-01	1.6E+02	**7.3E+00**
Ra-226	4.3E+15		5.0E+01	**NR**	9.0E+14		1.6E+02	**NR**	8.0E+15		4.3E+00	**NR**
Th-230	NC		1.8E+03	**NR**	NC		8.5E+03	**NR**	NC		5.1E+00	**NR**
U-234	1.9E+04	3.3E+02	4.1E+03	**NR**	8.2E+03	1.1E+02	1.3E+03	**NR**	7.2E+04	8.4E+02	5.3E+03	**NR**
U-235 +1d	1.9E+04	3.3E+02	9.3E+02	**NR**	8.2E+03	1.1E+02	5.8E+01	**NR**	7.1E+04	8.4E+02	2.9E+02	**NR**
U-238 +2d	1.1E+04	1.9E+02	4.2E+04	**1.1E+04**	4.7E+03	6.4E+01	1.5E+03	**NR**	4.1E+04	4.8E+02	2.3E+04	**NR**
Np-237+1d	NC	NC	4.0E-01	**NR**	2.4E+01	8.1E-01	8.3E+01	**2.4E+01**	2.0E+02	5.8E+00	3.6E+00	**NR**

TABLE 5-3
(Continued)

	Waste Pit 4				Waste Pit 5				Waste Pit 6			
Constituent	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**
Radionuclides (pCi/g)												
Pu-238	NC	NC	5.0E-01	**NR**	2.0E+02	2.0E+02	4.4E+00	**NR**	3.6E+02	3.6E+02	1.4E+00	**NR**
Chemicals (mg/kg)												
Antimony	NC	NC	3.2E+02	**NR**	NC	NC	8.8E+01	**NR**	NC	NC	0.0E+00	**NR**
Boron	7.1E+03	4.3E+02	1.0E+03	**NR**	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Cadmium	NC	NC	3.5E+01	**NR**	NC	NC	1.7E+01	**NR**	NC	NC	5.7E+00	**NR**
Copper	NC	NC	4.8E+02	**NR**	NC	NC	1.8E+04	**NR**	NC	NC	0.0E+00	**NR**
Lead	NC	NC	6.3E+01	**NR**	NC	NC	2.4E+02	**NR**	NC	NC	9.0E+01	**NR**
Mercury	NC	NC	0.0E+00	**NR**	9.6E+00	1.1E-01	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Arochlor 1221	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Vinyl Chloride	9.8E-02	2.6E-03	1.4E-02	**NR**	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**

TABLE 5-3
(Continued)

	Burn Pit				Clearwell			
Constituent	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**
Radionuclides (pCi/g)								
Sr-90 +1d	5.5E+05	NC	0.0E+00	**NR**	3.9E+05	NC	2.6E+01	**NR**
Tc-99	1.4E+01	2.9E-01	6.4E+01	**1.4E+01**	9.9E+00	5.9E-01	7.0E+02	**9.9E+00**
Ra-226	6.9E+15	NC	3.9E+01	**NR**	6.9E+15	NC	1.7E+02	**NR**
Th-230	NC	NC	4.5E+03	**NR**	NC	NC	5.6E+03	**NR**
U-234	1.5E+05	6.3E+02	1.7E+03	**NR**	1.0E+05	1.2E+03	1.1E+03	**NR**
U-235 +1d	1.5E+05	6.3E+02	1.0E+02	**NR**	1.0E+05	1.2E+03	3.7E+02	**NR**
U-238 +2d	8.4E+04	3.6E+02	2.0E+03	**NR**	5.9E+04	7.1E+02	1.6E+03	**NR**
Np-237+1d	NC	NC	6.0E-01	**NR**	NC	NC	4.5E+02	**NR**
Pu-238	NC	NC	5.0E-01	**NR**	NC	NC	2.2E+00	**NR**
Chemicals (mg/kg)								
Antimony	NC	NC	1.8E+01	**NR**	NC	NC	0.0E+00	**NR**
Boron	5.1E+04	7.7E+02	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Cadmium	NC	NC	3.5E+01	**NR**	NC	NC	1.1E+00	**NR**
Copper	NC	NC	0.0E+00	**NR**	NC	NC	3.3E+03	**NR**
Lead	NC	NC	2.8E+02	**NR**	NC	NC	4.3E+02	**NR**
Mercury	NC	NC	0.0E+00	**NR**	NC	NC	4.4E+00	**NR**

TABLE 5-3
(Continued)

	Burn Pit				Clearwell			
Constituent	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**	Off-Property User PRG	On-Property User PRG	Pit Waste Conc. (95% UCL)	**Proposed Remedial Level[b]**
Chemicals (mg/kg)								
Arochlor 1254	NC	NC	0.0E+00	**NR**	NC	NC	0.0E+00	**NR**
Vinyl Chloride	7.3E+01	5.0E-03	3.0E-03	**NR**	NC	NC	0.0E+00	**NR**

NC = Not calculated
NR = No Remediation Required

6.302, 10 CFR 1022), floodplains (40 CFR 257.3-1, 40 CFR 264.18, 40 CFR 6.302, 10 CFR 1022), and endangered species (50 CFR 17 and 402) during the on-property treatment and disposal of materials. All action alternatives would also comply with action-specific ARARs. For Alternatives 4A and 4B, the above-grade disposal cell would incorporate design requirements for the disposal of uranium mill tailings (40 CFR 192), and hazardous waste under RCRA (i.e., the treatment, storage, and disposal facility [TSDF] requirements). The design of the on-property disposal cell would also include appropriate engineered features that satisfy the requirements of the Clean Water Act (40 CFR 125.100 and 104), the Ohio Water Quality Standards, and RCRA Subtitle C - Hazardous Waste (40 CFR 262.11, 261.7, 262.20, and the 264 Subparts identified in Appendix F of the Draft Final FS). Alternatives 5A and 5B would comply with all pertinent action-specific ARARs identified in Appendix F of the Operable Unit 1 Draft Final FS for off-site disposal. Hazardous waste transport requirements would be complied with by following the regulations under 40 CFR 262 and the appropriate U.S. Department of Transportation (DOT) shipping standards under 49 CFR 172 and 173.

5.3 ALTERNATIVES SUMMARY

The following are the five alternatives that were retained through the Draft Final FS detailed analysis.

5.3.1 Alternative 1 - No-Action Alternative

Capital Cost	$ 0
Present Worth (PW)	$ 0
Months to Implement	0

The No-Action Alternative for Operable Unit 1 provides a baseline for comparison with the other alternatives per the President's Council on Environmental Quality and the National Oil and Hazardous Substances Pollution Contingency Plan (known as the NCP). Under the No-Action Alternative, designated as Alternative 1, the contaminated materials within the Operable Unit would remain unchanged without any further waste removal, treatment, containment, or mitigating activities. The No-Action Alternative would not decrease the toxicity, mobility, or volume of contaminants through treatment or reduce public health or environmental risks.

5.3.2 Alternative 4A - Removal, Treatment (Vitrification), and On-Property Disposal

Capital Cost	$654,852,965
Present Worth (PW)	$457,740,000
Months to Implement	120

Alternative 4A requires the excavation of Waste Pits 1 through 6, the Burn Pit, and the Clearwell including the waste, covers, surface soils outside the capped areas, liners and soils below the liners to health-based limits. Excavated material would be dried and treated by vitrification (a process that transforms the waste into a glassified material). The total quantity of glass frit produced would be approximately 145,000 tons. The treated material would be placed on site in an engineered waste disposal cell. The waste pits would be backfilled with clean soil and covered with an infiltration limiting multilayer cover. The areas where surface soil is excavated would be graded and vegetated. Topsoil would be used to support vegetative growth, where required. This alternative would incorporate institutional controls and monitoring measures.

The total amount of waste to be excavated in this alternative would be approximately 916,000 dry tons which would include approximately 110,500 tons of contaminated soils underlying the pit liners. These soils would be transferred to Operable Unit 5 for management if amenable to treatment methods being used by Operable Unit 5. Active waste processing will take approximately 10 years.

The State of Ohio has a number of solid waste disposal design requirements identified in the Ohio Administrative Code (OAC) 3745-27-07. OAC 3745-27-07(B)(5) prohibits new solid waste disposal facilities from being constructed over sole-source aquifers. In consideration of hydrogeologic factors of the proposed disposal cell location coupled with the design and impact prevention and mitigation capabilities, a waiver from OAC 3745-27-07 may be justified for Alternatives 4A and 4B. A waiver from this requirement would be required in order to implement this alternative.. DOE, EPA, and OEPA are evaluating the possibility of obtaining a waiver from the requirement. The location of the on-property disposal facility will be based upon the most suitable location available at the site. The disposal facility will also be engineered to compensate for the lack of a suitable siting location and to be as protective of the Great Miami Aquifer as technically possible.

5.3.3 Alternative 4B - Removal, Treatment (Cement Solidification), and On-Property Disposal

Capital Cost	$525,063,363
Present Worth (PW)	$404,903,000
Months to Implement	60

Alternative 4B includes the same remedial action components as Alternative 4A with the exception of the treatment process used. In this alternative, cement solidification would be used instead of vitrification. The volume of the treated material would be more than vitrified material, which in turn would increase the size of the site disposal cell. The total amount of excavated material, estimated to be about 916,000 dry tons, would be processed in about 5 years, yielding approximately 2.3 million tons (1.3 million cubic yards) of cement-solidified waste. Remedial action components within Alternative 4B which are identical to Alternative 4A include site preparation, excavation, drying and treatment, on-property disposal in an above-grade cell (the cell would be larger), site restoration, access control measures and monitoring.

The State of Ohio has a number of solid waste disposal design requirements identified in the Ohio Administrative Code (OAC) 3745-27-07. OAC 3745-27-07(B)(5) prohibits new solid waste disposal facilities from being constructed over sole-source aquifers. In consideration of hydrogeologic factors of the proposed disposal cell location coupled with the design and impact prevention and mitigation capabilities, a waiver from OAC 3745-27-07 may be justified for Alternatives 4A and 4B. A waiver from this requirement would be required in order to implement this alternative. DOE, EPA, and OEPA are evaluating the possibility of obtaining a waiver from the requirement. The location of the on-property disposal facility will be based upon the most suitable location available at the site. The disposal facility will also be engineered to compensate for the lack of a suitable siting location and to be as protective of the Great Miami Aquifer as technically possible.

5.3.4 Alternative 5A - Removal, Treatment (Thermal Drying), and Off-Site Disposal at NTS

Capital Cost	$856,102,282
Present Worth (PW)	$645,870,000
Months to Implement	60

Alternative 5A is identical to Alternative 4A except that the vitrification is eliminated and on-site disposal has been replaced by off-site transportation and disposal at the NTS. NTS is a DOE-owned facility that currently accepts low-level radioactive waste from DOE facilities. It is located approximately 3,219 kilometers (2,000 miles) from the FEMP site in an arid environment far from any population centers. For this alternative, the excavation rate would be limited by the capacity of the dryers. It is estimated that active waste processing would require approximately 5 years.

Off-site disposal at the Nevada Test Site involves drying and packaging the treated waste in sealed containers that comply with DOE orders and Department of Transportation requirements. The containers would be loaded onto flatbed railroad cars, and shipped to Las Vegas, Nevada. At Las Vegas, the containers would be transferred to trucks for the final shipment to Nevada Test Site, where the wastes would be disposed. Due to the heterogenous nature of the waste in the pits, size reduction, homogenization and blending would be required to allow for uniform drying and bulk handling.

The FEMP site can support rail transport to the Nevada Test Site by using existing on-property rail spurs. A combination of rail and truck transport can be used around the facilities. Improvements to the existing rail system at the FEMP site may be required to accommodate the increased activity. Evaluation of the need for improvements will consider the requirements of all operable units utilizing rail to support off-site waste disposal.

For this alternative, the waste would be processed to meet the requirements, known as "waste acceptance criteria" (such as contaminant concentration and moisture content), for off-site disposal at the Nevada Test Site. The dried waste would be sampled prior to shipment. Based on available data in the Operable Unit 1 RI Report (DOE 1994a) and NTS Waste Acceptance Criteria, Operable Unit 1 pit wastes should meet disposal requirements at NTS. However, due to the extreme heterogeneity of the pit wastes, it is possible that isolated pockets of waste could be encountered that would not meet NTS waste acceptance criteria. As a contingency, wastes that do not meet the NTS waste acceptance criteria, up to 10 percent of the total waste by volume, may be disposed of at a permitted commercial waste disposal facility.

5.3.5 Alternative 5B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at Permitted Commercial Facility

Capital Cost	$513,050,560
Present Worth (PW)	$389,509,000
Months to Implement	60

Alternative 5B is identical to Alternative 5A except that the treated waste would be shipped in bulk directly to a permitted commercial waste disposal facility. For the purposes of the analysis in the Operable Unit 1 Feasibility Study, the characteristics and waste acceptance criteria of a representative facility near Clive, Utah, were considered. The representative facility is located on the eastern side of the Great Salt Lake Desert, 4.8 kilometers (3 miles) west of the Cedar Mountains. The facility's license and waste acceptance criteria are discussed in Appendix J of the Draft Final FS. The facility is fully licensed to accept low-level radioactive waste and most mixed wastes for disposal. As implied, this facility is considered to be representative of any such facility that would be licensed to accept similar wastes. As stated above, Alternative 5B was developed and evaluated assuming that the Operable Unit 1 wastes would go to this representative facility. The facility is accessible directly by rail. Therefore, only rail transportation would be required. The rail siding east of the waste pit area would be used. The FEMP site can support rail transport by using existing on-property rail spurs. Improvements to the existing rail system at the FEMP site may be required to accommodate the increased activity. Under this alternative, the excavation and drying rate would be the same as Alternative 5A. At this rate, active waste processing would require approximately 5 years.

For this alternative, the waste would be processed to meet the waste acceptance criteria of the disposal facility. The dried waste would be sampled prior to being loaded into the rail cars. As a contingency, if any isolated pockets of waste are ready for disposal that do not meet the waste acceptance criteria of the waste disposal facility, some waste may be disposed of at the Nevada Test Site as long as it meets the NTS waste acceptance criteria. Such alternative disposal would be allowed for up to 10 percent of the total waste volume.

6.0 EVALUATION OF ALTERNATIVES

This section identifies the preferred remedial action alternative for Operable Unit 1, discusses the nine criteria used to evaluate alternatives (see Table 6-1), and summarizes the comparative analysis of the evaluation of the alternatives against the nine criteria that the U.S. Environmental Protection Agency (EPA) uses to evaluate alternatives. The alternatives comparison is presented in Table 6-2.

6.1 IDENTIFICATION OF THE PREFERRED REMEDIAL ALTERNATIVE FOR OPERABLE UNIT 1

The preferred remedial alternative for remediating Operable Unit 1 at the Fernald Environmental Management Project site is the following:

Alternative 5 B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at a Permitted Commercial Waste Disposal Facility

This section profiles the performance of the preferred alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria and their definitions are presented in Table 6-1. These requirements include protection of human health and the environment, compliance with other applicable or relevant and appropriate requirements (known as ARARs), a preference for permanent solutions which use treatment as a principal element (to the maximum extent possible), and cost effectiveness.

To address the overall remediation of Operable Unit 1, the preferred alternative consists of the following major components:

- Construction of waste processing and loading facilities and equipment
- Removal of water from open waste pits for treatment at the Advanced Waste Water Treatment facility
- Removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil

TABLE 6-1

EVALUATION CRITERIA

	EVALUATION CRITERIA
	The first two criteria are called threshold criteria because they relate directly to legal findings that must be made in the Record of Decision. Alternatives must meet these two criteria in order to be eligible for selection.
1.	Overall protection of human health and the environment - Examines whether a remedy would provide adequate overall protection to human health and the environment. Evaluates how risks would be eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls included in the alternative.
2.	Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) - Determines if a remedy would meet all applicable or relevant and appropriate federal and state environmental laws or be subject to waiver of the ARAR as described in the National Contingency Plan.
	PRIMARY BALANCING CRITERIA
	The next five criteria are grouped together as the primary balancing criteria under which the alternatives are evaluated.
3.	Long-term effectiveness and permanence - Evaluates the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met and the degree of certainty that the alternative will be successful.
4.	Reduction of toxicity, mobility, or volume through treatment - Reviews the anticipated performance of the proposed treatment technologies for their abilities to reduce the hazards of, prevent the movement of, or reduce the quantity of waste materials.
5.	Short-term effectiveness - Evaluates the ability of a remedy to achieve protection of workers, the public, and the environment during construction and implementation.
6.	Implementability - Examines the ease or difficulty of carrying out a remedy, including the availability of materials and services needed during construction and operation and the availability of the technology.
7.	Cost - Reviews capital costs (direct and indirect) and operating and maintenance (O&M) costs. A present worth analysis evaluates costs that occur after completion of the active remedial action. A sensitivity analysis may be conducted if there is sufficient uncertainty concerning specific assumptions.
	MODIFYING CRITERIA
	The final two criteria are called modifying criteria. These two criteria are formally considered following receipt of public comments on the FS/PP-EA. These comments will be formally addressed in the ROD.
8.	State Acceptance - Evaluates the technical and administrative issues and concerns the State of Ohio may have regarding each of the alternatives.
9.	Community Acceptance - Evaluates the issues and concerns the public may have regarding each of the alternatives.

TABLE 6-2

OPERABLE UNIT 1
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility or Volume Through Treatment	Short-Term Effectiveness	Implementability	Present Worth Cost
1 - No Action	Not protective	Does not meet all ARARs	Not effective or permanent	No treatment	High	Easy	Very Low
4A - Removal, Treatment, (Vit), and On-Property Disposal	Protective[a]	Complies with all ARARs[b]	Effective	Reduces toxicity, mobility, and volume	Moderate	Innovative Technology; Difficult	Moderately High
4B - Removal, Treatment (Cem) and On-Property Disposal	Protective[a]	Complies with all ARARs[b]	Effective	Reduces mobility, but increases volume	Moderate	More Reliable Technology; Difficult	Moderate
5A - Removal, Treatment (Drying), and Off-Site Disposal at NTS	Protective[a]	Complies with all ARARs	Highly Effective	Does not affect toxicity or mobility, but slightly decreases volume	Moderate	Reliable Technology; Moderately Difficult	High
5B - Removal, Treatment (Drying), and Off-Site Disposal at a Permitted Commercial Disposal Facility	Protective[a]	Complies with all ARARs	Highly Effective	Does not affect toxicity or mobility, but slightly decreases volume	Moderate	Reliable Technology; Moderately Difficult	Moderate

[a] Assessment of protectiveness assumes the use of continued federal government ownership and evaluates risk to the off-property farmer.
[b] Assumes substantive technical requirements for Ohio disposal facility siting are met sufficiently to obtain a waiver from the ARAR.

- Confirmation sampling of waste pit excavations to establish that proposed remediation levels have been achieved
- Pretreatment (crushing/shredding) of waste
- Drying of waste
- Off-site shipment of waste for disposal at a permitted commercial waste disposal facility
- As a contingency, for any waste that fails to meet the waste acceptance criteria of the permitted commercial waste disposal facility (up to 10 percent of the total waste volume), disposal at the Nevada Test Site (NTS) is permitted
- Decommissioning and removal of the drying treatment unit and associated facilities, as well as miscellaneous structures and facilities within the operable unit; oversized material that is amenable to the selected alternative for Operable Unit 3 would be segregated from Operable Unit 1 waste, decontaminated, and forwarded to Operable Unit 3 to be managed as construction rubble.
- Disposition of remaining Operable Unit 1 residual contaminated soils, as amenable, consistent with selected remedies for contaminated process area soils as documented in the Operable Unit 5 Record of Decision
- Placement of clean backfill into excavations; construction of cover system.

6.1.1 Comparative Analysis of Alternatives

6.1.1.1 Overall Protectiveness

Alternative 1, the No-Action Alternative, would not protect human health or the environment, since no remedial activities would be conducted and Operable Unit 1 currently presents unacceptable risks to human health and the environment. The other four alternatives, collectively referred to as the "action alternatives," would provide removal, treatment, and disposal of the waste pit material and contaminated soils to levels that would protect human health and the environment. (Alternatives 4A and 4B provide for on-property disposal, while Alternatives 5A and 5B provide for off-site disposal.) Appendix D of the Operable Unit 1 Draft Final FS Report documents assessment of residual risks.

6.1.1.2 Compliance with ARARs

Except for the No-Action Alternative, which would not meet certain ARARs, all action alternatives would either attain pertinent ARARs or justify that a waiver of an ARAR(s) may be appropriate. A comprehensive list of potential ARARs is presented in Appendix F of the Operable Unit 1 Draft Final

FS Report for both on-site and off-site disposal alternatives. Key requirements are discussed in Section 5 of this Proposed Plan for each of the action alternatives.

6.1.1.3 Long-Term Effectiveness and Permanence

Alternative 1, No-Action, would not be effective in the long term, since the Baseline Risk Assessment indicates that the current site conditions would not, in the long term, be protective of human health and the environment and no remedial activities would be conducted on Operable Unit 1 under this alternative.

The four action alternatives (Alternatives 4A, 4B, 5A, and 5B), if they perform as designed, would be effective in the long term and provide permanent solutions. Alternatives 4A and 4B provide excavation, treatment, on-property disposal in an engineered cell designed for a 1,000-year life with minimal maintenance, as well as capping of residual contamination. These alternatives would be approximately equal in effectiveness at reducing the residual risks to potential receptors. Long-term environmental impacts associated with construction of the on-property disposal cell and the probable maximum flood (PMF) channel for Alternatives 4A and 4B include permanent disruption of up to 47.3 hectares (116.9 acres) of land. No significant long-term impacts are expected for water quality and hydrology, air quality, socioeconomics, or cultural resources. The construction of an on-property disposal cell would permanently disrupt 0.5 hectare (1.3 acres) of drainage ditch/swale wetlands. The 100- and 500-year floodplains would not be permanently altered by regrading and revegetation activities.

Alternatives 5A and 5B would provide excavation, treatment, off-property disposal, and capping of residual contamination. These two alternatives would be equally effective at reducing residual risks to potential receptors. The long-term effectiveness of these alternatives is judged to be more certain than for Alternatives 4A and 4B, since the pit waste material, a potential contaminant source, would be removed from the site. As discussed in the following paragraphs, the two potential off-site disposal locations are in a very dry climatic region with no surface water in the vicinity, no usable groundwater and no human populations within many miles. The FEMP site, however, overlies a sole-source aquifer and is in a relatively populated area. In the event waste treatment and/or

engineering and institutional controls fail, there is a greater potential for human health and the environment to be impacted at the FEMP site then at either of the two off-site locations.

There are no long-term environmental impacts at the FEMP pertaining to the removal and treatment processes as a result of implementing mitigative measures. Long-term environmental impacts off-site would include some permanent disturbance of soils (e.g., acquisition of borrow material) associated with backfilled cover or disposal activities. No significant long-term impacts from off-site disposal would be expected for water quality and hydrology, air quality, biotic resources, socioeconomics and land use, or cultural resources.

The Nevada Test Site disposal facility (Alternative 5A) is located in a sparsely populated, arid environment with minimal potential for leachate generation and contaminant migration. Because the Nevada Test Site is owned and maintained by DOE and utilized for the disposal of selected low-level wastes from other DOE sites, the uncertainties associated with institutional controls are low. As the result of a low average annual precipitation and very deep groundwater, impacts to human health and the environment would be effectively mitigated in the event that engineering and institutional controls fail.

Similar to the Nevada Test Site, the representative permitted commercial waste disposal facility in Utah (Alternative B), is located in a sparsely populated, arid environment with insignificant potential for leachate generation and contamination migration. A combination of the high evapotranspiration rate, dry-dense soil bodies, highly mineralized and unusable groundwater, and lack of surface waters in the area make the facility physically conducive for the disposal of treated waste. Furthermore, because the facility is located in an area with an arid climate far from any population centers, the lack of human habitation offers many advantages for long-term disposal.

6.1.1.4 Reduction of Toxicity, Mobility, or Volume

Alternative 1, No-Action, does not include treatment and would not result in a reduction of toxicity, mobility, or volume. The treatment process for the on-property disposal Alternatives 4A and 4B consists of vitrification and cement solidification respectively. For Alternatives 5A and 5B, the

wastes would be treated by drying to meet the waste acceptance criteria of the off-site disposal facilities.

The treatment associated with Alternatives 4A (i.e., vitrification, which physically binds the constituents into a glass-like matrix) and 4B (i.e., cement solidification, which physically binds constituents into a cement mixture) would reduce the mobility of contaminants. In addition, the high temperatures associated with vitrification would destroy any residual organics remaining in the waste after drying. After drying, cement solidification would significantly increase the overall waste volume while vitrification would very slightly reduce it.

Alternatives 5A and 5B would not provide any treatment that significantly alters toxicity, mobility, or volume of contaminants. They employ treatment of the waste by drying. The drying technology has limited ability to irreversibly treat waste. However, volatile organic compounds (VOCs) are removed from the waste through thermal desorption during drying and do not return. In addition, drying and size reduction would slightly reduce the volume of material by reducing the moisture content and void ratio. Upon treatment, it is anticipated that the material would meet the waste acceptance criteria of the off-site disposal facilities. Appendix J of the Draft Final FS Report presents the criteria for both facilities and documents DOE's capability to meet those criteria.

6.1.1.5 Short-Term Effectiveness

Alternative 1, no action, would be very effective in the short term, relative to adverse impacts during construction since there would be no remedial activities. Therefore, there would be no additional risk to workers or the community near the FEMP site due to implementation of the No-Action Alternative.

The four action alternatives involve remedial activities and therefore all pose some risk to workers and the community. However, all four of the action alternatives would protect human health and the environment in the short term. Remediation workers, non-remediation workers, and the community would be subject to minimal chemical and radiological exposures. In addition, remediation workers would be subject to occupational hazards while performing remedial activities. Appendix D of the Operable Unit 1 Draft Final FS Report documents assessment of these risks.

The short-term risks (excluding transportation) to remediation workers would be approximately the same for Alternatives 4A and 4B, with Alternative 4B having a slightly higher potential for accidents than Alternative 4A. The short-term risks for Alternatives 5A and 5B (excluding transportation and waste container handling) would be equal, and somewhat lower than Alternatives 4A and 4B, due to the higher potential for accidents associated with on-property disposal. However, there would be the potential for exposures and accidents associated with transportation and waste container handling. Taking these risks into account, Alternative 5A would have higher dose equivalents and potential accidents for remediation workers than any of the other action alternatives. Alternative 5B, with less waste handling required by bulk waste shipment, would have the potential for significantly fewer accidents and exposures than the other alternatives, even after adding risks associated with transportation.

The short-term risks (excluding transportation) to off-site individuals and non-remediation workers would be approximately the same for all four action alternatives. During transportation of waste materials, Alternative 5A would result in slightly higher risks to communities along the transportation route than Alternative 5B because of the double handling of waste sent to NTS. No transportation risks are associated with Alternatives 4A and 4B.

The active waste processing and disposal for Alternatives 4B, 5A, and 5B are all approximately 5 years. That period is approximately 10 years for Alternative 4A.

During remediation, all four action alternatives would protect the community and workers through the use of engineered and institutional controls. Short-term risks to the community (not including transportation) and to non-remediation workers would be approximately equal and within acceptable risk limits for all four action alternatives.

Short-term impacts associated with the action alternatives would include temporary disruption of approximately 2.8 hectares (7 acres) of land at the FEMP site as a result of borrow areas and approximately 6.1 hectares (15 acres) for construction of the support facilities. Increased fugitive dust emissions during excavation activities and the potential for minor impacts to biota and wetlands

(up to 42 hectares [98 acres]) does exist. However, appropriate engineering controls would minimize these potential short-term impacts. All transportation to off-site facilities would be in compliance with Department of Transportation (DOT) regulations and DOE orders and guidelines.

Since both Alternatives 4A and 4B involve site preparation and construction for a treatment facility and an on-site disposal cell, they would result in an additional temporary disruption of 5.3 ha (13 acres) from equipment movement during on-site disposal cell construction. The nature and extent of impacts to biota from implementing Alternatives 4A and 4B would be similar. Potential environmental impacts associated with implementing Alternatives 4A and 4B include the permanent loss of some on-site habitats. Short-term impacts include the temporary loss of habitats at the FEMP site and possible impacts of accidental spills of construction and operational materials. Long- and short-term impacts include potential threatened or endangered (federal or state) species habitat. Mitigative measures and engineering controls would be employed to minimize these short-term impacts and risks.

6.1.1.6 Implementability

The technical implementability for the preferred alternative (Alternative 5B) is judged to be better than for the alternatives involving additional treatment and on-site disposal. The technologies associated with waste excavation, handling, drying, containerization and off-site transportation are commonly applied throughout various industries. Further, the heterogeneity of the waste pit contents is not likely to adversely affect the implementability of any of these technologies. In contrast, the waste heterogeneity does impact the ability to treat the wastes using cement solidification or vitrification. The impacts of waste heterogeneity are discussed further in the technical feasibility discussion.

Technical Feasibility

Alternative 1 would be easy to implement because there would be no removal, treatment or disposal actions required.

For the action alternatives (Alternatives 4A, 4B, 5A, and 5B), removal and disposal activities would be very similar. All could be implemented using standard equipment, procedures, and readily available resources. Dry and wet excavation methods would be implemented with careful excavation planning. The disposal cell size for Alternative 4B, although still readily implementable, would be approximately double the size of the Alternative 4A cell due to the 100 percent increase in volume produced by cement solidification used in Alternative 4B. Variations in treatment options employed by these alternatives have varying degrees of technical feasibility. The vitrification process used in Alternative 4A would be considered to be marginally less difficult to implement generically for all types of waste material encountered at Operable Unit 1. Vitrification process equipment would be more complex to construct and operate than that of the cement solidification process, yet the extreme heterogeneity of the waste would make successful cement/waste mix formulation and quality control extremely difficult. A full-scale facility for vitrification of hazardous or radioactive waste similar to the waste at Operable Unit 1 has not yet been constructed elsewhere, and thus the start-up of a first-of-its-kind facility is expected to be difficult. Cement solidification has been previously applied to similar low-level wastes with varying degrees of success. The construction of either the vitrification facility or the cement solidification facility is expected to be straightforward. Vitrification technology is not as widely available as the cement solidification technology. The complexity of off-gas treatment for gases emitting during vitrification is also an additional complexity where difficulties could occur. However, operational experience is being gained as part of the structured treatability studies and vitrification pilot facility planning currently in progress.

The cement solidification facility would be difficult to operate due to the heterogenous nature of the waste in the pits. The mix would need constant testing to ensure that the solidified waste would meet performance requirements. However, EPA considers cement solidification a demonstrated treatment technology and has approved its use in the final remedy for many NPL sites. The cement solidification process would require large quantities of cement and other additives which increases the volume of the treated waste.

The technical feasibility of Alternatives 5A and 5B are dependent upon meeting the waste acceptance criteria of the disposal site and off-site transportation requirements. Based on the evaluation of the

waste material, it is expected that the treated waste would meet the waste acceptance criteria at both the representative permitted commercial waste disposal facility and the Nevada Test Site. It is possible that localized areas of RCRA characteristic wastes for metals and/or volatile organics could be encountered during remediation and, therefore, not meet NTS waste acceptance criteria. In the event RCRA characteristic wastes are encountered during waste acceptance criteria sampling, treatment options could be employed. Waste drying will be designed such that it will thermally desorb volatile organics in the waste. Simple modifications to the waste treatment process, such as lime addition during the crushing phase of the process, would be undertaken to immobilize metals encountered. It should be noted that if a waste is treated such that it no longer demonstrates a hazardous characteristic, then it is no longer a RCRA hazardous waste. Therefore, any RCRA characteristic wastes that are identified during waste acceptance criteria sampling could be treated such that they are no longer RCRA regulated, leaving only radiological concerns for waste acceptance criteria. Since the wastes of Operable Unit 1 are considered low-level radiological wastes which are acceptable for disposal at NTS and since they can be treated for RCRA characteristics as noted above, it is anticipated that all wastes could meet NTS waste acceptance criteria, if necessary.

Off-site transportation is technically feasible for both alternatives as further discussed under administrative implementability. Nevertheless, logistics issues associated with transporting large volumes of material would make implementation moderately difficult for both Alternatives 5A and 5B. Both the Nevada Test Site and the representative permitted commercial waste disposal facility have the capacity to accept wastes from Operable Unit 1. Appendix J of the Operable Unit 1 Draft Final FS discusses the ability of Alternatives 5A and 5B to meet the respective waste acceptance criteria.

Administrative Feasibility

Alternatives 4A and 4B would be conducted entirely on site and would not require issuance of any permits. The only known administrative barrier to implementing Alternatives 4A and 4B, is the need to obtain a waiver of the ARAR prohibition against building a disposal facility over a sole-source aquifer. The administrative feasibility concerning these alternatives is assessed as potentially difficult

to implement because of the Ohio ARAR. Specifically, a waiver from the regulation would be required.

Off-site disposal Alternatives 5A and 5B consist of on-site and off-site activities. The excavation, material handling and processing of the wastes will occur entirely on site. For these portions of the remedial alternative the administrative feasibility analysis presented above would apply, i.e., no permit is required for on-site remediation. However, the off-site transportation and disposal of the wastes would have to comply with applicable permitting requirements.

The Superfund Off-site Policy was issued in the Federal Register, Volume 58, No. 182, dated September 22, 1993. This policy supersedes the May 1985 (revised November 1987) Off-site Policy. The Off-site Rule provides that a facility used for off-site management of wastes generated from CERCLA response actions must be in physical compliance with RCRA, or other applicable Federal and State laws. In addition, the following criteria must be met:

- Units receiving CERCLA waste at RCRA Subtitle C facilities must not be releasing any hazardous wastes, hazardous constituents, or hazardous substances
- Receiving units at Subtitle C land disposal facilities must meet minimum technology requirements
- All releases from non-receiving units at land disposal facilities must be addressed by a corrective action program prior to using any unit at the facility
- Environmentally significant releases from non-receiving units at Subtitle C treatment and storage facilities, and from all units at other-than-Subtitle C facilities, must also be addressed by a corrective action program prior to using any unit at the facility for the management of CERCLA wastes.

Under the revised rule, EPA will make the final determination as to whether off-site facilities are acceptable under this rule to receive CERCLA waste, with the State being an active participant during the decision-making process. In addition, the distinction between criteria for CERCLA wastes resulting from pre- and post-SARA decision documents has been removed.

Review of applicable DOT regulations (49 CFR 171-173) indicates that there are currently no provisions that would prohibit shipments of the Operable Unit 1 waste from the site to NTS or a permitted commercial waste disposal facility using either trucks or rail. In addition, there are no known transit state or local regulations that would categorically prohibit waste shipment.

For Alternative 5B, which proposes off-site disposal at a permitted commercial waste disposal facility, it is noted that DOE Order 5820.2A currently prohibits use of commercial disposal facilities for disposal of low-level radioactive wastes of the type present in Operable Unit 1; but the order does have an exemption provision and precedence exists for the granting of such exemptions. The FEMP will obtain an exemption from DOE Order 5820.2A for Operable Unit 1 pit wastes to be disposed of at a permitted commercial waste disposal facility.

In summary, the administrative feasibility of the on-property disposal alternatives (4A and 4B) are difficult because of the State prohibition against disposal over a sole-source aquifer (OAC 3745-27-07(B)(5); this regulation is an ARAR. The administrative feasibility of the off-site disposal alternatives (5A and 5B) are moderately difficult because of the transportation of wastes through a number of states and municipalities. There is no administration involved with the No-Action Alternative.

6.1.1.7 Cost

The preferred alternative, with disposal at a permitted commercial waste disposal facility, has a very slight cost advantage compared to Alternative 4B. There is a larger cost advantage compared to Alternative 4A. The most costly alternative is for off-site disposal at the Nevada Test Site. Cost calculations are provided in Appendix E of the Draft Final FS Report.

6.1.1.8 State Acceptance

State and community acceptance are not formally evaluated until after the public comment period ends. The NCP states, however, that these criteria may be considered to the extent appropriate in the Proposed Plan. In discussions with representatives of the State of Ohio, it has been indicated that the state preference is an alternative involving waste disposal at an off-site location. At this point,

however, it can not be stated that the State would not support an alternative involving on-site disposal of Operable Unit 1 wastes.

6.1.1.9 Community Acceptance

In roundtable sessions, members of the public have indicated that they would prefer that as much waste from the FEMP site be disposed of off site as possible. However, they have recognized that it is probably not feasible to dispose of all wastes off site. Community acceptance will be further evaluated in the Record of Decision.

6.2 SUMMARY OF PREFERRED REMEDIAL ALTERNATIVE IMPACTS

Short-term and long-term environmental impacts were considered for the preferred alternative. Section 4 and Appendix G of the Draft Final FS Report contain further details. Short-term environmental impacts associated with removal, treatment, and transportation of treated materials to the permitted commercial waste disposal facility would be minimized through engineered operations designed to control releases to the air, soil, surface water, and groundwater caused by remedial activities. A small area of low-quality wetlands will be impacted by short-term and long-term operations at the FEMP site, while floodplains will be impacted by short-term operations. Long-term environmental impacts associated with the permanent disposal of treated residues at the disposal facility are minor. Short-term impacts would occur to biota at the FEMP site during implementation of the preferred remedial alternative. Long-term effects would be favorable to biota at the FEMP site due to cleanup actions; and no long-term impacts to biota are expected from disposal activities at the disposal facility.

6.3 SUMMARY OF BASIS OF PREFERENCE

DOE's initial preference for this alternative is based on a number of factors relating to technical implementability, long-term effectiveness, cost, and state and community acceptance. First, the technical implementability of this alternative is judged to be better than for the alternatives involving additional treatment and on-site disposal. The technologies associated with waste excavation, handling, drying, containerization and off-site transportation are commonly applied throughout various industries. The heterogeneity of the waste pit contents is not likely to adversely affect the

implementability of any of these technologies. The waste heterogeneity does impact the ability to treat the wastes using cement solidification or vitrification. The effectiveness of both of these technologies depends on use of the appropriate reagent or additive ratios which, in turn, is dependent on the waste form and type. The waste heterogeneity of Operable Unit 1 would make operational field control of the appropriate reagent or additive ratio difficult. It is also noted that vitrification has never been implemented at the scale that would be required for even a portion of Operable Unit 1 wastes, thereby further increasing uncertainties associated with application of that technology.

The long-term effectiveness of the preferred alternative is judged to be more certain than for the alternatives involving additional treatment and on-site disposal. It is recognized that, if successfully implemented, the additional treatment of cement solidification or vitrification can significantly reduce the contaminant mobility, thereby increasing the long-term effectiveness and permanence of the alternative. There are a combination of three factors, however, that lead to the conclusion that the long-term effectiveness of the preferred alternative is more certain.

- The first factor is that over the long term, despite treatment and placement in an on-site engineered disposal facility, releases from the disposed waste are possible. This statement takes into account the uncertainties discussed above that are associated with technical implementation of cement solidification and vitrification.
- The second factor is the location of the Great Miami Aquifer beneath the FEMP, designated as a sole-source aquifer by EPA under the Safe Drinking Water Act. A release could have significant impacts on this valuable resource.
- The third factor is the fact that at Nevada Test Site and at the representative permitted commercial waste disposal facility, there are no usable groundwater resources, surface water or residences within many miles of the disposal location. Thus, there is no sole-source aquifer at either location. Because of these factors, the potential impacts of a release at the Nevada Test Site or the representative permitted commercial waste disposal facility are considered to be less significant than for a similar scenario with on-site disposal. This statement considers the presence of the soil-source Great Miami Aquifer beneath the FEMP and the relatively large number of potential human and ecological receptors in the vicinity of the FEMP. It is also noted that, due to area demographics, there is a greater long-term potential for intrusion into an on-site disposal cell. If in the future the facility institutional controls broke down, the FEMP would be attractive for various uses, including agriculture. This is not the case for the

potential off-site disposal locations. Cost is the major difference between the off-site disposal alternatives. It is the cost advantage of disposal at a permitted commercial facility which led to the selection of the preferred alternative over use of NTS.

State and community acceptance are two of the nine criteria that must be evaluated in selecting a remedial alternative. The State of Ohio has indicated a preference that the waste pit contents, because of their nature, be disposed of off-site. Because of this, the State of Ohio, in all likelihood, would more readily accept an alternative that involves the off-site disposal of the waste pit contents. In roundtable sessions with members of the public, a desire to dispose of as much FEMP material off site as possible has been expressed. Because of this, in all likelihood, the community would more readily accept an alternative that involves the off-site disposal of the waste pit contents as long as it can be safely implemented.

The preferred alternative, with disposal at a permitted commercial disposal facility, has a very slight cost advantage compared to cement solidification and on-site disposal. There is a larger cost advantage compared to vitrification and on-site disposal. There is also a large cost advantage to off-site disposal at a permitted commercial disposal facility compared to off-site disposal at the NTS.

Based on the information available at this time, DOE believes the preferred alternative provides the best balance of factors considered among the other alternatives with respect to the evaluation criteria. DOE also believes the preferred alternative satisfies the statutory requirement in CERCLA Section 121(b); namely, the preferred alternative would be protective of human health and the environment, would comply with ARARs, would be cost effective, would utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and would satisfy the statutory preference for treatment as a principal element.

7.0 COMMUNITY PARTICIPATION

Input from the public is an important element of the decision-making process for cleanup actions at the FEMP site. Comments on the proposed remedial action at the FEMP site will be received during a public review and comment period following issuance of the Draft Feasibility Study/Proposed Plan-Environmental Assessment (FS/PP-EA) for Operable Unit 1 documents. Oral comments may be presented at a public meeting that will be conducted. Written comments may be submitted at that public meeting or mailed to the following address before the close of the public comment period:

Mr. Gary Stegner
Director, Public Information
U.S. DOE Fernald Area Office
P.O. Box 398705
Cincinnati, OH 45239-8705
513-648-3014

Information concerning the schedule for the public meeting and dates for the comment period will be announced in the local media and will be available at the Public Environmental Information Center.

Information relevant to the proposed remedial actions, including the RI Report, Baseline Risk Assessment, Draft Final FS Report, Proposed Plan, and supporting Operable Unit 1 technical reports and documents are provided in the Administrative Record. The public is encouraged to review and comment on this Proposed Plan, and the RI/FS in order to gain the understanding needed to comment on the Proposed Plan. The Administrative Record is located at the Public Environmental Information Center, just south of the FEMP site. For information regarding the Public Environmental Information Center, call 513-738-0164.

PUBLIC ENVIRONMENTAL INFORMATION CENTER LOCATION AND HOURS
10845 Hamilton-Cleves Highway
Harrison, OH 45030
Monday and Thursday, 9 a.m. to 8 p.m.
Tuesday, Wednesday and Friday, 9 a.m. to 4:30 p.m.
Saturday, 9 a.m. to 1 p.m.

EPA REGION V ADMINISTRATIVE RECORD LOCATION AND HOURS
77 West Jackson
Chicago, Illinois 60604
Monday - Friday, 8:30 a.m. to 5:00 p.m.

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OPERABLE UNIT 1 PROPOSED PLAN GLOSSARY

Administrative Record - Documentation of response actions for each operable unit. The documents in the Administrative Record are used to make decisions for the Fernald Environmental Management Project (FEMP) remediation program, as well as for short-term protective measures (removal actions) implemented. The Administrative Record is made available for public review so that community members have the opportunity to provide comments to the DOE on proposed cleanup activities at the FEMP site. The Administrative Record for the FEMP site is located at the Public Environmental Information Center (see separate entry below), and the U.S. EPA Region V office in Chicago, Illinois.

Advanced Wastewater Treatment - Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids.

Amended Consent Agreement - The Amended Consent Agreement signed by U.S. EPA and the U.S. DOE in September 1991, effective December 1991. This agreement modified the April 1990 Consent Agreement and includes the renegotiation framework and schedules for developing, implementing, and monitoring appropriate response actions at the Fernald Environmental Management Project (FEMP), and to facilitate cooperation, exchange of information and participation between the U.S. EPA and the U.S. DOE in such actions. The DOE is the lead agency and is remediating the site with oversight from the U.S. EPA, which is the support agency.

Applicable or Relevant and Appropriate Requirements (ARARs) - Any state or federal environmental law that pertains to protection of human life and the environment in addressing specific conditions or use of a particular cleanup technology at a National Priorities List (NPL) site.

Calcined - Heated to a high temperature, but below the melting or fusing point, causing loss of moisture, reduction or oxidation, and the decomposition of carbonates and other compounds (The American Heritage College Dictionary, Third Edition, Houghton Mifflin Company, Boston, MA, 1993.)

Central Tendency - The exposure to chemical and/or radiological contaminants one could receive from being in the vicinity of contaminated areas.

Clearwell - A basin, or pit, constructed as a holding area for surface water from another source (the Clearwell was constructed as a holding area for the waste pit area), where heavier particles sink to the bottom and clean or clear water is released from the top of the basin.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as Amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 - (1) An act enabling the EPA to investigate and cleanup abandoned or uncontrolled hazardous waste sites. (2) The law that mandates the development of organizational structure and procedures to respond to releases, or threats of releases of hazardous substances or pollutants/contaminants.

Consent Agreement - The Consent Agreement which supersedes the FFCA 1986, (see below), is an agreement between the U.S. EPA and DOE to: (1) ensure the environmental impacts associated with the past and present activities at Fernald Environmental Management Project (FEMP) are thoroughly investigated and appropriate response action(s) taken are necessary to protect the public health, welfare, and the environment; (2) establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response action at FEMP in accordance with CERCLA, the National Contingency Plan (NCP), and EPA Superfund guidance and policy.

Depleted - Used up or decreased, having something essential removed. For uranium, depleted uranium is uranium having less than 0.711 percent by weight of the isotope U-235 (OU1 RI, Appendix F, June 1994, and The American Heritage College Dictionary, Third Edition, Houghton Mifflin Company, Boston, MA, 1993).

Environmental Impact Statement (EIS) - (1) A document required of federal agencies by the National Environmental Policy Act (NEPA) for major projects or legislative proposals significantly affecting the environment. A tool for decision making, it describes the positive and negative effects of the undertaking and cites alternative actions. (2) A concise, analytical document which serves as the means of assessing in detail the environmental impact of proposed Department of Energy (DOE) actions. An EIS is the result of an Environmental Assessment (EA) which has concluded that the risks involved in the proposed project are significant enough to require a more detailed study.

Feasibility Study - Analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site on the National Priorities List (NPL). The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the "RI/FS."

Federal Facilities Compliance Agreement (FFCA) - An agreement between the EPA and the DOE (that pre-dated both the Consent Agreement and Amended Consent Agreement), pertaining to the Fernald Environmental Management Project (FEMP) to: (1) ensure compliance by DOE, Oak Ridge Operations, Oak Ridge, Tennessee (DOE-ORO), with existing environmental statutes, and implementing regulations to include the Clean Air Act (CAA), Resource Conservation Recovery Act (RCRA), and Comprehensive Environmental Restoration Conservation Liability Act of 1980 (CERCLA) at the FEMP; (2) ensure environmental impacts associated with past and present activities at the FEMP are thoroughly investigated, and appropriate remedial response action taken as contemplated by CERCLA.

Finding of No Significant Impact (FONSI) - A document required by NEPA that is prepared by a federal agency showing why a proposed action would not have a significant impact on the environment and thus would not require preparation of an Environmental Impact Statement (EIS). An FONSI is based on the results of an environmental assessment (EA).

Great Miami Aquifer (GMA) - A source of ground water that has been designated as a sole-source aquifer under the Safe Drinking Water Act (SDWA).

Hazardous Waste - (1) A waste material exhibiting the characteristics of ignitability, corrosivity, reactivity, or toxicity or which is listed in 40 CFR Part 261, "Protection of Environment/Solid Waste/Resource Conservation and Recovery Act (RCRA)" or identified in applicable state regulations. (2) Any waste material that is designated as hazardous by the Administrator of the Environmental Protection Agency (EPA) in 40 CFR Part 261 and that is subject to the Hazardous Waste Manifest requirements of 40 CFR Part 262. (3) A discarded material which is listed in the Environmental Protection Agency Hazardous Waste List which exhibits characteristics of ignitability, corrosivity, or reactivity. Both "listed" and "characteristic" wastes are regulated under RCRA as hazardous wastes.

Hazardous Waste Management Unit (HWMU) - A contiguous area of land on or in which hazardous waste is placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area.

Incremental Lifetime Cancer Risk (ILCR) - A numerical value representing the risk of cancer incurred by receptors, or people exposed to cancer-causing agents, during their lifetimes.

Isotope - A variation of an element that has the same atomic number of protons but a different weight because of the number of neutrons. Various isotopes of the same element may have different radioactive behaviors, and some are highly unstable.

Leachate - Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances being released into surface water, groundwater, or the soil.

National Environmental Policy Act of 1969 (NEPA) - was signed into law in 1970. It declares a national environmental policy and promotes consideration of environmental concerns by federal agencies.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - Provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Priorities List (NPL) - EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System. EPA is required to update the NPL at least once a year. A site must be on the NPL to receive money from the Trust Fund for remedial action.

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

Operable Unit - A discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.

PAHs - polynuclear aromatic hydrocarbons - Highly reactive compounds consisting of hydrogen and carbon atoms arranged in multiple rings.

picoCuries (pCi) - Measurement of radioactivity. A picoCurie is a trillionth of a curie, representing about 2.2 radioactive particle disintegrations per minute. A Curie is the basic unit used to describe the amount of radioactivity in a sample of material. It is based upon the approximate decay rate of 1 gram of radium which is 37 billion disintegrations of radioactive particles per second. PicoCuries are often expressed in units related to a liquid volume unit such as picoCuries per liter (pCi/L) or related to a solid volume unit such as picoCuries per gram (pCi/g).

picoCuries per Liter (pCi/L) - A unit of measure for levels of radon gas.

Polychlorinated Biphenyl (PCB) - Any of several organic compounds that are commonly used in industrial processes. PCBs are environmental pollutants which tend to accumulate in animal tissues.

progeny - In nuclear physics, the isotope formed when a radioactive isotope decays.

Public Environmental Information Center (PEIC) - An information repository located approximately one and a half miles south of the FEMP site. In addition to the Administrative Record, the PEIC contains additional materials to help the public understand cleanup activities at the site, such as the Annual Environmental Report, news clippings, fact sheets and textbooks.

Pyrophoric - The quality of being liable to cause fires through friction. Pyrophoric material has retained heat from manufacturing or processing, or can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation, handling, and disposal hazard (DOE 5820.2A, 09-26-88, and OU1 RI, Appendix F, 1994).

Rad - Unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joules per kilogram (0.01 J/kg or 0.01 gray.)

Radionuclide - Radioactive particle, man-made or natural, with a distinct atomic weight number.

Radon - A colorless, naturally occurring, radioactive, inert gas formed by radioactive decay of radium atoms in soil or rocks.

Raffinate - The portion of a liquid that remains after other components have been dissolved by a solvent (The American Heritage College Dictionary, Third Edition, Houghton Mifflin Company, Boston, MA, 1993). In the refinery process at the FEMP, uranium-bearing feed materials were digested in nitric acid to solubilize the uranium. The uranium was extracted, leaving most of the nitric acid, impurities associated with the materials being processed and small quantities of insoluble, nonextractable uranium in the resulting "raffinate" (OU1 RI, Section 1, 1994).

Reasonable Maximum Exposure - The most exposure to chemicals and/or radiological contaminants one could receive from contact with the contaminants.

Record of Decision (ROD) - A public document that explains which cleanup alternative has been selected.

Remedial Action (RA) - The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Design - A phase of remedial action that follows the RI/FS and includes the development of engineering drawings and specifications for site cleanup.

Remedial Investigation - An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site; establish site cleanup criteria; identify preliminary alternatives for remedial action; and support technical and cost analyses of remedial alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the "RI/FS."

Removal Action - Short-term immediate actions taken to address releases of hazardous substances that require expedited response.

Risk Assessment - A study to determine the nature and extent of contamination at a site on the National Priorities List and the risks posed to public health or the environment. A risk assessment supplements the remedial investigation.

Settling basin - A basin, or pit, constructed as a holding area for surface water from another source, where heavier particles sink to the bottom and clean or clear water is released from the top of the basin.

Slag - Magnesium fluoride. A reaction product resulting from the thermite reduction reaction (UF_4 [uranium tetrafluoride] + 2Mg [magnesium] = U [uranium] + $2MgF_2$ [magnesium fluoride]) (OU1 RI, Appendix F, 1994).

Slag leach - A white to gray granular material that is the result of magnesium fluoride dissolved in nitric acid, uranium extraction, and denitrification. The insoluble materials left over were mixed with lime (calcium oxide) to a pH of approximately 11, and pumped to the waste pits. The composition of slag leach is approximately 96.5 percent magnesium fluoride, 3 percent filter aid (diatomaceous earth), and 0.5 percent uranium, with some amount of calcium compounds from the neutralization step, as well as nitrates (OU1 RI, Section 1, 1994).

Slurry - (Plural: slurries) a thin mixture of a liquid, usually water and insoluble matter (OU1 RI, Appendix F, June 1993, and The American Heritage College Dictionary, Third Edition, Houghton Mifflin Company, Boston, MA, 1993).

Solid Waste Disposal Act as Amended by the Resource Conservation and Recovery Act (RCRA) of 1976 - The Congressional act which established safe and environmentally acceptable management practices for specified hazardous wastes by imposing management requirements on generators, transporters, and owners/operators of treatment, storage, and disposal (TSD) facilities. RCRA enabled the EPA to issue regulations for a national hazardous waste management program. The regulations govern hazardous waste from the time it is created to the time of its disposal.

Solid Waste Management Unit (SWMU) - Any discernible area where wastes have been routinely and systematically released.

Supernatant - The clear fluid above a sediment or precipitate (The American Heritage College Dictionary, Third Edition, Houghton Mifflin Company, Boston, Ma, 1993).

Trailer cake - The dry, white to gray granular material left after the reduction of magnesium fluoride and uranium tetrafluoride. Trailer cake is approximately 96.5 percent magnesium fluoride, 3 percent filter aid diatomaceous earth), and 0.5 percent uranium, with some amount of nitrates (OU1 RI, Section 1, 1994).

Vadose Zone - Pertaining to or being water that is located in the zone of aeration in the earths crust above the ground water level.

Weir - A dam placed across a river, canal, or drainageway to raise or divert the water to regulate the flow.

OPERABLE UNIT 1 PROPOSED PLAN REMEDIAL INVESTIGATION AND FEASIBILITY STUDY CROSS-REFERENCE MATRIX

PROPOSED PLAN SECTION		OTHER FEMP OPERABLE UNIT 1 DOCUMENTS
2.1	Site History	RI Section 1.1, 1.2.2 FS Section 1.2.2
2.2	Site Description	RI Section 1.1, 1.2.1 FS Section 1.2.1
3.1	The Operable Unit Concept	RI Section 1.0 FS Section 1.1.1.1
3.2	Scope and Role of Operable Unit 1	RI Section 1.2 FS Section 1.2.1.1
4.1	Overview of the Nature and Extent of Contamination	RI Section 4.0, 7.3
4.2	Overview of the Baseline Risk Assessment	RI Section 6.0, Appendix E FS Section 1.2.5
5.1.1	No-Action Alternative	FS Section 4.2
5.1.2	Alternative 4A - Removal, Treatment (Vitrification), and On-Property Disposal	FS Section 4.3
5.1.3	Alternative 4B - Removal, Treatment (Cement Solidification), and On-Property Disposal	FS Section 4.4
5.1.4	Alternative 5A - Removal, Treatment (Thermal Drying), and Off-Site Disposal at NTS	FS Section 4.5
5.1.5	Alternative 5B - Removal, Treatment (Thermal Drying), and Off-Site Disposal at Permitted Commercial Facility	FS Section 4.6
6.1	Preferred Remedial Alternative	FS Section 4.1.2, 4.6.2
6.1.1	Summary of the Comparative Analysis of Alternatives	FS Section 5.0, FS Table 5-1
6.2	Summary of Preferred Alternative Impacts	FS Section 5.0, Appendix I
6.3	Summary of Basis for Preference	FS Section 5.0
7.0	Community Participation	NA

NA = Not Applicable